



Ekonomická
fakulta
Faculty
of Economics

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice

Proceedings of the 16th International Scientific Conference INPROFORUM

DIGITALIZATION
Society and Markets,
Business and Public Administration





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Foreword

The conference INPROFORUM is a traditional event held by the Faculty of Economics, the University of South Bohemia in České Budějovice since 2007.

It has provided a long-term platform for academics, students, and practitioners from the field of economics, business, and administration to share their knowledge, experience, thoughts, and opinions concerning topical issues.

The subtitle of the 16th annual international conference INPROFORUM 2022 was “Digitalization – Society and Markets, Business and Public Administration”.

As the process of digitalization and its need are omnipresent, this topic provided ample scope for discussions from many points of view.

Robert Jeyakumar Nathan (Multimedia University, Melaka, Malaysia), Martin Volek (Volis International), Luděk Kühr (DIH Tourism 4.0), and Martin Pech (University of South Bohemia) opened the conference as keynote speakers. They contributed to the discussion on digitalization in education, the secondary sector, and tourism and on the increasing availability of data, its role, and the increasing need for data in the ongoing transformation.

Our participants submitted 41 talks that they proposed to the seven discussion forums on the following topics:

Bioeconomy, Society and Public Administration: Who is Ready for the Future?

Challenges and Opportunities for the Economy

Economics of Agriculture: Current Trends in Agribusiness

Impacts of Changes and Policies in the Fields of Finance, Accounting, and Taxation

Management of Small-and Medium-sized Enterprises at the Time of Digitalization

Mathematical-Statistical Modelling and Optimisation in Practice

Trends in Marketing, Retail, Tourism, and Services in the Context of Digitalization

The conference was closed by a workshop titled The Paths of Transformation for Tourism. It invited tourism-oriented academics and practitioners from South Bohemia and other regions of the Czech Republic to discuss the future challenges to tourism development relating to the overall situation and the digitalization process of the tourism sector and the related industries.

The conference INPROFORUM 2022 has been organized under the auspices of Dagmar Škodová Parmová, Dean of the Faculty of Economics, University of South Bohemia in České Budějovice.

We want to thank all the conference participants, the members of the conference committee, the keynote speakers, and the organizing staff. We also would like to express our thanks to the reviewers for their valuable feedback on the authors' articles.

On behalf of the organizing committee

Roman Švec

Trends in Marketing, Retail, Tourism and Services in the Context do Digitalization

Digitalization of sales in the automotive field and changes in customer purchasing behavior

Sandra Arbesová¹, Kamil Pícha²

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Abstract: As we all have known in recent years, digitalization is a key topic for almost all manufacturing and trading companies. This trend was accelerated not only by the Covid-19 pandemic but also by the ever-increasing demands on the conditions and mutual interactions of all market entities. The need to digitalize production processes, as well as offer and sales activities towards customers, forced even a very traditional field such as automotive to completely change the structure of its production and sales processes. And that in a very short period of time, let's say a couple of years. Producers also had to respond to the global and rapid development of IT by researching and developing new products. The pioneer of digital/online selling worldwide is the used car market, but in recent years producers and sellers have focused on new automotive products. These products, especially electric drive technology, vehicle-connected services, autonomous driving, and car sharing, mean an important change of customers' needs from vehicle ownership to mobility on demand. They bring necessary changes to the automotive market for all subjects. In recent years, the customer has also changed, and his transformation of purchasing behavior will continue. So how has the evolution of customer buying behavior responded to the rapid global changes in business in this field? And what will the "new digital" automotive customer look like? The article deals with differences between addressing traditional automotive customers and the approach and perception of the offer to the modern customer generation, which is daily and aggressively influenced by the offer of the "reborn" automotive market.

Keywords: automotive, customer, Covid-19, technology, digitalization, digital marketing

JEL Classification: M31, D10, D20

1 Introduction

Especially in the last ten years, companies are confronted with massive technological development which effects on them in almost all internal and external structures and business or produce activities (see e.g. Suprobawati, & Kalpikajati, 2021; Ihsana, & Aldiantob, 2020; Kotarba, 2018). On the other hand, rapid technological development has affected and still affects customers every day (Kurdi et al., 2022; Grzegorzczuk, 2022; Lavoye, Mero, & Tarkiainen, 2021). It brings them new information and opportunities for global connection every second, endless communication (Dagnes, 2019), and endless new possibilities in all areas of life. For these reasons, it was necessary for companies to change their structures and business models (Wirtz, 2019). And why? It is simple. Because they have to be competitive to keep their customers, their business must go on.

The automotive industry is a very important economic sector. Concurrently it is an important economic multiplier, which is connected with many other branches of industry. These are mainly the steel, chemical, and textile industries, as well as downstream industries such as ICT³, IoT⁴, mobility and repair services, etc. In the EU automotive industry work around 13.8 million people. Turnover generated by the automotive industry represents more than 7% of the EU GDP (European Commission, n.d.). In 2021, more than 66 million cars were sold worldwide. Estimates before the coronavirus pandemic spoke about an amount of 80 million cars sold (Statista, 2022). The prognosis was not confirmed. The reason was the pandemic, production outages, and the subsequent general slowdown of the economy in all markets. The sales

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³ Information and Communication Technologies - all information technologies used for communication and informatics (working with information).

⁴ Internet of Things - a network of physical devices, vehicles, home appliances, and other devices that are equipped with electronics, software, sensors, moving parts, and network connectivity that allow these devices to connect and exchange data.

forecast for 2023 is 71 million cars sold. But this is nowhere near the situation before the pandemic. When this trade was almost trouble-free and prosperous.

The digital transformation of companies is generally considered to be very beneficial (Zhao, Liu, & Dai, 2021), especially in direct communication and relation to their customers (Hendriyani, & Auliana, 2018). It brings them new possibilities and ways, as well as speeding up communication with customers (Lambin, 2014) and, more precisely, ensuring their needs. And now, even very traditional industries, such as the automotive industry, are strongly moving from a more manufacturing concept to a data-driven direct marketing concept (Rekha, & Jain, 2019; Cernicova-Buca, Cocea, 2021). And more than ever before. For the industry to return to at least pre-pandemic numbers, it is necessary to invest significant costs and efforts in research and development, as well as new dynamic approaches to today's rapid changes in the global market. The direct participation of the customer in these processes is indispensable and very effective for many reasons (e.g. Gardiner, 2019; Anita et al. 2022). It makes it possible to effectively design, manufacture, and sell exactly what the customer wants and needs with the maximum use of all technological innovations. Brand interest and customer engagement are also increasing.

There is an enormous difference between the traditional and the modern generation of automotive customers. Especially in their awareness and the resulting greater demand for quality at a good price and technological equipment. Their mobile phone and smart home equipment already offer almost everything that is technologically possible. And why wouldn't their car offer them this? A wish turns into a need, and the customer looks more at the design and, above all, the technological equipment than at the performance of the vehicle's engine and fuel consumption. They are interested in "what else their car can do". They no longer see it as just a means of transportation. They want "something more".

It is a big challenge for companies to keep up with technological progress and, at the same time, respond to changes in customer requirements and their purchasing behavior. The paradox is that, on the one hand, the customer is forced by technological development to accept an offer to which he wouldn't have responded before, and on the other hand, he has a lot of power to put pressure on the manufacturers. The modern automotive customer has a great influence on the entire industry. He can search for detailed information about the offer, he can easily and quickly compare the offers and choose the best satisfaction of his needs. It is quite clear that even in the future, the development will continue to be very fast and customers will respond more to the direct customer experience that manufacturers and retailers have to provide them. Whether it is high demands on car safety systems, connectivity, car sharing or autonomous driving technology. Cars are the new living rooms, and customers want to feel at home in them. They want to be comfortable, feel safe, and have all kinds of technology at the fingertips.

2 Methods

We have prepared our results, and conclusions based on an analysis and compilation of the data from the available research reports published recently concerning the automotive industry and car market.

3 Research results

A set of research results on the purchasing behavior of automotive customers in recent years

A fundamental change in the customer journey map

Head of Digital marketing strategy at Microsoft, Mr. Allister Frost said in 2010: "Technology has handed control over to the consumers of our brands. They are now part of the conversation, and if they choose to speak to us, we have to be prepared to speak back. Our days of purely shouting at them when we choose (advertising) are over. This is a box that, once opened, can never be closed... We ignore social media and the societal changes it will bring about our peril." ⁵

- Expected change in customer journey mapping

The reasons for changes in the purchasing behavior of the automotive customer are mainly technological progress and also the aforementioned covid pandemic in the years 2020 – 2021. Very interesting data is provided by the analysis of the company EY on the Czech Republic, Hungary, Turkey and Russia markets in 2021. I present selected data regarding digitalization in automotive and customer behavior. A total of 3,122 participated in the survey respondents, of which 568 residents of the Czech Republic, 533 inhabitants of HU, 1,510 inhabitants of RUS, and 511 inhabitants of TUR divided into groups according to: gender, age, education, residence, and gross household income.

7 % of respondents said that connectivity would be decisive for them when choosing a car brand.

⁵ Interview with Allister Frost, Integrated Marketing Communications Manager, Microsoft UK , 2010, *Youtube* [online]. Available from: (250) Interview with Allister Frost, Integrated Marketing Communications Manager, Microsoft UK - YouTube

15 % of respondents would buy a used car online. In 2020, 8 % answered positively.

78 % of respondents who intend to buy an electric car consider the digitalization of the brand to be an important criterion when buying a car.

64 % of respondents who want to buy a hybrid car consider the digitalization of the brand as an important criterion when buying a car.

49 % of respondents with a budget for a car of up to 500,000 crowns listed digitalization of brands as another of the most important criteria, next to the price, performance, safety and design.

16 % of Czechs, 11 % of Hungarians, 24 % of Russians, and 35 % of Turks would buy a car online. 35 % of them would be deterred by online payment and 33 % by the limited possibility of negotiating a discount.

67 % of respondents would use the vehicle's Internet connection for traffic information and safety alerts. Households with income over 150 thousand CZK would be most interested (61%) in monitoring cars, and households with an income (up to CZK 20,000) have an increased interest (28%) in receiving notifications about discount events.

56 % of Czech respondents would not convince any type of online offers or services to buy used car without checking it live (52 % HU, 51% RU, 27% TR).

From this data, it is evident that the car customer is not as progressive in his approach to the digitalization of his purchasing behavior as the manufacturers are in the development and production of new automotive technologies and services. It is obvious that considering the purchase of an electric car or a hybrid is directly related to the choice of a manufacturer that is already in the process of digitalizing the company. This result is also supported by the survey on the best-selling electric car in the world from 2021, conducted in 61 countries by uswitch.com. The popular Tesla has become the best-selling electric car in 21 countries of them.⁶

Comparison of costs invested in online advertising

- Digital ad spend of the automotive industry - Comparison of data in the pre-pandemic period and now

Table 1 Paid search advertising spending in the automotive industry worldwide (in million U.S. dollars):

2018	124,1 ⁷
2021	51,16 ⁸

Source: Guttman. A, 2020, Search advertising spending worldwide from 2009 to 2019 , [www.statista.com](https://www.statista.com/statistics/267056/paid-search-advertising-expenditure-worldwide/) [online]. [Apr 7, 2020]. Available from: <https://www.statista.com/statistics/267056/paid-search-advertising-expenditure-worldwide/>
Statista research department, 2022, [www.statista.com](https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/) [online]. [May 3, 2022]. Required on: <https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/>

Based on 2021 data on U.S., UK, and EU companies, the retail industry invested 39.66 million U.S. in paid search advertising, roughly 60 percent less than in the previous year. The automotive industry spent 51.16 million on paid search ads in 2021, reducing its annual expenditure by a similar share as the retail industry.⁹

⁶Top selling electric car model, 2021, *Uswitch Limited* [online]. Available from: <https://www.uswitch.com/gas-electricity/top-selling-electric-cars/>

⁷ Guttman. A, 2020, Search advertising spending worldwide from 2009 to 2019 , [www.statista.com](https://www.statista.com/statistics/267056/paid-search-advertising-expenditure-worldwide/) [online]. [Apr 7, 2020]. Available from: <https://www.statista.com/statistics/267056/paid-search-advertising-expenditure-worldwide/>

⁸ Statista research department, 2022, [www.statista.com](https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/) [online]. [May 3, 2022]. Required on: <https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/>

⁹ Statista research department, 2022, [www.statista.com](https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/) [online]. [May 3, 2022]. Required on: <https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/>

Based on the given data, it can be seen how spending on advertising in digital search has fallen. 2021 was problematic for most industries. However, the automotive industry faced not only the covid pandemic but also problems in production. These were mainly shutdowns in production caused by a lack of chips. This problem gradually affected all the world's car manufacturers and continues to the present time.

Table 2 US digital ad Spending Growth 2019 – 2023¹⁰

2019	13,9 %
2020	9,0 % ¹¹
2021	20, 5 %
2022	13, 7 %
2023	11, 7 %

Source: US Digital Ad spend Growth by industry 2019-2023, 2021, www.emarketer.com [online].[June 2021]. Required on: <https://www.insiderintelligence.com/chart/249891/us-digital-ad-spending-growth-by-industry-2019-2023-change>

I find the comparison of digital ads' costs in the US market very illustrative. At first glance, there is a noticeable decrease in investment in advertising during the first pandemic year 2020. At the same time, we can see a gradual return on investment in this advertising channel. However, manufacturers and marketers now need much more strategic and effective digital ads to spend. Furthermore, they must count on investment in technological innovation both within production and online communication platforms and platforms for working with customer data.

The automotive industry is going through an economic crisis, and manufacturers and dealers still have an uncertain future. The situation forces marketers to reassess their marketing mix, and adjust and allocate costs differently than before 2020. Supply problems in the manufacturing industry are the reason for the increase in interest rates. High interest rates reduce demand and sales. And that impacts marketing budgets naturally. Manufacturers are trying to offset the loss of development and sales of expensive models to achieve profit margins. (Joseph, 2022)

Table 3 Growth in sales of alternative fuels in the Czech Republic in 2021¹²

Fuel	2019	2020	2021
Electric drive	756 vehicles	3 262 vehicles	2 646 vehicles
Hybrid (mild, full)	7 873 vehicles	10 693 vehicles	19 338 vehicles
Plug-in hybrid	466 vehicles	1 978 vehicles	3 736 vehicles
Hydrogen	0 vehicles	1 vehicle	9 vehicles

Source: Bures, D., 2022, Nejprodávanejší alternativy na českém trhu v roce 2021: Propad elektrovozdů, úspěch LPG a plug-inů, Auto.cz [online].[10.1.2022] Required on: <https://www.auto.cz/nejprodavanejsi-alternativy-na-ceskem-trhu-v-roce-2021-propad-elektrovozu-uspech-lpg-a-plug-inu-142304>

From the above data, a year-on-year drop in electric cars and, conversely, an increase in sales of plug-in hybrids can be seen. Data on the number of electric car registrations prove that there is still only minimal interest in this type of drive in the Czech market. Although in 2020 - 2021, the offer increased for almost all the world's car manufacturers. The best-selling electric car in the Czech Republic in 2021 was the Škoda Enyaq iV; its price starts at approx. 1,200,000 CZK. (Bureš, 2022).

¹⁰ US Digital Ad spend Growth by industry 2019-2023, 2021, www.emarketer.com [online].[June 2021]. Required on: <https://www.insiderintelligence.com/chart/249891/us-digital-ad-spending-growth-by-industry-2019-2023-change>

¹¹ The start of the covid pandemic on 1st March 2020

¹² Bures, D., 2022, Nejprodávanejší alternativy na českém trhu v roce 2021: Propad elektrovozdů, úspěch LPG a plug-inů, Auto.cz [online].[10.1.2022] Required on: <https://www.auto.cz/nejprodavanejsi-alternativy-na-ceskem-trhu-v-roce-2021-propad-elektrovozu-uspech-lpg-a-plug-inu-142304>

Changes in cars financing preference

The multi-brand Prague dealer Autosalon Klokocka centrum Ltd.¹³ stated in its analysis that in the second half of 2022, the demand for financing the private vehicles with credit or leasing in the B2C sector decreased. Funding from savings prevails.

67 % of new requests for new and used cars are for cash payment.¹⁴

The above internal analysis is based on a comparison of sales data in the years 08/2021 - 08/2022. The decrease in demand for loan financing or leasing is directly related to the decrease in demand for the purchase of new and used cars. The questionnaire survey revealed that most customers react mainly to high inflation and are afraid of debt. They prefer to spend their savings or not make a purchase at all. (Source: Autosalon Klokocka Centrum a. s., 2022)

4 Conclusions

In general, it can be said that the automotive industry is going through a huge crisis that is putting pressure on manufacturers and sellers all over the world. The crisis forced changes in production and sales models, as well as in marketing mixes and budgets. The customer has moved from physical shopping in showrooms to the Internet and is interested in more details. (95% of vehicle buyers use digital as a source of information)¹⁵. When choosing, the customer decides more about the technological equipment of the car than its performance. Great emphasis is placed on a positive customer experience.

In the future, automotive dealers and marketers can be recommended to increase a good customer experience, work with a personalized offer and make maximum use of customer data, mainly for retention marketing. It is beneficial to improve sales on the websites in accordance with UX16 and UI17 processes to reduce the bounce rate¹⁸ to a minimum. In customer preferences, high-quality and detailed customer photos or 360 photo galleries win. Quality content of sales websites and display ads are central to the online offer. They should not forget about expert customer articles and test videos. And last but not least, it is necessary to have quality lead management. Today's customer selects and gathers information online but usually wants quality personal communication with a call center or salesperson before visiting a dealer's showroom. The companies in the automotive industry, together with their authorized dealers and sellers are to consider their communication and selling strategy. Showrooms may expect a big evolution. Researchers interested in consumer behaviour and communication ways within the car market can seek for the most important elements of the online communication the future customers' requirements from the showrooms and the personalized one to one communication.

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References:

- Andersen, D.(2022). 35 Statistics Automotive Marketers Need to Know in 2023, Invoca Blog, [online].[September 16 2022] Required on: <https://www.invoca.com/blog/automotive-marketing-statistics>
- Anita, T. L., Siahaan, T. M., Suparman, A., & Yaputra, H. (2022). The Role of Customer Value Co-Creation Behavior in Business Management. *Proceedings of the International Conference on Industrial Engineering and Operations Management*. Istanbul, Turkey, March 7-10, 2022. 1674-1684.
- Bures, D. (2022). *Nejprodávanejší alternativy na českém trhu v roce 2021: Propad elektrovozů, úspěch LPG a plug-inů*, Auto.cz [online].[10.1.2022] Required on: <https://www.auto.cz/nejprodavanejsi-alternativy-na-ceskem-trhu-v-roce-2021-propad-elektrovozu-uspech-lpg-a-plug-inu-142304>
- Cernicova-Buca, M., & Cocea, E. (2021). Public Engagement Strategies in the Automotive Industry: the Case of Romania. *Professional Communication and Translation Studies*, 14, 31-41

¹³ Car dealer of Audi, Skoda, VW, Kia brands.

¹⁴ Specific internal data is confidential

¹⁵ Andersen, D., 35 Statistics Automotive Marketers Need to Know in 2023, 2022, Invoca Blog, [online].[September 16 2022] Required on: <https://www.invoca.com/blog/automotive-marketing-statistics>

¹⁶ User Experience

¹⁷ User Interface

¹⁸ The percentage of visitors to a particular website who navigate away from the site after viewing only one page

- Dagnes, A. (2019). Two Truths. In *Super Mad at Everything All the Time* (1-26). Palgrave Macmillan, Cham.
- European Commission (n.d.). Policy and Strategy. European Commission Website: Internal Market, Industry, Entrepreneurship, and SMEs. Required on October 1st, 2022. https://single-market-economy.ec.europa.eu/sectors/automotive-industry/policy-and-strategy_en
- E-marketer. (2021). *US Digital Ad spend Growth by industry 2019-2023*, www.emarketer.com [online]. [June 2021]. Required on: <https://www.insiderintelligence.com/chart/249891/us-digital-ad-spending-growth-by-industry-2019-2023-change>
- Ernst & Young Audit, s. r. o., (December, 2021). Očekávání automobilových zákazníků při nákupu a užívání vozidel. Survey., ey.com
- Gardiner, S. P. (2019). Do Luxury Car Brands Market Premium Status in a World of Likes, Followers, and User-Generated Content?. *Journal of Marketing Management*, 7(2), 18-27.
- Grzegorzczak, T. (2022). Technological innovations and consumer behaviour. In *European Consumers in the Digital Era* (43-58). Routledge. DOI: 10.4324/9781003263685
- Guttman, A. (2020). *Search advertising spending worldwide from 2009 to 2019*, www.statista.com [online]. [Apr 7, 2020]. Required from: <https://www.statista.com/statistics/267056/paid-search-advertising-expenditure-worldwide/>
- Hendriyani, C., & Auliana, L. (2018). Transformation from relationship marketing to electronic customer relationship management: A literature study. *Review of Integrative Business and Economics Research*, 7, 116-124.
- Ihsana, M., & Aldiantob, L. (2020, August). Reinventing Business Model of Bigmedia Group in Digital Era. *Proceedings from the 5th International Conference on Management in Emerging Markets*. 1041-1047.
- Interview with Allister Frost, Integrated Marketing Communications Manager, Microsoft UK, 2010, *Youtube* [online]. Required on: (250) Interview with Allister Frost, Integrated Marketing Communications Manager, Microsoft UK - YouTube
- Joseph, S., (2022). *A downturn in media spend? It depends, automotive advertising is slowing, while CPG accelerates*, *Digiday*, [online]. [June 28, 2022]. Required on: <https://digiday.com/marketing/a-downturn-in-media-spend-it-depends-automotive-advertising-is-slowing-while-cpg-accelerates/>
- Kotarba, M. (2018). Digital transformation of business models. *Foundations of management*, 10(1), 123-142. DOI: 10.1515/fman-2017-0010
- Kurdi, B., Alshurideh, M., Akour, I., Alzoubi, H., Obeidat, B., & AlHamad, A. (2022). The role of digital marketing channels on consumer buying decisions through eWOM in the Jordanian markets. *International Journal of Data and Network Science*, 6(4), 1175-1186. DOI: 10.5267/j.ijdns.2022.7.002
- Lavoye, V., Mero, J., & Tarkiainen, A. (2021). Consumer behavior with augmented reality in retail: a review and research agenda. *The International Review of Retail, Distribution and Consumer Research*, 31(3), 299-329. DOI: 10.1080/09593969.2021.1901765
- Lambin, J. J. (2014). A digital and networking economy. In *Rethinking the market economy* (147-163). Palgrave Macmillan, London.
- Rekha, & Jain, P. (2019). Consumer management in internet age: a study of Indian car buyers digital communication adoption by applying competing models. *FIIB Business Review*, 8(4), 279-291.
- Statista (2022). Number of cars sold worldwide from 2010 to 2022, with a 2023 forecast. Required on from <https://www.statista.com/statistics/200002/international-car-sales-since-1990/>
- Statista research department. (2022). www.statista.com [online]. [May 3, 2022]. Required on: <https://www.statista.com/statistics/1306040/search-ad-spend-industry-worldwide/>
- Suprobawati, G. D., & Kalpikajati, S. Y. (2021, December). The Urgency of Using Electric Vehicles and Creating an Adequate Legal Ecosystem. In *International Conference For Democracy and National Resilience (ICDNR 2021)* (61-64). Atlantis Press. DOI:
- Top selling electric car model. (2021), *Uswitch Limited* [online]. Required on: <https://www.uswitch.com/gas-electricity/top-selling-electric-cars/>
- Wirtz, B. W. (2019). *Digital business models* (137-152). Cham: Springer International Publishing. DOI: 10.1007/978-3-030-13005-3_7
- Winkelhake, U. (2018.) *The digital transformation of the automotive industry: catalysts, roadmap, practice*. Cham, Switzerland: Springer. DOI:10.1007/978-3-319-71610-7
- Zhao, M., Liu, R., & Dai, D. (2021). Synergistic Effect between China's Digital Transformation and Economic Development: A Study Based on Sustainable Development. *Sustainability*, 13(24), 13773. DOI: 10.3390/su132413773

Literature review: Examining social media influencer in viral marketing

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Abstract: The concept of viral marketing has been researched for many years but has earned a new meaning with the intense use of social networks, which have become essential part of our daily lives. The use of social media applications provides not only countless possibilities of advertising and commerce, but also instant communication between marketers and consumers. The new types of ‘opinion leaders’, who spread electronic word of mouth through numerous platforms such as YouTube or Instagram, are labelled ‘social media influencers’. In this paper, we explore the relationship between social media influencers, viral marketing, and bridges between related concepts to better understand and improve online marketing strategies. Although many researchers address various concepts on interrelated topics, the questions of origin of virality remain unclear.

Keywords: viral marketing, social networks, influencer marketing, social media influencer, viral content

1 Introduction

The contemporary world is intensely interconnected, and advanced technology plays a crucial role not only in the innovation and digital transformation of businesses but also enables us to share information instantly. In this sense, digitalization refers to digital communication that impacts our social life, since digitization is perceived as ‘the transmission of all types of information’ (Brennan and Kreiss, 2014; Sevalnev and Tsirin, 2022). Therefore, digitalization has transformed the communication and information processes. Social networks have emerged as an instant medium through which consumers interact both in positive and negative ways (Prapotnik, 2016). Among the most popular social networks are Facebook, Twitter, Instagram, and YouTube (Prapotnik, 2016; Arora et al., 2019; Burgess, 2014). Currently, with the increase in social networks, viral marketing has become essential. Viral marketing benefits from the spread of electronic word of mouth, which further encourages consumers to share marketing information (Hinz et al., 2011). Furthermore, traditional advertising and marketing is said to have changed due to information overload (Bui et al., 2022). Lance and Guy (2013) claim that consumers are increasingly dissatisfied with the excessive amount of advertising information that is simultaneously associated with the increasing number of various advertising channels, among which television is said to be declining in popularity. In that sense, the consumer exercises their power over their choices, and as a result, advertisers, therefore, opt for viral content (Lance and Guy, 2013). A new type of opinion leader known as social media influencers has emerged (Lou and Yuan, 2018; Vrontis et al., 2020; Jin and Ryu, 2019). Influencers on social networks are directly related to viral marketing due to their perceived credibility, trustworthiness, reach, and ability to influence others through social networks (Lou and Yuan, 2019; Kim and Kim, 2021; Jin and Ryu, 2019). Content is shared across various online platforms such as YouTube, Instagram (Arthurs and Drakapoulou, 2018; Lee et al., 2018; Ling et al., 2022).

2 Literature Review

Viral Marketing Vs. Influencer Marketing

Viral marketing refers to the new phenomenon of sharing and spreading marketing information. Furthermore, it is commonly compared to information dissemination that mimics a disease, therefore, referred to as ‘viral’ (Mohr, 2014). The messages are then delivered through eWOM to encourage ‘exponential growth’ of information dissemination (Mohr, 2014). The main benefit of viral marketing is its cost effectiveness, time efficiency, and reach (Dingh et al., 2015; Dolan et al., 2019). Despite the common perception of apparently obvious benefits, the authors reveal that ‘virality’ can be short-

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lived due to numerous unpredictable factors. However, social networks in relation to viral marketing can improve ‘brand awareness, encourage discussion about improving products, and recruit new employees’ (Ding et al., 2015; Roy 2018). Additionally, to improve viral content, a targeted algorithm can influence customers (Ding et al., 2015). According to Bajpay and Pandey (2012), successful viral marketing requires people with ‘high networking potential’ who can spread the information quickly.

Related to the activities of influencing others, comes influencer marketing, which directly capitalizes on a significant following of social media influencers to alter the behavior of consumers. However, the main difference is in the lifespan or duration of the ‘influence’. While one is rapid, the other requires a deliberate effort to acquire a large following. However, a transition from viral marketing to influencer marketing is possible (Zhang and Huang, 2022). For example, the authors have researched the case of a man whose viral content made him a social media influencer to further boost tourism in his region (Zhang and Hhang, 2022).

Social Media Influencer

Social media influencers (SMI), commonly referred to as opinion leaders, is not a new concept. The terminology of an ‘opinion leader’ originated from the works of Katz and Lazarsfeld in 1948 and in an online environment SMI represents a creator with a large following who can influence and can alter the behavior of their audience, usually through electronic word of mouth (Vrontis et al., 2019). Therefore, social media influencers use eWOM to influence others and increase engagement to further boost sales, promotion, brand awareness and contribute to general outreach (Arora et al., 2019, Milnes, 2016; Zhu et al., 2021; Arora 2019). In addition to that, the authors highlight the importance of ‘narrative strategies’ for the best result (Zhu et al., 2021). Influencers are undoubtedly important in making content successful for companies. However, reverse benefits also apply, as influencers operate through lucrative endorsements by brands to further promote products based on their perceived credibility (Appelman and Sundar, 2016). For example, Kim and Kim (2021) found that consumers consider posts by influencers on Instagram to be more trustworthy. Chekima et al. (2020) confirm that the trustworthiness and credibility of the source are contributing factors along with attractiveness and similarity contributes to effectiveness of the ads. Additionally, a high number of the following is said to imply perceptions of greater popularity and likeability (Agam, 2017). In this regard, influencers are leveraged in viral marketing due to their ability to spread information based on their large network of followers (Leung et al., 2022). The authors further compare different types of online marketing and point out that viral marketing also needs certain type of agents, referred to as ‘seeding agents’, who typically promote “firm-generated content” but unlike influencers on social media, seeding agents do not operate through endorsements, commissions, fees, and other incentives. In this sense, influencers are asked to promote through creating a content with relative freedom in creativity (Leung et al., 2022).

Social Media Platforms

The rise of social networks improved the effectiveness of viral marketing by improving speed and spread (Both, 2013). In academic writing, social networks are described as having a characteristic feature that involves ‘interactive participation’ (Manning, 2014). To specify, the authors point out that a digital platform does not imply social networks, a certain form of participation is needed, for example, the creation of an account. Secondly, interaction with a circle of people is needed to distinguish social media from other media such as television (Manning, 2014). Social media platforms remain a ‘significant source of information’ where consumers create online communities with their peers through various devices (Zhu et al., 2018). It is suggested that consumers are likely to trust the information shared within their social media groups without any additional verification (Shareef et al., 2020). Although there are many studies on social networks, researchers point out the prevailing challenges of acquiring statistical comparisons across various platforms, as there are additional features and functionalities such as hashtags, bots, ‘logs’, active vs. inactive users, and more. However, researchers continue to shed light on the topic through numerous methods (Weller, 2016). Generally, YouTube and Instagram continue to expand as it provides participatory culture and user-generated content (Arthurs and Drakapoulou, 2018; Lee et al., 2018). Furthermore, the promising application TikTok is directly associated with the concept of virality due to its short and entertaining content (Ling et al., 2022).

Viral Content

Sharing viral content is a common practice for many, but what makes a content go viral? According to Berger and Milkman (2012), the mechanism lies in psychology, which is simultaneously claimed to have a ‘physiological arousal’ effect. The authors discuss how emotions play a crucial role in what becomes viral (Berger and Milkman, 2012; Rubin, 2022). Their results demonstrate that positive content evokes high arousal and thus enhances virality of the content as opposed to content with negative, low-driven emotions. In this context, content that induces sadness, anger, or anxiety is less likely to become viral. The surprising or interesting message did not have an altering effect. In that regard, the authors contribute to designing content more effectively for future marketing campaigns (Berger and Milkman, 2012). Libert and Tynski (2013) agree that the success of the content going viral depends on creating rapid emotional excitement and

eliminating heavy branding as it can cause loss of interest. In conclusion, viral content requires an ‘emotional rollercoaster’ that invokes emotions such as curiosity, astonishment, and interest, among others (Libert and Tynski, 2013; Chiang et al., 2021). Furthermore, it is argued that the willingness of users to participate in the sharing of content on social networks was determined by the perceived ‘meaningfulness’ of the content (Borges-Tiago et al., 2019). However, some authors claim that ‘the most reliable indicator of virality’ is the number of followers, claiming that a creator with more than 10,000 followers is likely to go viral, as demonstrated in the case of TikTok videos (Ling et al., 2022). Additionally, videos shot recently and, in close-up, contribute to the virality, unlike the effect of texts and memes, which remain inconclusive (Ling et al., 2022).

Methods

The purpose of the study is to explore topics related to viral marketing, influencers on social networks, and related subtopics. The study is qualitative, uses document analysis and aims to further enhance understanding of concepts. Secondary sources from available research databases were used: books, journal articles, and conference proceedings within research databases such as Web of Science, Google scholar, among others. Document analysis refers to a process that involves reviewing and evaluating documents in paper and electronic form. (Bowen, 2009). Document analysis aims to gain knowledge, understanding, synthesizing data, and producing meanings. Additionally, document analysis is especially useful in qualitative research when accompanied by case studies. However, it can also be used as an independent method (Bowen 2009). The advantages of document analysis are the collection of information, the generation of questions, the comparison of research data, the tracking of changes in the draft and verification of the credibility of the conclusions. (Bowen, 2009).

In the future, complementary case studies will be proposed, as they can cover “the complexity within a case”. (Johansson, 2007). Case studies usually focus on cases that will be described or analysed, which usually means “an individual, a community, a decision-making process, or an event”. (Creswell and Poth, 2017). In addition, researchers selected real-life cases to arrive at a precise conclusion. The case study must be framed in terms of time, space, other parameters, and procedures. The main objective of the case study is to deepen understanding. Data analysis can differ, but key themes are considered. The types of case studies vary from single or instrumental case studies to collective or multiple case studies. In the last step, the researcher explains the ‘patterns’ (Creswell and Poth, 2017).

Limitations

Limitations of document analysis (Bowen, 2019; Yin, 1994):

- a. Limited in details
- b. Documents inaccessible
- c. Bias

Challenges of the case study (Creswell and Poth, 2017):

- a. Single case study or multi-case study
- b. Resource limitations
- c. Case selection
- d. Cross-case analysis
- e. Boundaries of the Case

Despite possible errors in overgeneralization within both methods, case studies have especially gained popularity over the past few decades, especially within the circle of social scientists (Feagin et al., 2016). While the main advantages of document analysis are low cost, coverage, availability, and efficiency, to name a few (Bowen, 2009; Merriam, 1988; Yin, 1994). In qualitative research, both methods are said to have a desired result, as the qualitative study requires ‘robust data collection’ (Bowen, 2009).

3 Results

The literature review suggests that viral content is random (Reichstein and Brush, 2019; Ding et al., 2015; Roy, 2018). However, virality can be predicted by the number of factors such as followings, content quality, emotions aroused, and others (Bajpay and Pandey, 2012; Berger and Milkman, 2012; Rubin, 2022). Although academics have explored the endorsement of social media influencers to further promote a product or service, research on merging viral marketing and influencer marketing is scarce due to their similarities despite their differing underlying mechanisms. Different types of online marketing use social media influencers. Viral marketing uses seeding agents who promote brand predesigned content, while social media influencers are asked to create content (Leung et al., 2022). Paths of virality appear to be two-way: 1. The existing following of the influencer makes content go viral, 2. Viral content can be designed through seeding agents in various types of online marketing (Leung et al., 2022). The contribution is two-fold: first, we explore possible links between viral marketing and influencer marketing through social media influencer and virality concepts. Second, with this knowledge, further research can be developed to improve marketing strategies across social media platforms. However, challenges remain due to other unpredictable and unmeasurable factors. More research is needed.

4 Conclusion

Viral marketing and social media influencers accompany each other throughout the academic literature. However, in-depth research, underlying mechanisms, bridges, and gaps exist within interrelated topics. Online marketing strategies, including ‘virality’ theories or ideas, offer lucrative opportunities for academics and marketers alike, as it can lead to exponential growth, remarkable spread of eWOM to improve product promotion, brand awareness, and consequently increased sales relatively low cost. Despite challenging aspects of measuring, obtaining data, algorithms, and other functionalities of social media platforms, it remains a new and ‘hot topic’ among academics and marketers alike. More research is required.

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Reference

- Agam, D. N. L. A. (2017). Followers Ratio on Instagram Affects the Product's Brand Awareness. *Australian Journal of Accounting, Economics and Finance (AJAEF)*, 3(2), 86.
- Appelman, A., & Sundar, S. S. (2016). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism & Mass Communication Quarterly*, 93(1), 59-79. DOI: 10.1177/1077699015606057
- Arora, A., Bansal, S., Kandpal, C., Aswani, R., & Dwivedi, Y. (2019). Measuring social media influencer index-insights from Facebook, Twitter and Instagram. *Journal of retailing and consumer services*, 49, 86-101. DOI: 10.1016/j.jretconser.2019.03.012
- Arthurs, J., Drakopoulou, S., & Gandini, A. (2018). Researching youtube. *Convergence*, 24(1), 3-15. DOI: 10.1177/1354856517737222
- Bajpai, V., & Pandey, S. (2012). Viral marketing through social networking sites with special reference of Facebook. *International Journal of Marketing, Financial Services & Management Research*, 1(7), 194-207.
- Berger, J., & Milkman, K. L. (2012). What makes online content viral?. *Journal of marketing research*, 49(2), 192-205. DOI: 10.1509/jmr.10.0353
- Borges-Tiago, M. T., Tiago, F., & Cosme, C. (2019). Exploring users' motivations to participate in viral communication on social media. *Journal of Business Research*, 101, 574-582. DOI: 10.1016/j.jbusres.2018.11.011
- Botha, Elsamari; Reyneke, Mignon (2013). "To share or not to share: the role of content and emotion in viral marketing". *Journal of Public Affairs*. 13 (2): 160–171. DOI: 10.1002/pa.1471
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative research journal*. DOI: 10.3316/QRJ0902027
- Brennan, S., & Kreiss, D. (2014). Digitization and Digitalization. *Edited by KB Jensen. The International Encyclopedia of Communication Theory and Philosophy*. Malden, MA: Wiley-Blackwell., forthcoming.
- Bui, M., Krishen, A. S., Anlamlier, E., & Berezan, O. (2022). Fear of missing out in the digital age: The role of social media satisfaction and advertising engagement. *Psychology & Marketing*, 39(4), 683-693. DOI: 10.1002/mar.21611
- Burgess, J. (2014). ‘All your chocolate rain are belonging to us?’: Viral video, YouTube and the dynamics of participatory culture. *Art in the Global Present*, 86-96. DOI: 10.5130/978-0-9872369-9-9.e
- Creswell, J. W. (2017). *Qualitative Inquiry & Research Design + 30 Essential Skills for the Qualitative Researcher*. SAGE Publications.

- Dolan, R., Conduit, J., Frethey-Bentham, C., Fahy, J., & Goodman, S. (2019). Social media engagement behavior: A framework for engaging customers through social media content. *European Journal of Marketing*. DOI: 10.1108/EJM-03-2017-0182
- Feagin, J. R., Orum, A. M., & Sjoberg, G. (2016). *A Case for the Case Study*. Amsterdam University Press.
- Hewlett, S. A., Sherbin, L., & Sumberg, K. (2009). How Gen Y and Boomers will reshape your agenda. *Harvard Business Review*, 87(7-8), 71-6.
- Hudders, L., De Jans, S., & De Veirman, M. (2021). The commercialization of social media stars: a literature review and conceptual framework on the strategic use of social media influencers. *Social Media Influencers in Strategic Communication*, 24-67. DOI: 10.4324/9781003181286-3
- Chekima, B., Chekima, F. Z., & Adis, A. A. A. (2020). Social media influencer in advertising: The role of attractiveness, expertise and trustworthiness. *Journal of Economics and Business*, 3(4). DOI: 10.31014/aior.1992.03.04.298
- Chiang, L. L. L., Huang, T. L., & Chung, H. F. (2021). Augmented reality interactive technology and interfaces: a construal-level theory perspective. *Journal of Research in Interactive Marketing*. DOI: 10.1108/JRIM-06-2021-0156
- Jin, S. V., Muqaddam, A., & Ryu, E. (2019). Instafamous and social media influencer marketing. *Marketing Intelligence & Planning*. DOI: 10.1108/MIP-09-2018-0375
- Johansson, R. (2007). On case study methodology. *Open house international*. DOI: 10.1108/OHI-03-2007-B0006
- Kim, D. Y., & Kim, H. Y. (2021). Trust me, trust me not: A nuanced view of influencer marketing on social media. *Journal of Business Research*, 134, 223-232. DOI: 10.1016/j.jbusres.2021.05.024
- King, R. A., Racherla, P., & Bush, V. D. (2014). What we know and don't know about online word-of-mouth: A review and synthesis of the literature. *Journal of interactive marketing*, 28(3), 167-183. DOI: 10.1016/j.intmar.2014.02.001
- Lance, P., & Guy J, G. (2006). From subservient chickens to brawny men: A comparison of viral advertising to television advertising. *Journal of interactive advertising*, 6(2), 4-33. DOI: 10.1080/15252019.2006.10722116
- Lee, C. S., Abu Bakar, N. A. B., Muhammad Dahri, R. B., & Sin, S. C. J. (2015, December). Instagram this! Sharing photos on Instagram. In *International Conference on Asian Digital Libraries* (132-141). Springer, Cham. DOI: 10.1007/978-3-319-27974-9_13
- Leung, F. F., Gu, F. F., & Palmatier, R. W. (2022). Online influencer marketing. *Journal of the Academy of Marketing Science*, 50(2), 226-251. DOI: 10.1007/s11747-021-00829-4
- Libert, K., & Tynski, K. (2013). The emotions that make marketing campaigns go viral. *Harvard Business Review*, 1(1), 108230.
- Ling, C., Blackburn, J., De Cristofaro, E., & Stringhini, G. (2022, June). Slapping Cats, Bopping Heads, and Oreo Shakes: Understanding Indicators of Virality in TikTok Short Videos. In *14th ACM Web Science Conference 2022* (164-173). DOI: 10.1145/3501247.3531551
- Lou, C., & Yuan, S. (2019). Influencer marketing: how message value and credibility affect consumer trust of branded content on social media. *Journal of Interactive Advertising*, 19(1), 58-73. DOI: 10.1080/15252019.2018.1533501
- Manning, J. (2014). Social media, definition and classes of. *Encyclopedia of social media and politics*, 1158-1162.
- Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco: JosseyBass.
- Mohr, I. (2014). Going viral: An analysis of YouTube videos. *Journal of marketing development and competitiveness*, 8(3), 43.
- Praprotnik, T. (2016). Digitalization and new media landscape. *Peer-reviewed academic journal Innovative Issues and Approaches in Social Sciences*, 1855-0541. DOI: 10.12959/issn.1855-0541.IIASS-2016-no2-art5
- Reichstein, T., & Brusch, I. (2019). The decision-making process in viral marketing—A review and suggestions for further research. *Psychology & Marketing*, 36(11), 1062-1081. DOI: 10.1002/mar.21256
- Roy, M., Mathur, N., & Jauhari, S. Marketing Strategies and Brand Awareness.
- Rubin, V. L. (2022). Manipulation in Marketing, Advertising, Propaganda, and Public Relations. In *Misinformation and Disinformation* (157-205). Springer, Cham. DOI: 10.1007/978-3-030-95656-1_6
- Sevalnev, V. V., & Tsirin, A. M. (2022). Globalization Using Network Effects. In *The Platform Economy* (379-389). Palgrave Macmillan, Singapore. DOI: 10.1007/978-981-19-3242-7_26
- Shareef, M. A., Kapoor, K. K., Mukerji, B., Dwivedi, R., & Dwivedi, Y. K. (2020). Group behavior in social media: Antecedents of initial trust formation. *Computers in Human Behavior*, 105, 106225. DOI: 10.1016/j.chb.2019.106225
- Vrontis, D., Makrides, A., Christofi, M., & Thrassou, A. (2021). Social media influencer marketing: A systematic review, integrative framework and future research agenda. *International Journal of Consumer Studies*, 45(4), 617-644. DOI: 10.1111/ijcs.12647
- Weller, K. (2016). Trying to understand social media users and usage: The forgotten features of social media platforms. *Online Information Review*. DOI: 10.1108/OIR-09-2015-0299
- Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage
- Zhang, T., & Huang, X. (2022). Viral marketing: Influencer marketing pivots in tourism—a case study of meme influencer instigated travel interest surge. *Current Issues in Tourism*, 25(4), 508-515. DOI: 10.1080/13683500.2021.1910214

- Zhou, S., McCormick, H., Blazquez, M., & Barnes, L. (2019). eWOM: The rise of the opinion leaders. In *Social Commerce* (189-212). Palgrave Macmillan, Cham. DOI: 10.1007/978-3-030-03617-1_11
- Zhu, H., Wu, H., Cao, J., Fu, G., & Li, H. (2018). Information dissemination model for social media with constant updates. *Physica A: Statistical Mechanics and its Applications*, 502, 469-482. DOI:10.1016/j.physa.2018.02.142

Case study: Sustainable production certification methods

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Abstract: This article describes the linking of different fairtrade programmes and certifications with retailers' own brands. The last two decades have seen a growing share of private labels in both retail and wholesale environments for several reasons. Reasons include difficult to predict socio-economic crises such as COVID 19, the political impact of the war in Ukraine, the current energy crisis and the economic crisis that took place between 2008 and 2012. It could be argued that these crises provide fertile ground for the development and growth of private label, with consumers looking for more cost-effective substitutes for mainstream branded products. However, this article will not look at the growth of private label share due to the crises, but rather at the linking of private labels in the case studies in relation to different fairtrade practices, programs or certifications. The aim of the paper is to analyse market trends at the level of the use of certified sustainable commodities in private label products.

Keywords: Case studies, fair trade, private label, programmes, certification

JEL Classification: Q01, M31

1 Introduction

Although private labels have long been synonymous with something of poor quality (Šalamoun et al, 2014), according to Nielsen (2019), the share of private labels is gradually increasing to around 23% in the Czech Republic. In other countries, however, the share of private labels in retail is even higher (MediaGuru 2019). In the Czech Republic, private label accounts for almost fifty percent of total sales in the discount sector. In the European Union as a whole, the share of private labels in retail has been increasing for a long time. In some EU countries, the share of own brands of retail companies accounts for up to 40 % of the assortment offered to customers (MediaGuru 2020). Recently, they have played an important role in the competitive struggles in retail and wholesale markets not only in the Czech Republic but also in other European countries.

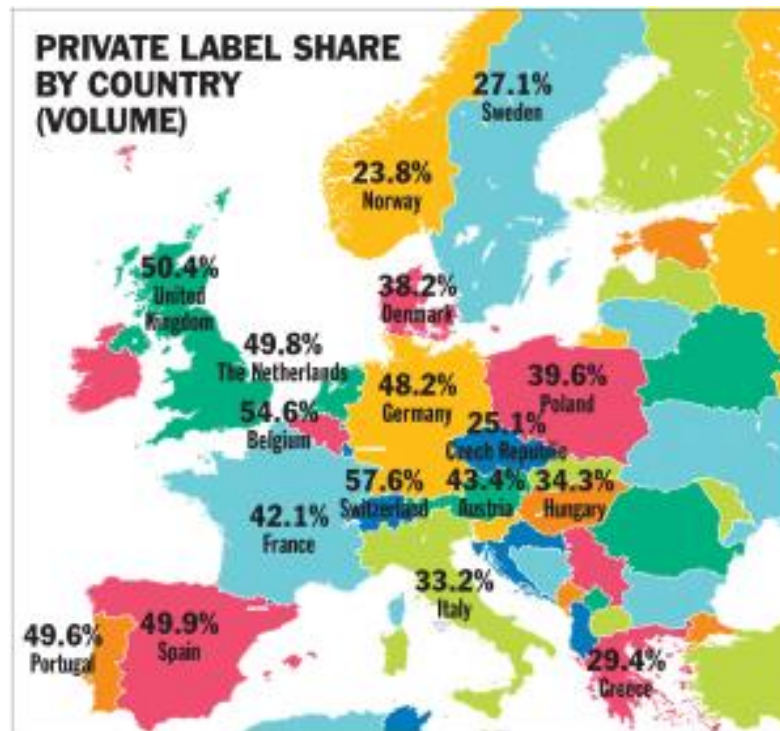
According to Čepelíková (2022), private labels, such as those available for purchase in various chains in our country, have already become a common part of our shopping carts. Often we may not even be aware that it is own brand. Whereas years ago, private labels were characterised by garish packaging (for example, Globus' Korrekt in bright orange), today, even economy-class private labels come in modern garb.

Although own brands have long been perceived as a cheaper alternative to classic brands, the share of own brands is steadily increasing not only in the Czech market but also in the markets of other European countries, according to Slaba (2021). The actual increase in the share of private labels in the Czech market is illustrated in Figure 1.

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Figure 1 Private label share by country



Source: PLMA (2022)

The value share of Private Label in Europe (28%) declined (-0.5%) in 2021, according to NielsenIQ's data across 32 European markets, as reported during PLMA's pre-show seminars on 30 May. In the context of the Covid pandemic, consumers in West Europe continued to maintain their spending power but had limited possibilities to spend. This boosted premium in-home consumption at the cost of Private Label. In South European markets, this was less the case and resulted in increased Private Label share for Spain and Portugal. In Eastern Europe, Private Label share continues to grow. Strongest gains were seen in Czech Republic +2.1 % and Hungary +0.6%, keeping their positive momentum of the past 4 years. Poland remains above 30% but declined with -0.4% (PLMA, 2022).

Merchants' private labels don't have to be just status compared to other branded products. Levy a Weitz (2009) described the differences between national brands and private labels: buying from vendors of national brands can help retailers build their image and traffic flow and reduce their selling/promotional expenses. When it comes to product quality, most consumers see virtually no difference between private label and familiar national brands.

Private labels can also be a trend setter in areas of sustainable consumption. A typical example that we already see today is the linking with Fairtrade International's programme certifications or other certifications such as UTZ or Rainforest Alliance.

Fairtrade International certification is in the realm of global certification organisations. Fairtrade International is not a direct certification organisation, this is done by FLOCERT or FLO, which was set up to oversee compliance with the rules set by Fairtrade International. At its core, it promotes sustainable business or farming and ensures that fair conditions are met worldwide. It also ensures the integrity of production and trading practices throughout the supply chain to help primary producers, traders and brands become truly sustainable. Over the past decade, credibility with this certification body has grown thanks to the never-ending work of the certification process. The company's paradigm is based on a holistic approach that both ensures the possibility of a diverse range of certification options for products, raw materials or production processes, and measures impacts depending on what is and is not right for a business in the Fairtrade system (FIOCERT, 2011). In addition to overseeing compliance related to the Fairtrade® certification mark, the organization also handles various programmatic modalities such as the Cacao Program, Flower Program, Banana Program, Rice Program and others. FIOCERT also carries out regular audits, both on the basis of physical inspection and through accounting checks of all areas that are relevant to the production and processing of Fairtrade products. The company audits the following:

Figure 2 Areas audited by FLOCERT



Source: Modified from FLOCERT (2011)

The Rainforest Alliance and UTZ, like Fairtrade, strive to set fair conditions for both producers and the preservation of biodiversity in areas of developing countries.

As the impact of human activities increasingly degrades the quality of the environment, the role of conservation is becoming increasingly important. In agricultural areas, however, this protection must be balanced against the competing economic needs for agricultural production. Agriculture is a significant activity that contributes to environmental degradation and is one sector where research has focused on practices that can reduce the level of degradation (Bellamy et al., 2016).

A new finding of this paper could also be that a few years ago, the two types of certification such as Rainforest Alliance and UTZ were merged into a certification called UTZ-RA. Dual certification can refer to the case where a farmer cooperative implements two different certification systems simultaneously in order to produce certified products under two separate certified labels. Producers who adopt the UTZ-RA certification rules have the opportunity to market their products using two certified labels, thereby reducing the risk associated with increasing valuable or marketing costs. In the literature, most of the impact evaluation studies mainly focus on the purely economic and environmental impacts of voluntary sustainability programs (Jena et al., 2012, Ranjan Jena and Grote, 2016).

From the above, it is evident that the trend carrier in the areas of sustainable consumption may not only be the interdependence of private labels with FLO. It can also be other types of certifications such as UTZ, Rainforest Alliance or the UTZ-RA dual certification. These and other certifications in conjunction with self-labels will be analysed in the results section.

2 Methods

The aim of the paper was to evaluation market trends in the use of certified sustainable commodities in own-brand products. In order to meet the objective of the article, it was necessary to make a comparison of the issues related to this content through literature sources available from different databases (Web of Science, Science Direct, Proquest, Ebsco and others).

In order to meet the objective of the paper, the case study method was used to evaluate sustainable private label products. According to Stejskalova et al (2008), case studies can illustrate or validate research models in specific organisations, especially in cases that are significantly different or unique.

Case studies are one of the forms that belong to effective business strategies What do we mean by case studies? There are a number of definitions of the term case study. Yin (2012) describes case studies as complex examples that give insight into a range of corporate contexts with existing problems. Similarly, there are also case studies that take the form of a single central theme (Simons, 2009). In many cases, a case study is conceptualised as a situation focused on a specific topic, involving both the theoretical aspect of a problem Smith (1988) and its manifestation in applied form in a specific

setting (Stake, 1995). According to Mills et al (2010), it can focus on, for example, a specific solution to a problem situation in economic, managerial or business practice.

Although the use of case studies for scientific research appeared sporadically in the 19th century (Mares, 2011), according to Johansson (2007), it was not until the 20th century that it began to be fully exploited. Johansson (2007) postulates two distinct research traditions that developed in parallel but separately for many decades. On the one hand, it was the positivist tradition (statistical analyses of archival data, public opinion surveys), and on the other hand, it was the hermeneutic tradition (anthropological research). According to Johansson (2007), the first generation of research case studies included fieldwork by American sociologists who used techniques familiar from cultural anthropology to study society. They are known as the Chicago School. Then, logical positivism took over the research field and its era in research peaked after World War II. Then, as its influence waned, space gradually opened up for the next stage. In the second half of the 1960s, according to Mares (2011), quantitative and qualitative approaches gradually began to converge and a second generation of research case studies emerged. In these studies, the two approaches had already begun to be used together, albeit in different proportions to each other. The era of the mixed approach was beginning and has intensified in the 21st century.

The case studies were divided into individual cases represented by selected programs and certifications.

3 Results

To assess the sustainability of private label products, case studies of Fairtrade programmes and other certification labels will be used. In the case of the Fairtrade programmes, it is always a matter of ensuring that the main raw material contained in the product meets the conditions of FLO certification. For other certifications, it is based on their own rules that determine the certification of a given commodity or product.

Case study1 Fairtrade Cocoa Programme

Cocoa is one of the most important commodities on the world market alongside oil and coffee and is characterised by price volatility. Despite growing demand, the income of smallholders is not enough to support their families. Child labour is widespread, particularly in West Africa.

The European Union is one of the world's largest importers of cocoa. Central African countries, including Côte d'Ivoire, Ghana and Cameroon, are the most concentrated cocoa growers. Here, cocoa cultivation is the main source of livelihood for several million farmers and indirectly contributes to the livelihoods of tens of millions more. Cocoa cultivation is the main source of income in the Global South. In the main cocoa-growing areas of West Africa, most cocoa is grown by smallholders on plantations of a few hectares. Most cocoa farmers in these countries live below the poverty line.

In 2018, fairtrade cocoa consumption increased on the Czech market, with a total of 1,420 tonnes sold, mostly in the form of chocolate and confectionery. This is a continuing consequence of the introduction of the Fairtrade cocoa programme, which has been in place since 2014, simplifying the conditions for processors to produce Fairtrade cocoa products and giving cocoa farmers more opportunities to market their produce under Fairtrade conditions. As a result, Fairtrade cocoa products are increasingly being used by major retail chains under their private labels. The leader in Fairtrade cocoa is Lidl, which sold 584 tonnes of Fairtrade cocoa beans during 2018, increasing sales by more than 200% compared to 2017. However, Gunz saw the biggest jump in sales (in 2018, it sold confectionery made from 177 tonnes of fairtrade cocoa, compared to just 753 kg in 2017). The third largest seller of fairtrade private label cocoa in 2018 was Penny market (155 tonnes of cocoa, eight times more than in 2017) (Fairtrade Česko a Slovensko, 2019). Although the Penny supermarket chain was the third largest seller of fairtrade cocoa, one of the best-known private labels in fairtrade cocoa is Kaufland's K-Clasic. These are chocolate products in the form of chocolates, chocolate spreads and biscuits. The Lidl chain is similar. It offers, for example, fairtrade cocoa in the private label Way To Go products in the form of Fairtrade chocolate. This is made from sustainably grown cocoa from Ghana. Ghana is the world's second largest producer of conventional and certified cocoa.

Case study 2 Fairtrade programme for cotton

Cotton is largely grown in countries of the Global South. Due to subsidies for cotton cultivation in the Global North, the price of cotton is kept artificially low, this harms growers in the Global South who do not receive any subsidies. By purchasing cotton textiles with the FAIRTRADE® label, you will be making a significant contribution to improving the living and working conditions of cotton growers in the Global South and supporting environmental protection.

Sales of Fairtrade cotton have seen the largest percentage increase in the Fairtrade cotton programme. These increased by 317% year-on-year to 217 tonnes last year. The increase in consumption was mainly driven by the Kaufland chain, which purchases Fairtrade cotton workwear for its employees, Lidl and the dm drogeriemarkt drugstore chain, which offer Fairtrade cotton shopping bags in their stores, and the bedding manufacturer Dibella. Worldwide, around 100 million households in 70 countries are involved in cotton production. Cotton is an important source of income, especially for people in West and Central Africa, India, Pakistan and Central Asia (Fairtrade Czech Republic and Slovakia, 2019). The certification of fairtrade cotton does not belong much to the area of private labels, rather it is used in the clothing of employees of the Kaufland and Lidl retail chains.

Case Study 3 UTZ Certification

UTZ is a global programme for the sustainable cultivation of coffee, cocoa and tea. Companies that have committed to sourcing (sustainable) UTZ raw material are global brands and retailers. The aim is to improve the livelihoods of farmers as much as possible. UTZ is a certification standard that enables compliance with requirements for working conditions, good agricultural practices and environmental compatibility of production from retailers to customers.

The requirements of the independent certification bodies include good agricultural practices and management of producer enterprises, safe and healthy working conditions, addressing illegal child labour and protecting the environment through sustainable farming practices. The UTZ label on the product presents the brand in support of sustainable agriculture.

The UTZ certification could be found on products of retail chains such as Albert, Lidl, Penny, Billa and others until 2020. This certification system allowed the UTZ logo to be placed on the private label product of a given chain after meeting the above certification criteria, similar to the Fairtrade programmes.

The UTZ certification program is now part of the Rainforest Alliance system. UTZ Certification teamed up with the Rainforest Alliance in 2018 to, on the one hand, create a better future for people and nature and, on the other hand, be an even better partner for the many stakeholders it works with. Since the merger, the UTZ certification program and the Rainforest Alliance certification program have been running in parallel. At the same time, a new agricultural standard has been developed that builds on the strengths of both organisations and decades of combined experience (Rainforest Alliance, 2020).

As well as fairtrade cocoa, other chocolate products under the private label K-Classic can also be found in Kaufland that contain UTZ certification. Thanks to this certification, Kaufland customers can indirectly contribute to improving the social and economic conditions of the farmers in the countries where the cocoa comes from. The aim here is therefore to make the production of sustainable cocoa the norm, not a super-standard. Thanks to the growing demand for certified products and ongoing education and advice in the countries where the crops are grown, this process can be greatly accelerated.

Case Study 4 Rainforest Alliance Certification

The Rainforest Alliance is a non-profit organisation based in New York. It aims to conserve biodiversity through the application of sustainable development practices in agriculture, forestry, tourism and other sectors. The Rainforest Alliance certifies coffee and other products and services if their production or provision follows certain standards.

Rainforest Alliance Certified, or Green Frog, is awarded to foods, beverages and foods for special diets, according to Jaderna and Volfova (2021). Frogs are a symbol of environmental health. Also, certified products with the green frog logo signify a farm, forest or tourist area that has been audited and meets standards requiring environmental, social and economic sustainability. The audit is carried out on a regular basis and builds on the principles of sustainable production.

In general, Rainforest Alliance standards are set to protect the environment and workers' rights. The basic rules are called the Sustainable Agriculture Standards (Kávové listy, 2021).

The certification systems are designed to provide greater value to the several million farmers and workers and thousands of businesses that use Rainforest Alliance certification to promote more sustainable agricultural production and responsible supply chains. As the impact of human activities increasingly degrades the quality of the environment, the role of conservation is becoming increasingly important. In agricultural areas, however, this protection must be balanced against the competing economic needs for agricultural production.

The symbol of this certification is the green frog, symbolising environmental protection. The Rainforest Alliance logo can be found on a range of products, both private label retailers and brands of tea, coffee, cocoa, banana and nut producers. These commodities are among the most common items certified by the Rainforest Alliance.

The Kaufland chain is not lagging behind in this other certification, which is the Rainforest Alliance. The Rainforest Alliance Certified seal can be found on products such as the private label K-Clasic, which contain raw materials from the rainforest (citrus, bananas, cocoa, tea and more) and are grown with respect for ecological, social and economic requirements.

Discussion

The positive aspects of the above certifications are undoubtedly the voluntary opportunity to improve the producers' living conditions, to prevent child labour, to enable producers to earn a living from their own work and, last but not least, to contribute to the protection of the environment.

The negatives or weaknesses of the various certifications are their credibility, or a certain convincingness as to whether people really believe that the organisations that own and issue the certification criteria are acting ethically and that there are not frequent problems that would have the effect of bringing the various certification schemes into disrepute.

The creation and set-up of any certification process is very complex. While there is a certain amount of voluntariness involved, there are rules to be followed. However, this article has not addressed those rules. For this purpose, other methods would be needed to uncover perhaps the weaknesses of the certifications mentioned that may exist.

4 Conclusion

In this paper, different ways of sustainability standards have been analysed. The first two case studies concerned Fairtrade programmes for cocoa and cotton. In addition to these programs, there are others such as programs for rice, roses and bananas. Next, the paper analysed other sustainability pathways such as UTZ certification and Rainforest Alliance.

The aim of the paper was to evaluate market trends in the use of certified sustainable commodities in private label products. The methodology for assessing market trends was case studies that analysed individual cases of different Fairtrade programmes and certifications.

From the information provided, it is not possible to generalize too much about the impact of sustainable commodity certifications on current market trends. The conclusions are only supported by the figures given in the results, which declare that many trade operators are using modern trends in sustainability, and not only for private labels. For clearer answers another research method, a questionnaire survey or focus group, would be needed.

References

- Bellamy, S. A., Paul, S. O., Brink, J van den. & Tedengren, M. (2016). What is in a label? Rainforest-Alliance certified banana production versus non-certified conventional banana production. *Global Ecology nad Conservation*, 7. 39-48. DOI: 10.1016/j.gecco.2016.05.002
- Čepelíková, K. (2022). Velký přehled privátních značek českých řetězců: nejvíc jich mají Lidl a Penny Market. Available from: <https://www.vitalia.cz/clanky/privatni-znacky-retezcu-2022/>
- Fairtrade Česko a Slovensko. (2019). Zboží s certifikací Fairtrade se prodává v ČR stále více, dominují kakao a káva. Dostupné z: <https://fairtrade.cz/news/zbozi-s-certifikaci-fairtrade-se-prodava-v-cr-stale-vice-dominuji-kakao-a-kava/>
- FLO-CERT (2011) *What is certification*. Dostupné z <http://www.flo-cert.net/flo-cert/certification.html>
- Iddrisu, M., Aidoo, R., & Wongnaa, A. C. (2020). Participation in UTZ-RA voluntary cocoa certification scheme and its impact on smallholder welfare: Evidence from Ghana. *World Development Perspectives*. 20. DOI:10.1016/j.wdp.2020.100244
- Jaderná, E. & Volfova, H. (2021). *Moderní retail marketing*. Grada Publishing a.s.
- Jena, P. R., Chichaibelu, B. B., Stellmacher, T. & Grote, U. (2012). The impact of coffee certification on small-scale producers' livelihoods: A case study from the Jimma Zone, Ethiopia. *Agricultural Economics*. United Kingdom. DOI:10.1111/j.1574-0862.2012.00594.x
- Johansson, R. (2007). On Case Study Methodology. *Open House International*, 32(3):48-54. DOI: 10.1108/OHI-03-2007-B0006
- Kávové listy. (2021). Certifikace kávy: Co je Rainforest Alliance? Dostupné z: <https://www.kavovelisty.cz/clanek/certifikace-kavy-co-je-rainforest-alliance/>
- Levy, M., Weitz, B. (2009). *Retailing Management*. New York: McGraw-Hill Irwin.
- Mareš, J. (2011). Tvorba případových studií pro výzkumné účely. *Pedagogika*, 65(2), 113–142.
- MediaGuru. (2019). Privátní značky rostou nejrychleji v drogerii. Available from: <https://www.mediaguru.cz/clanky/2019/02/privatni-znacky-rostou-nejrychleji-v-drogerii/> 3

- MediaGuru. (2020). Privátní značky jsou v Evropě na vzestupu. Available from: <https://www.mediaguru.cz/clanky/2020/06/privatni-znacky-jsou-v-evrope-na-vzestupu/2>.
- Mills, A. J., Durepos, G., Wiebe, E. (2010). *Encyclopedia of case study research*. Vol. 1 and 2. USA. DOI:10.4135/9781412957397
- Nielsen. (2019). V lednu se důležitost privátních značek zvyšuje. Available from: <http://www.socr.cz/clanek/tz-nielsen-v-lednu-se-dulezitost-privatnich-znacek-zvysuje/>
- PLMA. (2022). Industry News. Available from: <https://www.plmainternational.com/industry-news/private-label-today>
- Pradyot Ranjan Jena, R. P. & Grote, U. (2016). Fairtrade certification and livelihood impacts on small-scale coffee producers in a tribal community of India. *Applied Economic Perspectives and Policy*, 39. DOI: 10.1093/aep/ppw006
- Rainforest Alliance. (2020). UTZ Certification (Now Part of the Rainforest Alliance). Dostupné z: <https://www.rainforest-alliance.org/utz/>
- Simons, H. (2009). *Case study research in practice*. Sage Publication. London. DOI: 10.4135/9781446268322
- Slabá, M. (2021). *Maloobchodní trh privátních značek v České republice*. Young Science, Prešov.
- Smith, R. E. (1988). The logic and design of case study research. *The Sport Psychologist*, 2(1), 1–12. DOI:10.1123/tsp.2.1.1
- Stake, R. E. (1995). *The art of case study research*. Sage Publication London.
- Stejskalová, I., Rolínek, L. & kol. (2008). *Manažerský audit v malých a středních podnicích*. Praha: ASPL a.s.
- Šalamoun, J., Kubínová, J., & Pavezová, I. (2014) Strategic Marketing and Management of Private Labels. *Recenzovaný časopis pro oblast společenských a humanitních věd*. České Budějovice.
- Yin, R. K. (2012). Application of case study research. *COSMOS Corporation*. USA.

The use of neuromarketing tools in the field of tourism: Discussion of available methodological approaches to understanding the emotions and decision-making process of consumers

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Abstract: In response to changing conditions and growing competition in the tourism sector, there is a growing interest in a deeper understanding of consumer emotions' influence and subsequent behaviour and decision-making. Conventional marketing research methods are often insufficient, as tourists themselves cannot fully verbally formulate their internal preferences. The presented paper aims to provide the field of tourism with alternative research methods. Neuromarketing presents a suitable addition, which with the help of neuroscientific tools, can reveal the mysteries of consumer behaviour in tourism and the individual components of the decision-making process involved in the final choice of destination. For this purpose, a systematic review of existing literature was carried out, followed by a description of development and research trends and the current state of knowledge of neuromarketing in tourism. The records obtained allowed an in-depth insight into how neuromarketing may contribute to understanding the tourists' emotional reactions and how they influence their decision-making. Finally, a discussion of possible methods of future research were proposed.

Keywords: marketing, branding, brand image, neuromarketing, sensory marketing

JEL Classification: M31, O33, Z33

1 Introduction

The modern market is highly turbulent and dynamic (Mufudza, 2018), and at the same time, it is becoming a highly competitive environment (Nogueira & Madaleno, 2021). Cuns et al. (2019) describe how by increasing the diversity of the product range on the one hand and increasing attention to the consumer experience on the other hand, an improvement in competitiveness can be achieved. Shopping is not only rational (Hellenkemper, 2017): Nadanyiová (2015) states that a proportional part of purchasing decisions among consumers is based on emotions. There is a relatively new field of science set to uncover the emotional reactions of consumers and their subsequent behavior: neuromarketing (Berčík et al., 2021; Gkaintatzis et al., 2019). Neuromarketing is a modern discipline that has a relatively short history. The first records were observed in the 1980s. However, the leading development did not begin until 2004 (Bočková et al., 2021). Levallois et al. (2019) investigated whether neuromarketing developed parallel or with a time gap on the academic and practical levels and discovered a paced development of theoretical and practical knowledge. Neuromarketing is a multidisciplinary science connecting neuropsychology with traditional marketing research methods (Hakim et al., 2020). On the other hand, Yoon et al. (2012) mention that consumer neuroscience lies at the intersection of three disciplines: marketing, psychology, and neuroscience. Morin (2011) describes neuromarketing in a little more detail: it is a field at the border of marketing, economics, decision theory, neurology, physiology, and psychology. It has been proven that using traditional marketing research methods is insufficient to accurately identify consumer purchasing preferences because consumers cannot perfectly formulate their purchasing intentions, verbally or in writing. Often, these methods are also labelled ineffective, leading to incorrect interpretation of consumer behavior, as expected behavior does not always reflect the customer's purchasing behaviour (Dursun & Goker, 2018; Pileliene, 2011). This complexity can be achieved precisely based on supplementing research with neuromarketing tools, which bring insights into the

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neuropsychological mechanisms of consumers. This way, marketing questions regarding consumer behaviour and preferences can be answered (Levallois et al., 2012).

Even though neuromarketing as a scientific field is young and not yet fully explored, the technical progress of neuroscience tools in marketing has taken place. Several tools and techniques are used to study consumer behaviour and decision-making. These are devices that measure electrical and metabolic brain activity (Berčík et al., 2018; Hakim et al., 2020):

- electroencephalography (EEG);
- functional magnetic resonance imaging (fMRI);
- physiological functions of the human organism:
 - heart rate (ECG),
 - respiratory rate, blood pressure,
 - ectodermal activity (EDA);
- and reflexes: eye movements (Eye Tracking), facial muscle movements (FaceReader).

Each of these methods enables obtaining other data, so it is advisable to combine them (Bočková et al., 2021).

Electroencephalography (EEG) is a non-invasive tool to measure the electrical activity of cortical areas of the brain using several electrodes placed on the participant's head. Specifically on the prefrontal, frontal, occipital, parietal, temporal, and central brain parts (Khurana et al., 2021). The EEG tool has excellent time resolution, where the brain's electrical activity is measured in milliseconds (Morin, 2011). It is mainly used to measure attention, memory, and emotional valence (Alsharif et al., 2022). Higher acquisition costs, insufficient areal resolution, and the associated incomplete activity records, especially from the distal part of the brain, belong to its shortcomings. Since this method for marketing research is relatively new, its use in scientific research is still limited. Existing studies, for example, dealt with the help of EEG to determine the prediction of consumer purchase intention (Mashrur et al., 2022), to predict consumer purchasing behaviour (Gill & Singh, 2022), or to detect consumer preferences (McInnes et al., 2022). Functional magnetic resonance imaging (fMRI) provides slightly more information than EEG about subcortical activity in the brain by recording the ratio of oxygen level to blood flow through the brain. This way, deeper information can be obtained about consumers' emotions, brand memory, preferences, and how different marketing stimuli influence consumer purchasing decisions (Boksem & Smidts, 2015). In already conducted studies, fMRI was used to understand consumer behaviour (Golnar-Nik et al., 2019) and to effectively modify marketing and corporate strategies (Hapenciuc et al., 2019).

Electrodermal activity (EDA) is a tool that measures changes in the electrical properties of the skin in response to sweat secretion. This method can identify specific neural reactions that lead to certain emotions (happiness, sadness, anger, and indifference). Baraybar-Fernandez (2017) reported that people have lower EDA with positive emotions, while negative emotions are associated with higher EDA. Since emotional arousal is a significant indicator of product and brand preference, measuring EDA makes it possible to predict whether a product or brand will satisfy buyers' interest. Research using EDA also investigated, for example, whether it is a suitable tool to determine the impact of influencers on the personal identity of young adolescents (Garczarek-Bak et al., 2021).

Eye Tracking is a tool that can measure and inform about the gaze path. A software application can display heat maps with information about the level of interest and the time of visual focus of attention, as well as record the size of the pupils. However, the disadvantage is that it cannot be used to detect the evoked emotions of consumers (Iloka & Anukwe, 2020). Eye Tracking is usually combined with the Facereader tool, which recognizes emotions experienced by measuring facial muscles' movements with special software. It has many advantages: a high spatial resolution and high reliability, and it can analyze the response to taste, smell, and hearing. And information about individuals and the general information is speedy. One of the disadvantages is that the double meaning of certain expressions can be a significant obstacle, and only one person can conduct the research. These two tools were used in combination to determine consumer behaviour when watching an advertising spot (Santos et al., 2015, 2020).

Sensory marketing also uses these tools (Alhazmi & Khan, 2021). Sensory marketing is a product or service promotion that improves the consumer experience using all five senses (taste, smell, sight, hearing, and touch). These human senses subsequently generate a specific focus in connection with marketing. The sense of smell is a focus of "aroma marketing" (Berčík et al., 2021), the taste is used in "taste marketing" (Liang et al., 2016), "audio marketing" focuses on hearing (Malenkaya & Andreyeva, 2016), sight forms "visual marketing" (Zhang et al., 2020), and "haptic marketing" study and use the sense of touch (Rodriguez et al., 2017). This new marketing strategy influences consumers' subconscious and individual senses, perceptions, and behaviour (Krishna, 2012). Kalenskaya (2019) refers to sensory marketing as a low-cost sales promotion tool, which is very effective in increasing profits. However, Gajewska (2019) mentions that effectiveness only occurs when individual sensory attributes evoke positive sensory experiences. Gosal et al. (2021) points out that "suitability" is individually distinctive and depends more on sensory experiences that decide whether a given

consumer will have positive sensory experiences or not. At the same time, they profoundly influence the resulting consumer purchase decision.

Literature review methodology

The following literature review was conducted to explore the background and research developments related to the use of neuromarketing and sensory marketing in tourism. Google Scholar platform was used for searching and selecting relevant articles, with preference given to those articles specifying the practical application of neuromarketing in the field tourism and destination management. The keywords we used for the search include neormarketing, sensory marketing, neuroscience, sound, smell, touch, sight, taste, aroma, facereader, MRI, EEG, tourism, destination management, and travel. Various iterations of keywords and their combinations were used. We examined over 62 articles focused on neuromarketing and sensory marketing in tourism in English language from years 1998 to 2022 based on their relevance and the number of citations. Through the following literature research we gained a comprehensive knowledge of the aspects of neuromarketing in tourism and previous neuromarketing research approaches. This allowed us to determine significant research gaps before designing and conducting our own experimental neuromarketing research in the field.

2.1 Neuromarketing research in tourism

Using neuromarketing technologies in tourism research helps identify those sensory patterns significant for communicating a destination brand (Gretzel & Fesenmaier, 2003). They offer the insight necessary for optimising the destination offer for potential visitors' ideal perception. Karremans, Stroebe & Claus (2006) fully trust the data collected via this novel conceptual approach for their reliability and unbiased nature. Javor et al. (2013) favour an MRI for tourism research. Šerić et al. (2015) explain: *"when a prospective tourist understands the characteristics of the brand's destination offer, lateral prefrontal cortex is activated. (...) brain's reaction is based on all of the information known regarding the destination. This (...) is responsible for the (...) process of destination selection. It is primarily based on the person's own experiences, memories and associations relating to the destination brand. The medical practice confirms that associativeness of the brand can be measured using an MRI technique"*. Bastiaansen et al. (2018) prefer the EEG, which also presents an option for a deeper insight into consumers' unconscious perception of marketing messages and other materials. The EEG allows the researchers to record brain reactions at high speed while participants observe the stimuli in a more natural environment (compared to the MRI). FaceReader™ software is also valuable for analysing emotional arousal by detecting research participants' facial expressions. The movements of the participant's face combine into seven specific detectable emotions: natural, happiness, sadness, anger, fear, disgust, and surprise (Zaman & Shrimpton-Smith, 2006). Lee et al. (2014) find that a within-participant neuromarketing research design allows for assessing the impact of marketing materials on the change of perception of the destination. Šerić et al. (2015) warn that using neuromarketing data singularly may not result in a relevant and comprehensive understanding of the destination brand's positioning. Instead, they call for an integrated approach of standard and novel neuromarketing methods in tourism research.

2.2 Sensory marketing in tourism

The satisfaction of all senses is crucial in the act of consumption. The rise of sensory marketing follows the development and alliance of neuroscience, psychology and marketing research with stimulating experimental outcomes (Krishna, 2010). Tourism presents a principal example of consumption experience (Woodside et al., 2000) where the customers came to expect intense or unusual experiences of services and not only the product or service itself (Holbrook, 1999).

The focus on sensory experiences, both in experiencing the destination itself and in its marketing, is crucial to increase overall tourist satisfaction. Achieving positive gratification through sensory experience can happen pre-visit, during, or even after the visit by seeing, smelling, touching, tasting and hearing. Every human sense taken into account in destination marketing impacts how the tourist perceives and remembers the destination image (Abd Rahman, Khalifah & Ismail, 2017). Urry (2002) created the concept of the Tourist Gaze: sightseeing and other tourism activities bring delightful and memorable experiences by gazing at "landscapes, people, sights and weather" (Gibson, 2012). Urry and Larsen (2011) further modified this concept by adding that: *"in almost all situations different senses are inter-connected with each other to produce a sensed environment of people and objects distributed across time and space. There are not only landscapes (and visual townscape), but also associated 'soundscapes,' 'smellscape,' 'tastescape,' and geographies of touch"*. All the sensory elements combined form a 'tourism space' for savouring the destination holistically (Lew, 2002). Pine and Gilmore (1998) encourage service providers to construct products that enhance customers' sensory encounters to make their experiences memorable. They propose the clients' emotional, physical, intellectual, and spiritual engagement by stimulating various human senses while interacting with products or services. The titillation of all of the visitors' senses influences their perception of the destination, preferences and behaviour (Krishna, 2010). Agapito et al. (2012) suggest that intentional sensory marketing can intensify tourists' contentment, loyalty and remembrance by effectively designing, communicating and branding tourist experiences (Morgan, Elbe & de Esteban Curiel, 2009).

Many scholars have examined the character and effects of sensory marketing. Agapito et al. (2014) have decoded the sensory classification of destinations comprising beach vacations, rural getaways, immersing in nature and balanced experience in the country. Based on their findings, extensive strategic marketing plans may be developed for specific attractions. Franklin & Crang (2001) understand the tourist experience as a physical and sensory encounter of the tourist and the spaces through which they move. An engaging research points toward a stronger purchase intention after experiencing a visual sensation that compels the customers to touch displayed products (Hultén, 2012). Oh et al. (2007) offer a tourism experience measurement approach considering education, aesthetics, entertainment, escapism, arousal, memory, overall perceived quality, and customer satisfaction. The component of "aesthetics" is devised to appraise sensory incitements (Agapito, 2012). The consumption experience, according to Mossberg (2007), consists not only of personnel conduct, the sufficiency of products or crowding but also of relevant stimulation of the five senses. Dann & Jacobsen (2003) further focus their research on the olfactory experience, Hashimoto & Telfer (2006) study the gustatory aspects of tourism, and Gibson & Connell (2007) delve into the auditory complements of tourism geography.

Sensory techniques have been used creatively and widely to gain a competitive advantage in tourism and hospitality. Establishments have long used sound (e.g., live music) to attract customers. A sensory experience was created during a dark restaurant concept, where the darkness is meant to stimulate the remaining senses. São Paulo offers a whole tourism product, a "map of sensations", focused on sensory and emotional elements of attractions (Agapito et al., 2012).

2.3 The use of sensory marketing and neuromarketing tools by a destination organisation

Destination marketing organisations (DMOs) are competitive bodies that organise all the products and services offered in the destination and deliver them to businesses or end customers. The usual tasks of the DMO include primarily marketing and promoting a destination (Hanna et al., 2018) while also productively managing, planning, operating and monitoring everyday tourism activities (Hounnaklang, 2016). Crompton (1979) defined destination image as the entirety of beliefs, notions and convictions about the destination that its visitors, potential visitors and residents (Stylidis, Sit, & Biran, 2014) hold. A favourable or unfavourable destination image defines behaviour such as visit or recommendation intentions (Josiassen, Assaf, Woo, & Kock, 2015). Abd Rahman et al. (2017) stress the value of incorporating sensory elements to enhance the destination image by destination managers. Šerić et al. (2015) promote the application of sensory marketing and neuromarketing in brand management, specifically in destination image and positioning. They base brand-positioning efforts on successful differentiation from the competition and find insight into the customers' subconsciousness very beneficial. The outcomes of neuromarketing research data collected at the precise moment of perceiving promotional media can become a foundation for implementing the correct destination demand elements for global brand positioning (Lindstrom, 2008) and brand differentiation (Markgraf, Scheffer & Pulkenat, 2012).

2.4 Existing neuromarketing research

Korenková et al. (2020) investigated respondents' opinions (emotions) about the presented communication proposals. The use of neuromarketing tools, combined with traditional marketing research tools, are used in their article to comprehensively obtain data to improve companies' success in a highly competitive environment. The conclusions of the research prove that the resulting data provided more options on how existing marketing strategies can be changed to be more effective (save money, and time, attract consumers based on positive emotions). De-Frutos-Arranz & Blasco (2022) confirm that consumer emotions and their disclosure are vital to designing and implementing effective marketing communication forms. Gaafar & Al-Romeedy (2022) found that incorporating neuromarketing into a destination's marketing strategy provides a comprehensive picture of the destination and shows new avenues for strategy development (such as product development). Mengual-Recuerda et al. (2020) investigated the influence of various stimuli in gastronomy (food presentation, design, taste, and food service) using a combination of neuro-tools and traditional marketing research tools. It has been found that the design and presentation of food are crucial for creating consumer interest. Although, Picha et al. (2018) did not directly examine the effect of neuromarketing on local food, their article gave rise to the idea of our next focus, for the support of local food is important for the destinations and, for example, the use of sensory marketing could help this. Giraldi et al. (2022) investigated multi-sensory stimuli (sight, smell, taste, hearing and touch) to achieve a greater intensity of the tourist experience of the visited destination.

Several experimental projects in tourism research have been conducted with the help of neuromarketing tools in the last decade. Bastiaansen et al. (2018) analysed participants' emotional responses by measuring the ERP component changes, showing them destination marketing materials complemented by (or lacking) a clip from a popular movie with destination-promoting content. Boz et al. (2017) examined the effect various approaches to pricing had on customers using numerous tools, including positron emission tomography, magnetoencephalography, eye tracking, facial coding system, and galvanic skin response. Boz & Yilmaz (2017) measured the influence of attractiveness of job candidates on recruiting managers using a neurological data gathering tool, the Eye Tracker. Murakami et al. (2021) conducted an experiment analysing the influence of photographs and videos of scenery on stimulating tourists' interests in visiting

Japan by recording the brain activity of subjects, which is monitored by using near-infrared spectroscopy (NIRS) and evaluated for each image using Semantic Differential (SD) method. Zurawicki (2010) used scanpaths and saccades when exploring the browsing habits of the visitors of tourism websites to make sense of how they perceived them. Finally, Hadinejad et al. (2019) assessed the emotional impact of the different background sounds of three Iranian tourism advertisements using a FaceReader™, skin conductance, self-report surveys and interviews.

3 Discussion

Based on the above literature review, the use of neuromarketing tools is under-researched in the field of tourism, and there are many research gaps. The following is an overview of several possible methodological approaches to understanding the tourism consumer's emotions and decision-making processes with the help of neuromarketing.

It is possible to consider the given topic from several points of view. The first thing to mention is the marketing point of view, from which it is possible to assess, for example, the designs of printed information materials of destination organisations or individual businesses regarding the effect on emotions (from the point of view of visual stimulus). It would also be possible to assess proposals for e-communication outputs (social networks, web, and reservation systems). Furthermore, it could be valuable to examine emotions when dealing with clients in the tourism industry in business-to-business (B2B) and business-to-consumer (B2C) proceedings. Testing the difference in the perception of emotions in the case of the B2B and B2C sectors would yield valuable data.

A managerial perspective with a personnel orientation presents another possibility for neuromarketing research. The employee perception of changes to various stimuli (for example, uniforms, workplace equipment, and work tasks) or general personnel evaluation might be assessed. The management could specifically benefit from uncovering the employees' perception of the work environment as a tool for understanding their needs.

Neuromarketing tools could also be used from the point of view of operations in the tourism industry for the examination of architectural designs of interiors of individual tourism businesses with an emphasis on design (hotel lobbies, hotel rooms, catering facilities, info centres), assessment of new building designs or reconstruction or visualisation of planned tourism products by experts and public. More specifically, the research might focus on examining the emotions of guests when they enter hotel rooms or the design of food and beverage service and whether the food and beverage arrangement is essential and influences the enjoyment of food and beverages or not. Another possibility could be the application of sensory marketing, and its individual stimuli, and neuromarketing tools to strengthen the local foods of a given destination. Furthermore, examining the perception of individual monuments in a specific destination by chosen visitor segments for effective targeted communication would be beneficial.

Finally, evaluating the influence of various stimuli in a destination (music, videos/images, smells) on end consumers' emotions would prove a curious intersection of sensory marketing and neuromarketing research. Comparing the experience of tourism activities with and without materials offered by the destination would comprise an exciting destination management research. Such an examination might provide insight into various forms of supporting marketing and educational materials and their importance regarding the final effectiveness and consumer decision.

These research proposals have not yet been addressed in the available literary sources.

4 Conclusions

In this paper, we have discussed possible methodological approaches to neuromarketing research in tourism. First, we conducted a systematic review of the existing literature on neuromarketing and sensory marketing, followed by a report on the current state of knowledge of sensory marketing and neuromarketing research in the tourism industry. Many possible approaches to tourism research using neuroscientific tools have been proposed and confronted with the existing scientific literature.

Nevertheless, the mentioned literature cannot be generalized and categorized for it is impossible to find connections between a specific solved problem in the field of tourism, and specific neuroscientific tools, whose choice largely depends on what neuroscientific tools are available to the researchers at the time. In a fully equipped laboratory, a combination of several tools can be used for research and to obtain more data and more complex and comprehensive results; that is, however, still exceedingly rare. Usually, the researcher uses only one neuroscientific tool.

As part of a detailed analysis of the available literature in the field of neuromarketing and sensory marketing in the tourism industry, our effort was to find an approximate match between the research problem and the selected neuroscientific tool from said literature. For evaluating marketing promotional proposals (photos, videos, websites,

placement of tourist advertisements, perception of the image of a selected destination based on the design elements of destination advertisements) Facereader, EEG, and Eye Tracking is used the most. Eye Tracking is also appropriate for gaining insight into the choice of specific advertisement design, positioning of text, photos, and videos that are attractive for tourists. Contrastly, thanks to Facereader, it is possible to evaluate complex emotions from the facial expressions of the observed subject from the entire time of observation of a given marketing stimulus (website, advertisement, advertisement placement), and it is also possible to evaluate the individual percentage representation of emotions in specifically selected periods (in a few seconds). EEG is the tool to measure electrical impulses in the brain using electrodes sticking to the research participant's head. EEG can quickly determine the level of calmness and agitation. These methods and their combination are used to provide different information, more specific findings, and suggest changes more goal-setting (e.g. increase tourist satisfaction, or increase the potential number of visitors to the given destination). In the field of gastronomy and hospitality, there was the more frequent use of the already mentioned Facereader, EEG, and also the sensing of galvanic skin reactions (electrodermal reaction, EDR). EDR measures the various electrical conductivity of skin caused by the reaction to external and internal stimuli. The internal stimulus means e.g. response to the taste of food. External stimulus is reactions, e.g., to the design of the plate and the presentation of food or the perception of the behavior of waiters. In the future, we will select from the possible methods of neuromarketing research that have used only the Facereader tool that our research team has in disposal. First possible specific research area could be the designs of printed information materials of destination organizations and their effect on emotions (from the point of view of visual stimulus), or assessment of proposals for e-communication outputs (social networks, web, and reservation systems). Practically applicable goals will be identified based on interviews with representatives of the destination management organization. This will be followed by empirical research in cooperation with selected destination organizations.

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References

- Abd Rahman, N. H.; Khalifah, Z., & Ismail, H. (2017). Addressing the Importance of the Sensory Aspect in Tourism Studies-A Literature Review. *Advanced Science Letters*, 23. DOI: 10.1166/asl.2017.7690
- Agapito, D.; Pinto, P., & Mendes, J. (2012). Sensory Marketing and Tourist Experiences. *Discussion Papers - Spatial and Organizational Dynamics*, 10(7). DOI: 10.1016/j.tourman.2013.11.011
- Agapito, D.; Valle, P., & Mendes, J. (2014). The sensory dimension of tourist experiences: Capturing meaningful sensory-informed themes in Southwest Portugal. *Tourism Management*, 42.
- Alhazmi, A., & Khan, S. (2021). The role of sensory marketing in influencing the consumers' purchase patterns. *PalArch's Journal of Archaeology of Egypt / Egyptology*, 18(16), 356-366. <https://www.archives.palarch.nl/index.php/jae/article/view/8193>
- Alsharif, A., Salleh, N.Z.M., Pileliene, L., Abbas, A.F., & Ali, J. (2022). Current Trends in the Application of EEG in Neuromarketing: A Bibliometric Analysis. *Scientific Annals of Economics and Business*, 69(3). DOI: 10.47743/saeb-2022-0020.
- Baraybar-Fernandez, A., Banos-Gonzalez, M., Barquero-Perez, O., Goya-Esteban, R., & Morena-Gomez, A. (2017). Evaluation of Emotinal Responses to Television Advertising through Neuromarketing. *Media Education Research Journal*, vol. 25(2). DOI: 10.3916/C52-2017-02
- Bartl, H., & Schmidt, F. (1998). *Destination management*. Wien: Institut für Regionale Innovation.
- Bastiaansen, M.; Straatman, S.; Driessen, E.; Mitas, O.; Stekelenburg, J., & Wang, L. (2018). My destination in your brain: A novel neuromarketing approach for evaluating the effectiveness of destination marketing. *Journal of Destination Marketing & Management*, 7. DOI: 10.1016/j.jdmm.2016.09.003
- Berčík, J., Paluchová, J., Gálová, J., Neomániová, K., & Hladíková, L. (2018). Aroma Marketing - a Modern Marketing Phenomenon. *International Scientific Days 2018. Towards Productive, Sustainable and Resilient Global Agriculture and Food Systems: Proceeding*. [cit. 2021-12-15]. DOI: 10.15414/isd2018.s2-3.02
- Berčík, J., Neomániová, K., Mravcová, A., & Gálová, J. (2021). Review of the Potential of Consumer Neuroscience for Aroma Marketing and Its Importance in Various Segments of Services. *Applied Sciences*, 11. <https://doi.org/10.3390/app11167636>
- Bočková, K., Škrabánková, J., & Hanák, M. (2021). Theory and Practice of Neuromarketing: Analyzing Human Behavior in Relation to Markets. *Emerging Science Journal*, 5(1), 44-56. [cit. 2021-12-15]. DOI: 10.28991/esj-2021-01256
- Boksem, M.A.S., & Smidts, A. (2015). Brain Responses to Movie Trailers Predicts Individual Preferences for Movies and Their Population-Wide Commercial Success. *Journal of Marketing Research*, 52(4). DOI: 10.1509/jmr.13.0572
- Boz, H.; Arslan, A., & Koc, E. (2017). Neuromarketing aspect of tourism pricing psychology. *Tourism Management Perspectives*, 23. DOI: 10.1016/j.tmp.2017.06.002

- Boz, H.; & Yilmaz, Ö. (2017). An eye tracker analysis of the influence of applicant attractiveness on employee recruitment process: a neuromarketing study. *Ecoforum Journal*, 6(1).
- Crompton, J. L. (1979). An Assessment of the Image of Mexico as a Vacation Destination and the Influence of Geographical Location Upon That Image. *Journal of Travel Research*, 17(4). DOI: 10.1177/004728757901700404
- Cuns, M.C., Pollán, M.E.M., & Amboage, E.S. (2019). The Generation of Experiences as a Differentiating Strategic Factor in the Design of Products: An Approach from Neuromarketing. *14th Iberian Conference on Information Systems and Technologies (CISTI)*, 1-5. [cit. 2022-08-03]. DOI: 10.23919/CISTI.2019.8760642
- Dann, G., & Jacobsen, S. (2003). Tourism smellscape. *Tourism Geographies*, 5 (1).
- De-Frutos-Arranz, S., & Blasco, M.F. (2022). The State of the Art of Emotional Advertising in Tourism: A Neuromarketing Perspective. *Tourism Review International*, 26(2), 139-162. DOI 10.3727/1544277221X16317419620246.
- Dursun, M., & Goker, N. (2018). An Integrated Fuzzy Decision Framework for Neuromarketing Technology Selection Problem. *International Conference on Theory and Applications of Fuzzy Systems and Soft Computing (ICAIFS 2018)*, 195-200. DOI: 10.1007/978-3-030-04164-9_27
- Franklin, A., & Crang, M. (2001). The trouble with tourism and travel theory. *Tourist Studies*, 1(1). DOI:10.1177/146879760100100101
- Gajewska, P. (2019). Sensory Marketing as a Form of Impact on Consumers on the Example of the Catering Industry. *Academia*, 506-517
- Garczarek-Bak, U., Szymkowiak, A., Gaczek, P., & Disterheft, A. (2021). A comparative analysis of neuromarketing methods brand purchasing predictions among young adults. *Jornal of Brand Management*, 28, 171-185. DOI:10.1057/s41262-020-00221-7
- Gill, R., & Singh, J. (2022). A Proposed LSTM-Based Neuromarketing Model for Consumer Emotional State Evaluation Using EEG. *Wiley Online Library*. DOI: 10.1002/9781119792437.ch8
- Gkaintatzis, A., van de Lubbe, R., Karantinou, K., & Constantinides, E. (2019). Consumers' Cognitive, Emotional and Behavioral Responses towards Background Music: An EEG Study. In: Bozzon, A., Mayo, F.D. & Filipe, J., ed. *Webist: Proceedings of the 15th International Conference on Web Information Systems and Technologie*, 314-318. DOI: 10.5220/0008346603140318.
- Gibson, C. (2012). Geographies of tourism: Space, ethics and encounter. *The Routledge Handbook of Tourism Geographies*.
- Gibson, C., & Connell, J. (2007). Music, tourism and the transformation of Memphis. *Tourism geographies*, 9(2). DOI: 10.1080/14616680701278505
- Golnar-Nik, P., Farashi, S., & Safari, M.S. (2019). The application of EEG power for the prediction and interpretation of consumer decision making: A neuromarketing study. *Physiol Behav*. Epub. DOI: 10.1016/j.physbeh.2019.04.025
- Giraldi, L., Sestino, A., & Cedrola, E. (2022). Emotional Analysis in Designing Tourism Experiences Through Neuromarketing Methods: The Role of Uncontrollable Variables and Atmosphere: A Preliminary Study. *International Journal of Marketing Studies*, 14(1).
- Gosal, G.G., Febry, C.T., & Vincent, F. (2021). The Relationship Between Sensory Marketing, Packing, and Purchasing Decision (a Study of Coffesia's Coffee Product). *Universitas Ciputra*. <http://dspace.uc.ac.id/handle/123456789/3479> DOI: 10.18502/kss.v5i5.8814
- Gretzel, U., & Fesenmaier, D. (2003). Experience-based Internet Marketing: An Exploratory Study of Sensory Experiences Associated with Pleasure Travel to the Midwest United States. In: Frew, A.; Hitz, M. & O' Connor, P. *Information and Communication technologies in Tourism 2003*. Springer Verlag, Vienna, Austria. DOI: 10.1007/978-3-7091-6027-5_6
- Hadinejad, A., Moyle, B.D., Scott, N., & Kralj, A. (2019). Emotional responses to tourism advertisements: the application of Facereader. *Tourism Recreation Research*, vol. 44(1). DOI: 10.1080/02508281.2018.1505228
- Hakim, A., Klorfeld, S., Sela, T., & Friedman, D. (Eds). (2020). Machines learn neuromarketing: Improving preference prediction from self-reports using multiple EEG measures and machine learning. *International Journal of Research in Marketing*, 38(3), 770-791. [cit. 2021-12-15]. DOI: 10.1016/j.ijresmar.2020.10.005
- Hanna, P.; Font, X.; Scarles, C.; Weeden, C., & Harrison, C. (2018). Tourist destination marketing: From sustainability myopia to memorable experiences. *Journal of Destination Marketing & Management*, 9. DOI:10.1016/j.jdmm.2017.10.002
- Hapenciuc, C.V., Stanciu, P., & Bejinaru, R. (2019). Business Neuromarketing Strategies in the Knowledge Economy. *Statefica*, 434-444.
- Hellenkemper, M. (2017). Emotional Vs Rational Purchases – How Social Media Triggers Consumers' Buying Decisions. *Business 2 Community*. [cit. 2021-12-15]. <https://www.business2community.com/instagram/emotional-vs-rational-purchases-social-media-triggers-consumers-buying-decisions-01867915>
- Holbrook, M. (1999). Consumer Value – A Framework for Analysis and Research. Routledge, London.

- Hounnaklang, S. (2016). Concepts, issues and the effectiveness of alternative tourism management in Thailand: A case study of Plai Pong Pang Homestay, Amphoe Ampawa, Samut Songkram Province. *International Journal of Arts & Sciences*, 9(3).
- Hultén, B. (2012). Sensory Cues and Shoppers' Touching Behaviour: The Case of IKEA. *International Journal of Retail & Distribution Management*, 40(4). DOI: 10.1108/09590551211211774
- Hadinejad, A.; Moyle, B. D.; Kralj, A., & Scott N. (2019). Physiological and self-report methods to the measurement of emotion in tourism. *Tourism Recreation Research*, 44(4). DOI:10.1080/02508281.2019.1604937
- Hashimoto, A., & Telfer, D. J. (2006). Selling Canadian culinary tourism: Branding the global and the regional product. *Tourism Geographies*, 8(1). DOI:10.1080/14616680500392465
- Iloka, B.C., & Anukwe, G.I. (2020). Review of eye-tracking: A neuromarketing technique. *Neuroscience Research Notes*, 3(4). DOI: 10.311117/neuroscirn.v3i4.61
- Javor, A.; Koller, M.; Lee, N.; Chamberlain, L., & Ransmayr, G. (2013). Neuromarketing and consumer neuroscience: contributions to neurology. *BMC Neurology*. DOI:10.1186/1471-2377-13-13
- Josiassen, A.; Assaf, A. G.; Woo, L., & Kock, F. (2015). The Imagery – Image Duality Model: An Integrative Review and Advocating for Improved Delimitation of Concepts. *Journal of Travel Research*, 55(6). DOI:10.1177/0047287515583358
- Kalenskaya, N.V., & Mukhadisova, R.F. (2019). Methods Of Sensory Marketing: Experience Of Russian Retail. *GCPMED 2018 - International Scientific Conference "Global Challenges and Prospects of the Modern Economic Development*. [cit. 2022-08-03]. DOI:10.15405/epsbs.2019.03.68
- Karremans, J.K.; Stroebe, W., & Claus, I. (2006). Beyond Vicary's fantasies: The impact of subliminal priming and brand choice. *Journal of experimental social psychology*, 42. DOI:10.1016/j.jesp.2005.12.002
- Khurana, V., Gahalawat, M., Kumar, P., & Roy, P. (2021). A Survey on Neurmarketing using EEG Signals. *IEEE Transactions on Cognitive and Developmental Systems*, 99. DOI 10.1109/TCDS.2021.3065200
- Korenková, M., Maros, M., Levicky, M., & Fila, M. (2020). Consumer Perception of Modern and Traditional Forms of Advertising. *Sustainability*, 12(23). DOI 10.3390/su12239996.
- Krishna, A. (2010). *Sensory Marketing*. Routledge, New York. DOI: 10.4324/9780203892060
- Krishna, A. (2012). An integrative review of sensory marketing: Engaging the sense to affect perception, judgment, and behaviour. *Journal of Consumer Psychology*, 22(3), 332-351. [cit. 2022-08-03]. <https://www.sciencedirect.com/science/article/abs/pii/S1057740811000830>
- Lee, B.; Lee, C. K., & Lee, J. (2014). Dynamic Nature of Destination Image and Influence of Tourist Overall Satisfaction on Image Modification. *Journal of Travel Research*, 53(2).
- Levallois, C., Smidts, A., & Wouters, P. (2019). The emergence of neuromarketing investigated through online public communications (2002–2008). *Business History*, 63. [cit. 2022-08-03]. <https://doi.org/10.1080/00076791.2019.1579194>
- Lew, A. A. (2002). Internationalising tourism geographies. *Tourism Geographies*, 4(3). DOI:10.1080/14616680210147391
- Liang, Y.J., Zheng, X.L., Zeng, D.D., & Zhou, X.S. (2016). Impact of Flavor on Electronic Cigarette Marketing in Social Media. In: Zheng, X., Zeng, D.D., Chen, H., & Leischow, S.J., ed. *Lecture Notes in Computer Science*, 9545, 278-283. DOI: 10.1007/978-3-319-29175-8_26
- Lindstrom, M. (2008). *Buyology: truth and lies about why we buy*. Crown Business, New York.
- Malenkaya, Y., & Andreyeva, A. (2016). Fashion and audio branding: The analysis and interpretation of luxury fashion marketing concepts. *Journal of Global Fashion Marketing*, 7(4), 291-304. DOI: 10.1080/20932685.2016.1198238
- Markgraf, I.; Scheffer, D., & Pulkenat, J. (2012). The needs of package tourists and travel agents – Neuromarketing in the tourism sector. *Trends and Issues in Global Tourism*. DOI: 10.1007/978-3-642-27404-6_8
- Mashrur, F.R., Rahman, K.M., Miya, M.T.I., Vaidyanathan, R., Anwar, S.F., Sarker, F., & A Mamum, K. (2022). An intelligent neuromarketing system for predicting consumers` future choice from electroencephalography signals. *Physiol Behav. Epub*. DOI: 10.1016/j.physbeh.2022.113847.
- McInnes, A., Sung, B., & Hooshmand, R. (2022). A practical review of electroencephalography`s value to consumer research. *Sage Journals*. DOI: 10.1177/147078532211126
- Mengual-Recuerda, A., Tur-Vines, V., & Juarez-Varon, D. (2020). Neuromarketing in Haute Cuisine Gastronomic Experiences. *Neuromarketing and Organizational Cognitive Neuroscience*, DOI: 10.3389/fpsyg.2020.01772
- Morgan, M.; Elbe, J., & de Esteban Curiel, J. (2009). Has the experience economy arrived yet? The views of destination managers. *International Journal of Tourism Research*, 11(2). DOI: 10.1002/jtr.719
- Morin, C. (2011). Neuromarketing: The New Science of Consumer Behavior. *Symposium: Consumer Culture in Global Perspective, Society*, 48, 131-135. DOI: 10.1007/s12115-010-9408-1
- Mossberg, L. (2007). A Marketing Approach to the Tourist Experience. *Scandinavian Journal of Hospitality and Tourism*, 7(1). DOI: 10.1080/15022250701231915

- Mufudza, T. (2018). Dynamic Strategy in Turbulent Business Environment. *Strategic Management: a Dynamic Vie*, 11-20. DOI: 10.5772/intechopen.81250
- Murakami, K.; Yamazaki, A.; Takahashi, R.; Kowata, K.; Ding, J.; Anuardi, M.; Yoshikawa, K. & Waki, K. (2021). Preliminary examination of scenery images for tourism promotion using a neuromarketing approach. *Journal of Global Tourism Research*, 6, 45-54. DOI: 10.37020/jgtr.6.1_45
- Nadayiova, M. (2015). The Perception of the Neuromarketing by the Slovak Customers and its Influence on their Purchasing Behaviour. In: Matus, J. & Petranova, D., ed. *Marketing Identity: Digital Life, PT II*.
- Nogueira, M.C., & Madaleno, M. (2021). New evidence of competitiveness based on the global competitiveness index. *Economics Bulletin, AccessEcon*, 41(2), 788-797.
- Oh, H., Fiore, A. M., & Jeoung, M. (2007). Measuring Experience Economy Concepts: Tourism Applications. *Journal of Travel Research*, 46(2). DOI: 10.1177/0047287507304039
- Pícha, K., Navrátil, J., & Švec, R. (2018). Preference to local food vs. Preference to “national” and regional food. *Journal of Food Products Marketing*, 24(2), 125-145. DOI: 10.1080/10454446.2016.1266549
- Pileliene, L. (2011). Neuromarketingo principai ir nauda organizacijoms: teorinis aspektas. *Management theory and studies for rural business and infrastructure development*, 5(29).
- Pine, J. B., & Gilmore, J. H. (1998). *Welcome to the experience economy*. Harvard Business Review 76(4).
- Rodrigues, T., Silva, S.C., & Duarte, P. (2017). The value of textural haptic information in clothing shopping. *Journal of Fashion Marketing and Management*, 21(1), 88-102. DOI: 10.1108/JFMM-02-2016-0018
- Santos, R.O.J., Oliveira, J.H.C., Rocha, J.B., & Giralaldi, J.M.E. (2015). Eye Tracking in Neuromarketing: A Research Agenda for Marketing Studies. *International Journal of Psychological Studies*, 7(1). DOI:10.5539/ijps.v7n1p32
- Šerić, Neven and Jurišić, Marijana and Petričević, Duje. (2015). Neuromarketing Potential for Tourist Destination Brand Positioning (April 27, 2015). *Tourism in Southern and Eastern Europe*, 3, 3rd International Scientific Conference Tourism in Southern and Eastern Europe 2015.
- Stylidis, D.; Sit, J., & Biran, A. (2016). An Exploratory Study of Residents' Perception of Place Image: The Case of Kavala. *Journal of Travel Research*, 55(5). DOI: 10.1177/0047287514563163
- Urry, J. (2002). *The Tourist Gaze*. SAGE Publications.
- Urry, J., & Larsen, J. (2011). *The Tourist Gaze 3.0*. SAGE Publications. DOI:10.4135/9781446251904
- Woodside, A.; Crouch, G.; Mazanec, J.; Opperman, M., & Sakai, M. (2000). *Consumer Psychology of Tourism, Hospitality and Leisure*. CABI Publishing, Wallingford, UK. DOI: 10.1079/9780851993225.0000
- Yoon, C., Gonzalez, R., Bechara, A., Berns G.S., Dagher, A.A., Dubé, L. (Eds.). (2012). Decision neuroscience and consumer decision making. *Marketing Letters*, 23, 473-485. DOI:10.1007/s11002-012-9188-z
- Zaman, B., & Shrimpton-Smith, T. (2006). The FaceReader: Measuring instant fun of use. *Proceedings of the fourth Nordic conference on human-computer interaction*, Oslo, Norway: ACM Press. DOI:10.1145/1182475.1182536
- Zhang, F., Lan, C.Q., Wang, T., & Gao, F. (Eds.). (2020). Research on Visual Performance Evaluation Model of E-commerce Website. *Proceedings of the 15th IEEE Conference on Industrial Electronics and Applications (ICIEA 2020)*, 1075-1080, DOI:10.1109/ICIEA48937.2020.9248390
- Zurawicki, L. (2010). *Neuromarketing: Exploring the brain of the consumer*. Springer Science & Business, DOI:10.1007/978-3-540-77829-5

Building of strong brands with emphasis on branding of tourism destination

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Abstract: The topic of this paper is the research of professional journals, reference books, published papers as well as study of best practice of building the strong brands. The key question is how to define a strong brand, from which values the strong brand has been formed and which factors create strong brands. The main point of interest is the branding of tourism destination and how are the standard modern branding strategies useable for it. Destinations brands have very specific characteristics, they are based on historical name of the location and are usually public property. This paper deals with the question which branding factors are most important for the strong brand of tourism destination. As an example had been evaluated two successful destinations Austria and Upper Austria and their approach to branding management. The research will be used as the basis of analysis of other destinations in dissertation „The marketing of tourism services with the accent of destination branding“.

Keywords: tourism, brand, destination, branding management

JEL classification : M31, Z32, Z33

1 Introduction

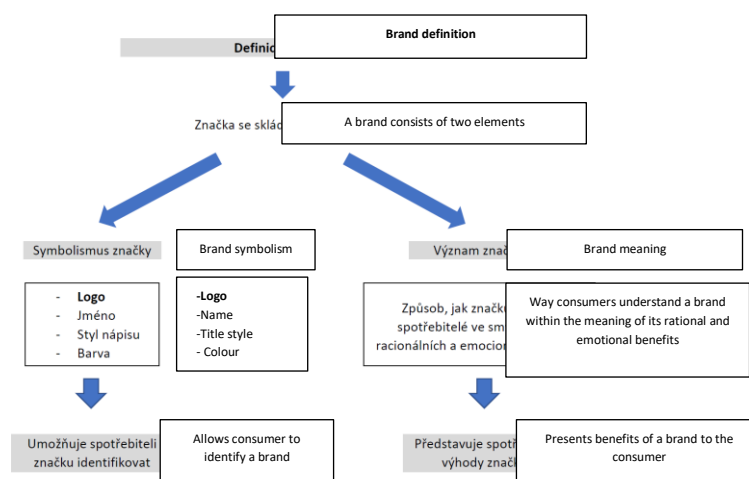
The need for branding has been influenced by the globalisation and internationalisation of markets, strong competition and social changes emphasizing environmental and social responsibility of actors. Virtually everything on the market is branded, these days. A strong brand is a prerequisite for competitiveness and success in any industry, including tourism in case of destinations. Building a strong brand is a strategic process with a long-term perspective and a continuous one, as the brand must respond to ongoing changes. The main objective of building a strong brand is to position the product in the market, differentiate it from competitors and gain market share. Experienced marketing managers know that building a strong brand is not just about a graphic symbol and a verbal slogan. The brand must embody trust, reputation and a certain excellence.

2 Tourism brand and destinations

According to the American Marketing Association (AMA), a brand is a name, title, symbol, graphic image, or combination that identifies the product of an entity distinguishing it from a product of another entity, i.e., a its competitor. It is not enough just to create a word slogan or a graphic symbol; a brand must embody trust, reputation and a certain excellence. Vysekalova (2020) reflects on the brand as a part of the corporate identity stating that “the logo is a part of the brand” in relation to the importance of the logo for corporate identity. For her definition of a brand see figure 1.

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Figure 1 Brand definition



Source: Her own elaboration according to Vysekalová, J., Mikeš, J., Binar, J. (2020). Image a firemní kultura – 2. aktualizované a rozšířené vydání. Praha: Grada Publishing a.s., s. 53

Keller (2007) deals with two views of a brand – a view of a customer and a view of an organization:

A brand provides **the customer** with information allowing him/her to make a quick decision, saves time and energy spent on searching for a suitable product and reducing the risk of buying a wrong product. A brand informs about the manufacturer, the quality standard and the product characteristics. A customer expects “his/her” brand to meet his/her requirements and gives trust, sometimes even loyalty, to the brand.

A brand allows **an organisation** to differentiate (differentiate itself from its competitors) and diversify the product (creating quality and price levels of brands). It also enables legal protection of unique product characteristics (e.g., local product, intellectual rights). The brand is a competitive advantage, it signals a quality standard when a satisfied customer chooses the product again and the organisation can better anticipate and plan its activities in the market. It is a marketing tool for communicating with customers, but also with partners, suppliers and the general public. A strong brand is a source of financial security and return (in some industries, the value of the brand may represent a high percentage of the organisation's assets, exceeding the value of tangible assets, or the organisation may only own the brand while the products themselves are manufactured by another company).

Strong brands are an important part of international marketing and strengthen an organisation's position in the global marketplace. Machkova (2015) even speaks of strategic *international brand management* of a brand as a major prerequisite for an organisation's success in international markets: “International marketing must rely on a very good knowledge of the target groups in foreign markets and must meet the prerequisites: Matching the organisation's capabilities and competencies with the brand image, defining main benefits and advantages of the product and brand for a given market, meeting expectations of customers in the market and their perceptions of the country of origin and the relationship with foreign brands, clearly communicating the brand's advantages over competitors, communicating real product features and being credible.”

International marketing and building a position in foreign markets is among core strategies of tourist destinations, with foreign visitors being the chosen target group in most cases. Palatková (2011, p. 11) specifies destinations as units of international tourism: “Destinations are defined as regional, internationally (globally) competitive, strategically managed units of supply in the international market.” Furthermore, Palatková (2006, p. 16) defines a destination as a system: “A destination is represented by a bundle of various services concentrated in a particular place or area, which are provided in relation to the tourism potential (attractiveness) of the place or area.” Bieger (1996) also understands a destination as a system and identifies linkages between service providers, the destination management organization and external influences such as natural and political environment and markets. There are other various concepts of destination definitions. For example, the geographical concept that “a destination is a geographical space chosen by visitors as their tour destination” Bieger (1996, p. 74), or the concept of destination as a tourism product, i.e. the marketing concept: “a destination as a tourism product is an object of purchase, sale and consumption” Királová (2003, p. 18). We can use marketing to influence the market, the behaviour of visitors and to implement a brand strategy.

The destination brand is usually the name of the geographical area that the destination represents. The name of the country where the destination is located is very often itself a strong brand, e.g., Austria with its strong association and visitor expectations of high-quality service, environment and offer. There is a certain degree of a strategy of targeting customer expectations associated with the country of origin of the product *made in.., country of origin*.

3 Brand value

The concept of brand value is not unambiguous for it has actually two dimensions:

The concept of brand equity, based on the customer's perspective of *customer-based brand equity*, expresses the added value a product receives when it is “branded” with a strong brand, i.e. how much influence the brand has on repeating purchases and whether the customer will choose our branded product over a competitor's product in the future. The value of a brand is directly related to its awareness and prevalence in the market, to the **sources of brand equity**, i.e. the **brand awareness and knowledge of the brand** among customers, and to the perception of the brand by customers, i.e. the **brand image**. At first customers must know and trust the brand and, to be loyal to the brand, if possible, in order to choose the product over competitors and purchase it repeatedly.

Brand value, from the perspective of the organisation the *brand value*, reflects the capitalisation of the brand and the financial valuation in an event of a sale or acquisition. A strong brand is part of the company's capital, albeit in an intangible form, yet very often with a high value in the market; therefore, brand building is seen as a long-term investment. “From the business point of view, brand value is the value of all future returns generated by the brand and its benefits.” De Pelsmacker (2003, p. 67).

Every year, rankings of the world's most valuable brands are published. The most often cited ones include the Kantar BrandZ global ranking² by the London-based analytical consulting firm KANTAR Group. The Kantar BrandZ Most Valuable Global Brands 2022 report identifies brand as a highly valuable asset to organisations, making up on average 29% of an organisation's total value, and can be as much as 50% of value with strong brands. The top 100 most valuable brands in the world in 2021 represent a sum of US\$8.7 trillion in financial terms.

Looking at branding in the tourism industry, we commonly see branded hotels, airlines, transport companies and various service providers. There is a strong competition in the travel market and branding is a tool, as in other industries, to differentiate and monetise the added value of the brand. The focus on customer, gaining customer attention and loyalty apply more in the tourism industry than anywhere else. Travelling and holidays are emotional issues, customers have high expectations and a lot of choice. In case of hotels, airlines, etc., acquisitions, mergers and ownership changes take place, and from the point of view of organisation *brand value* plays an important role in these business transactions. In 2021, TUI Group, one of the leading tourism companies, sold its ownership interest in the properties of the RIU premium hotel chain, reportedly due to the need to optimise assets and focus on brand strategy, service and optimisation of sales³.

In case of tourist destination branding, brand equity is understood mainly from the point of view of customers and it is a core element of destination marketing. The brand of a tourist destination is usually identical with the name of the location. For example, the “I Love NY” brand is owned or managed by a local tourism organisation, a destination company, most often a tourist association, “shareholders” of which are both from the public and private sectors. Destination brands are usually not for sale, or at least no such a case has ever been reported. **A strong destination brand increases the added value of the tourism services offered in the destination. The whole location benefits from its strength, including its inhabitants and private sector businesses.**

A strong destination brand often supports the attractiveness of the place itself. Investors, employees and residents perceive a strong brand and find the place attractive both for living and doing business. A strong destination brand is often a part of the positioning and regional development strategy of locations and regions within territorial units. The visual appearance of the destination brand - the logo - if it becomes iconic, as is the case of “I love NY”, can be a source of revenues for the place and the tourist association in the form of lending rights and its use for a fee and for merchandising.

² <https://www.kantar.com/inspiration/brands/what-are-the-most-valuable-global-brands-in-2022>

³ <https://www.tuigroup.com/de-de/medien/presseinformationen/ag-meldungen/2021/2021-07-30-tui-group-verkauf-immobilienportfolio-an-familie-riu-abgeschlossen>

4 Strategic brand management

The strategic brand management starts with deciding whether our product will be branded. It is assumed that it is, because there are very few specific commodities on the market that do not need a brand, e.g., raw materials such as oil, wheat, large single-unit machines or weapons. Everything else that has gone through the process of production or value-added processing needs to be differentiated from competitors by marketers. **The brand management strategy answers the question, how do we build a strong brand and how do we measure and enhance brand equity?** Returning to the brief statement by Kotler and Armstrong (2021, page 253) „Products / goods are made in the factory, brands are created in minds of customers.“, we will look at *brand equity* from the customer's perspective. This approach is also closer to the issue of tourist destination branding.

What is a strong brand and what factors do create a strong brand? A brand strength is based on customer opinion; customers have a high awareness of the brand, know it well, perceive it and have positive, strong and unique associations in their minds. **A strong brand is a combination of brand factors** that provide a range of benefits to the customer, the organization, and consequently the location and the society in general Aaker (1996, p. 9) creates a model of brand equity based on five factors: 1. Brand loyalty, 2. Brand awareness, 3. Perceived quality, 4. Brand association, 5. Protected assets such as visual and verbal symbols, trademarks, licenses, and in this model he demonstrates benefits of the brand to the customer and the organization.

4.1 Strategic brand management methods

According to Keller (2007, p. 72), strategic brand management involves the design and implementation of marketing programs and activities to build and manage brand equity. The strategic management process itself is defined in the following four steps:

1. Brand positioning means finding a proper position of the brand in the minds of customers, it is necessary to determine the target market, define the main competitors and know what the product has in common with the competitors and how they differ from each other on the other hand.

To determine the target market, we use **market segmentation** by demographic and geographic aspects. Also from a behavioural perspective, what the customer thinks about the product and what is the product's benefit, value to them. The competitive analysis defines organizations, product category affiliation and differentiation within that category. In relation to differentiation, **the concept of USPs (unique selling propositions)** is used.

In case of tourist destinations, market segmentation and the USPs method are a part of the destination strategies. The product of the destination is offered and provided by a chain of interrelated services provided by various organisations and the destination brand bears the name of the location. The destination, usually as a geographical historically shaped space, has its distinctive features “predestined” within the competition (a significant historical monument or a natural unique phenomenon). In the positioning phase, a proper knowledge of the market and customers, as well as the tourism potential of the destination that differentiates it from its competitors, is a key.

The core brand value serves as a basis for positioning, it is a set of abstract associations that characterise the brand. The **mental map** portrays all the associations and responses to the brand, the core value of which consists of about 5-10 most important aspects. Keller (2007, p. 188) further talks about the **brand mantra**, a short verbal expression of the essence of positioning and the core values of the brand. The *Urlaub in Österreich* brand is one of the pillars of the activities of the National Tourism Organisation Österreich Werbung. Building and nurturing the *Urlaub in Österreich* brand is the main tool this organisation applies in fulfilling its mission to maintain and strengthen Austria's position as one of the world's top tourist destinations. The brand's mantra is expressed in the short message *Die Marke "Urlaub in Österreich" bringt Österreichs Glanzpunkte zum Leuchten, i.e. the brand "Holidays in Austria" lets the best of Austria shine through*. Holiday in Austria fulfils wishes and expectations to find and renew harmony with the outside world and with oneself, to find the power of the vitality, simply “*Spüre das Leben*” *Live your life*.⁴

The core values of a tourist destination brand should appeal to and win over not only employees and tourism stakeholders in the locations but also residents. Residents are the best “marketers” of their city or region. For this synergic reason, a destination brand is also very often the marketing brand of the location, as a place to live or do business, Morgan, Pritchard, Pride (2002, p. 4) describe **place brands** from a holistic approach. Example from practice include

⁴ <https://www.austriatourism.com/marke-urlaub-in-oesterreich/>

linking of the Upper Austria tourist destination brand with the branding and communication of the Federal State of Upper Austria, starting in 2020⁵, with the aim of creating a unified brand for Upper Austria, the so-called *Oberösterreich als Standortmarke*, which will be one of the key tools to build its position as a modern and dynamic federal state. The brand will be used in various fields (education, culture, science, economy, sport, etc.). There is a manual available that companies and organisations will use for **co-branding**, see Figure 2. A manual for co-branding of the official emblem and logo has been created for the needs of the federal government.

Figure 2 - Co-branding of the emblem of the Federal State of Upper Austria and the logo of the destination Upper Austria



Source: <https://www.oberoesterreich-tourismus.at/marke.html>

2. Planning and implementation of marketing programs and brand is a continuous and long-term process with the aim of building as much brand awareness and familiarity as possible, creating and maintaining positive brand associations, and thereby gaining as many loyal customers as possible. The result is high *brand equity* from the customer's point of view.

When introducing a new brand, a **brand identity** must be created by selecting the appropriate elements for visual and verbal brand identification. This is the whole set of elements starting from the name, logo, symbols, slogans and jingles, packaging and elements for online communication, usually elaborated into so-called *corporate identity* of manuals, guidelines and binding rules for the use of elements, or a combination of them. Several important criteria should be considered when creating elements, Keller (2007, p. 245) lists 6 criteria: memorability, meaningfulness, popularity, accuracy, adaptability and the possibility of protection (legal protection - trademarks). **Tourist destinations usually choose the name of the location as the basis of their brand identity.**

Cooperation with VIP, stars and celebrities is a successful and essentially proven marketing tool for tourist destinations to increase *brand equity* from the point of view of customers. If a prominent and popular celebrity is spending holiday somewhere, this place becomes an attractive destination. An example of this is the Sommerfrische concept in the Salzkammergut region of Upper Austria, which has been operating since the mid-nineteenth century, when the imperial family, and later artists, politicians and prominent businessmen such as Gustav Klimt, spent their summer months here. We can also mention the marketing tool of **organizing cultural, sporting and social events in the destination**. Mass events are often a brand in themselves and they attract media attention for the destination (increase awareness and knowledge of the brand) and increase the market share of the destination (brand) by generating arrivals and overnight stays and strengthen the position of the destination on the international market, if the event is of an international nature, such as the Prague Spring music festival, Formula 1 racing etc..

3. Measuring, maintaining and enhancing brand value aims to provide a comprehensive picture of the brand from the customer's perspective and to express the evolution of the brand over time for decision-making by organisations and brand marketers on strategy and measures to maintain and enhance brand value. Keller (2007, p. 417) talks about the **brand value chain**: the brand value definitely depends on customers and he sees the beginning of creating, maintaining and increasing brand equity in implementation of marketing tools, i.e. investments in the brand and in customer opinion (awareness, associations, attitudes, relationship), which influences market performance (market share, profitability, added value of the price) and ultimately the capitalization of the brand for the organization (share price).

⁵ <https://www.oberoesterreich-tourismus.at/marke.html>

For a tourism destination, measuring brand value as a financial *valuation* is a theoretical option. A destination brand seen as a trademark is usually not for sale. What is relevant and desirable is to measure, maintain and enhance the value of the brand from a customer *brand equity* perspective. **The customer-guest is the most valuable asset for a destination.**

The market performance of a brand can be interpreted through statistical indicators of visitor arrivals, overnight stays and visitor spending in the destination. Secondary effects whose performance is monitored include prices of overnight stays and services in the destination, employment and business activity resulting from tourism and macro-economic benefits e.g. contribution to the GDP of a region or country. Tourism destination visitor statistics are globally aggregated by the UNWTO World Tourism Organization from 196 countries, which publishes regular data compilations on a monthly basis or in the form of yearbooks or compendia over long periods, such as the *Compendium of Tourism Statistics, Data 2016 - 2020, May 2022 Edition*.

Destination companies usually have a so-called *marketing information system*, in which they monitor and evaluate the statistics and data see above, i.e. *quantitative data*. However, it also includes *qualitative data* obtained from market and trend studies, marketing surveys, visitor surveys and visitor satisfaction surveys. The marketing information system is an essential tool for the strategic management of the destination, and hence the destination brand. **If a destination is building a strong brand, it periodically identifies the sources of brand value/equity, i.e. customer awareness and knowledge of the brand and customer perception of the brand, i.e. its image**

As a practical example we can mention the destination of Upper Austria. Oberösterreich Tourismus GmbH, the destination company of the Federal State of Upper Austria, carried out a follow-up study in the markets of Austria, Germany, Czech Republic and the Netherlands in autumn 2021, *Image und Bekanntheit Oberösterreich Oktober/November 2021*, Brand Awareness and Brand Image of Upper Austria and asked the question why holiday in Upper Austria yes and why not. The results of the study have been compared with the results of a pilot study from autumn 2016, which was conducted on the occasion of the development of a new strategy including re-branding.

4. Enhancing and maintaining brand value is a strategy that considers how to create, maintain and enhance brand value in a broader context and perspective under certain situations and circumstances. In companies, this typically involves the choice of a **product vs. brand matrix for product lines and possibly a brand portfolio or brand hierarchy**. The aim is to gain more market segments and market share in a given industry. An example in the travel industry includes the hotel chain called Holiday Inn Worldwide, which is divided into other hotel chains for various market segments by different accommodation categories: The Crown Plaza brand as the premium category, Holiday Inn the mid-traditional category and Holiday Inn Express the more convenient and cheaper category. Globalization and new technologies have brought challenges and opportunities for building global brands. **The strategy of global branding** is typical of technology, pharmaceutical and telecommunications companies.

5 Conclusion

A strong brand has benefits both for the organisation and the customer. In modern terms, building a strong brand is oriented towards the customer's view of *brand equity*, expressing what benefits and advantages a strong brand has for the customer, what value the brand has from the customer's point of view. *Brand value*, expressed in financial terms, is a part of the assets of organizations, and in case of very strong brands, the value of this intangible asset may exceed the value of tangible assets. The annual global rankings of the brand value of companies are published by specialised agencies and thus also reflect the strongest market position of these companies in the industry. Tourism destinations do not appear in these rankings. Building a strong destination brand has important specifics.

Tourism destinations concentrate a chain of services over a varying size of territory, in which various entities that may be brands themselves, such as accommodation establishments, exercise their interests. As a rule, the brand of a destination is usually the name of the location. The destination company is responsible for its building. The aim of building a strong destination brand is to gain the greatest possible familiarity and the most favourable image with customers, i.e. the highest possible value in terms of customer *brand equity*, so that they choose to spend holiday in that particular destination. The *brand value* in the financial terms is not typical of a destination. However, a strong destination brand can contribute to the brand value of service providers in the destination and make them more confident in pricing their services. Licensing revenues for the use of the destination brand for business activities can generate significant financial returns for the destination company.

What is a strong brand and what factors make up a strong tourism destination brand? As with other products, it is a brand knowledge or awareness, brand associations, perceived quality of the destination product and brand loyalty. In

practice, it can be traced and assumed that the most important factors in the process of building a strong destination brand are brand awareness and perception, i.e. brand image. These factors can be significantly influenced by the destination company through the proper *positioning* and marketing strategy. In particular, by working with the tools of the marketing mix, it can influence various target groups at different times and thus market the destination more than once, since the destination, unlike other products, is an object of purchase, sale and consumption. In practice, it can also be observed that perceived quality as a factor of a strong brand is understood and used strategically by successful destinations such as Austria or Switzerland, even though it is a very complicated process and is essentially a political decision and social agreement. The quality of all services from various providers cannot be directly influenced and guaranteed. However, the destination company and the self-governing bodies of the territory can very effectively create both positive and restrictive tools for managing the quality of the destination. The influence of communication technologies and the existence of a number of online evaluation portals, where the perception of quality is created by the customers themselves virtually live, should be taken into account. The question is the degree of objectivity. The loyalty factor is applicable within the product portfolio of a destination, some destinations can be offered to one customer several times, for example for a family trip and later for a romantic holiday. However, this factor has its limits, especially for customers, who like to discover as many destinations as possible and do not return to the same place. A deeper study of individual factors, understanding and finding the most important ones, or the best combinations of them, to be a successful destination is the subject of further research.

References

- Aaker, David A. (1996). *Building strong brands*. New York: Free Press.
- Bieger, T. (1996). *Management von Destinationen und Tourismusorganisationen* München: Oldenburg Verlag.
- Királová, A. (2003). Marketing destinace cestovního ruchu. 18. Praha: Ekopress
- Edelman, D. C. (2013). *Branding in the digital age*. In HBR's 10 must reads, on strategic marketing. Boston: Harvard Business Review.
- De Pelsmacker, P., Geuens, M., & Van den Bergh, J. (2003). *Marketingová komunikace*. Praha: Grada Publishing, a.s.
- Morgan, N., Pritchard, A. & Pride, R. (2002). *Destination branding*. Oxford: Elsevier Butterworth-Heinemann.
- Kantar Group (2022). *BrandZ Most valuable global brands*. London: Kantar Group. <https://www.kantar.com/inspiration/brands/what-are-the-most-valuable-global-brands-in-2022>
- Keller, K. Lane (2007). *Strategické řízení značky*. Praha: Grada Publishing, a.s.
- Machková, H. (2015). *Mezinárodní marketing*. Strategické trendy a příklady z praxe – 4. vydání. Praha: Grada Publishing, a.s.
- Palatkova, M. (2006). *Marketingová strategie destinace cestovního ruchu*. Praha: Grada Publishing, a.s.
- Palatkova, M. (2011). *Marketingový management destinací*. Praha: Grada Publishing, a.s.
- Perrier, R. (1997). *Brand valuation*. London: Premier Books.
- TUI Group Corporate & External Affairs Hannover (2021). TUI Group: *Verkauf des Immobilienportfolios an die Familie Riu abgeschlossen*. Hannover: TUI Group. <https://www.tuigroup.com/de-de/medien/presseinformationen/ag-meldungen/2021/2021-07-30-tui-group-verkauf-immobilienportfolio-an-familie-riu-abgeschlossen>
- Vysekalová, J., Mikeš, J., & Binar, J. (2020). *Image a firemní identita - 2.*, aktualizované a rozšířené vydání. Praha: Grada Publishing a.s.

Bioeconomy, Society and Public Administration:
Who is Ready for the Future?

Exploring the internal and external environment of the Civil Protection institution of Greece in the period of the Covid-19 pandemic

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Abstract: The danger of Covid-19 was an invisible enemy for life but also an opportunity both for political consensus on the essence and direction and for the strengthening of basic state institutions (structures and procedures). The General Secretariat for Civil Protection is the body that was called upon to coordinate the management of Covid-19 in Greece and to act within the framework of the operation of the European Civil Protection Mechanism. The management of the health risk was a challenge for the organization both for the effective and efficient operation of the body itself and for the implementation of a policy of multilevel governance and European cooperation. The present study attempts to map the internal and external environment of the civil protection institution of Greece with the use of secondary data from the literature, drawing the attention of relevant stakeholders, policy makers and governments, in order for the public policy of governments to find scope and be implemented effectively and efficiently.

Keywords: Greece, civil protection, Covid-19, national Crisis Management and Risk Response Mechanism (Nat-CHAMM)

JEL Classification: H12

1 Introduction

Lifestyles in both developing and developed countries are now affected daily by natural and technological disasters. The global health crisis due to Covid-19 was an additional factor that endangered the supreme good of "life" and brought about long-term and possibly irreversible effects on people's living conditions, the economy and the environment.

The basic constitutional obligation of any modern democratic state is the safety and security of citizens and the environment. To support this obligation, at the strategic level, each state establishes specific (administrative) civil protection systems and mechanisms at national, regional and local level, with a single planning and specific rules (Lekkas & Andreadis, 2015).

Civil Protection refers to a set of procedures and actions that cover all phases of the risk management cycle (prevention, preparedness, early warning, rapid response, consequences management, rehabilitation) utilizing the scientific and technological capabilities of various sciences. It is formed in the context of the existing organization of the state, is related to implemented policies and its design reflects the existing policy to reduce the likelihood of manifestation of negative effects from the manifestation of a phenomenon or event (Dandoulaki 2011). Its implementation presupposes political commitment, institutional regulation and social participation.

Civil Protection as a state body aims at the planning, organization, coordination of actions, the interconnection of bodies and services of the public administration (according to competence), and the private potential and means for the prevention and response to natural, technological and other disasters or emergencies (Karamanou, 2021, Goudrichou & Dandoulaki, 2017).

2 Methods

The present study presents the Greek Civil Protection System, the regulatory framework for operation, the way of organization and administration of this system. The methodology followed was based on the study of secondary sources, on laws of the Greek state, on official documents, scientific articles, reports and data from valid websites. The study focuses on the organizational structure, the planning at strategic and operational level and the coordinating function of

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the state Civil Protection body that has the responsibility of coordination during the management of the Covid-19 pandemic.

3 Research results

In Greece, civil protection came to the fore in an urgent way, especially after the deadly natural disasters, in 2017 by flooding (24 human losses) and in 2018 by forest fire (102 human victims), the material and environmental disasters caused in both cases.

3.1 Institutional framework for the operation of the GSCP

Although the institutional body for civil protection had been created in 1995 with the establishment of the General Secretariat for Civil Protection, it remained invisible while there was strong criticism of the negative actions of the country's civil protection system (overlapping of responsibilities, lack of coordination between the levels of administration, partial inadequacy of planning and prevention measures, reduced use of modern technologies) . The assessment of the events of 2017 and 2018 and the demands of society marked a political and institutional movement for the harmonization of the country with the internationally existing best practices but also the guidelines of the EU for crisis management and risk management.

On February 7, 2020, with the adoption of Law 4662/2020 on Civil Protection, the radical reform of civil protection in the country begins on the basis of a decade-long planning. The operational, executive and support structures for Civil Protection converge on the National Crisis Management and Risk Response Mechanism (Nat-CHAMM). The National Mechanism aims to create a single national civil protection system of vertical organization governed by specific statutory principles and which covers the entire spectrum of the cycle of disasters and risks (prevention, preparedness, response, rehabilitation), taking into account the needs of all citizens, including those with disabilities (information, individual rescue plans, accessible infrastructure, etc.).

19 days after the publication of the law, the first case of Covid-19 in the country is announced and Greece enters the vortex of the global pandemic. On March 12, 2020, the first death from the coronavirus is announced.

On March 11, by an act of legislative content (Government Gazette A ' 55 / 11-03-2020) the Secretary General of Civil Protection is given the authority to declare, by decision, areas of the Territory in a state of civil protection emergency for reasons of public health following a relevant recommendation of the National Committee for the Protection of Public Health (article 19). At the same time, the National Public Health Organization provides the GSCP with personal data of citizens of epidemiological correlation.

On March 15, the Secretary General of Civil Protection is upgraded to Deputy Minister of Civil Protection with special responsibility for the management of the pandemic and with a speech by the Prime Minister undertakes the general coordination of actions in "war conditions". With Presidential Decree 70/2021, the GSCP now comes under the newly established Ministry of Climate Crisis and Civil Protection, is an administrative structure and an overlying operational structure of the National Civil Protection Mechanism.

3.2 Organization of the Greek Civil Protection System

In the Civil Protection system of Greece, all citizens and especially public officials, as executors of the will of the State, are considered valuable resources, since they can participate in reducing the risk and dealing with the disaster, starting from their individual, family, neighboring and work environment.

In general, the organization of the Greek Civil Protection System follows the constitutionally defined system of public administration. The administration of the Greek state is organized according to the decentralized system. The regional bodies of the State have general decisive competence for the affairs of their region. The central bodies of the state, in addition to special responsibilities, have the general direction, coordination and control of the legality of the acts of regional bodies, as defined by law (Article 101 of the Constitution on Administrative Decentralization).

Despite the fact that due to the advent of the pandemic, a significant part of the articles of Law 4662/2020 were suspended, within the framework of this law, the GSCP activates the National Crisis Management Mechanism and prepares the strategic plan in cooperation with all co-competent Ministries and bodies. In this context, it is developing a system of digital, technological management of the crisis to shield the country against the virus by utilizing the most modern technological means and scientific data.

The pillar of this plan was the exhaustive tracing of cases and their close contacts, so that the GSCP monitors the development of the situation on a daily basis with the greatest possible accuracy and intervenes where necessary with emergency measures and targeted movements. Greece, despite its initial intention, is not developing mobile phone

applications for contact tracing in EU Member States and the GSCP's "Tracing Centre" undertakes tracing and warning to break the chain of infections and save lives.

3.3 The role of tracing

The term "tracing" refers to a set of techniques used by the public authorities of the States, for the identification of persons who they may themselves be a case of a disease or simply have been close to a confirmed case. Tracing is carried out in order to precautionary, isolation and healing measures are taken. (Loukaiti, 2021).

Initially, the tracings were carried out by the National Public Health Organization while in March 2019 corresponding responsibilities were assigned to a special department of the General Police Directorate of Attica where 150 uniformed special investigating officers had the authority to identify the contact cycle of confirmed cases and to take quarantine measures.

Then the "Tracing Center" was put into operation in the building of the GSCP for the tracing process, which is undertaken by uniformed and private individuals hired by an act of legislative content.

Through telephone communication with confirmed cases, information and guidance on positive cases are provided and their close contacts are identified. This is followed by telephone communication with the close contacts reported by the cases who are informed about the current protocols and guidelines of the National Public Health Organization.

The tracing process stopped on September 30, 2022, two years and eight months after the first confirmed case of Covid-19 in Greece. Publicly available information on contact tracing activities is limited and there is no official evaluation report on the Greek government's contact tracing programme (Riza et al., 2021).

3.4 Greece in European Civil Protection Mechanism for the management of Covid-19

Since 2001, Greece has been participating in the European Civil Protection Mechanism which aims to strengthen cooperation and assistance in cases of emergencies inside and outside the Union through a coordinated response at EU level, when the magnitude of an emergency situation exceeds the capacity of the affected country to respond independently (2001/792/EC, Euratom).

On 19 March 2020, the European Commission set up a strategic rescEU capacity – a common European stockpile – for emergency medical equipment such as ventilators, protective masks, gloves and laboratory supplies, to help EU countries cope with the coronavirus pandemic. Greece started creating such a stockpile in September 2020.

In April 2020, the World Health Organization, the EU and global health organisations launched the Access to COVID-19 Tools Accelerator (ACT-Accelerator). The vaccination pillar of the ACT-Accelerator is the COVAX mechanism, which aims at equitable access to COVID-19 vaccines. In July 2021, the EU provided support to Greece for the delivery of 200,000 doses of vaccines against Covid-19 200,000 to Albania and North Macedonia.

4 Conclusions

Greece was called upon to manage the Covid-19 health crisis in the context of a newly passed law aimed at curbing recognized difficulties and weaknesses of the existing civil protection system. However, the application of the law was suspended for the most part. In the context of managing the pandemic, the GSCP, as the competent body for the management of the pandemic, adopted the ECDC's policy on contact tracing, without, however, having a special website for contact tracing or a dashboard, as is the case in other countries. The European Commission's websites reflect Greece's cooperation and assistance in the management of the pandemic, as well as in ECDC reports. However, information on the action plans of the GSCP, the activities and the implementation programs is limited and needs further research and evaluation, which will be carried out with primary research in a second year.

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References

- 2001/792/EC, Euratom: Council Decision of 23 October 2001 establishing a Community mechanism to facilitate reinforced cooperation in civil protection assistance interventions <https://eur-lex.europa.eu/eli/dec/2001/792/oj>
- Dandoulaki, M. (2011). *Kallikratis - Civil Protection and Local Government*. Athens: Greek local development and self-government company EETAA. Available at: <https://www.eetaa.gr/ekdoseis/pdf/144.pdf>
- Decision (EU) 2019/420 on the Union Civil Protection Mechanism, <https://eur-lex.europa.eu/legal-content/EL/TXT/?qid=1553088553036&uri=CELEX:32019D0420>

- Explanatory Memorandum to the draft law "National Crisis Management and Risk Management Mechanism, restructuring of the General Secretariat for Civil Protection, upgrading of the civil protection volunteering system, reorganization of the Fire Brigade and other provisions". Available at: <https://www.hellenicparliament.gr/UserFiles/2f026f42-950c-4efc-b950340c4fb76a24/prostasia%20politi-synolo.pdf>.
- Goudrichou, C., & Dandoulaki, M. (2017). *Disaster and crisis management at National and International level – International Mediation*. Athens (Second edition).
- Karamanou, A. (2021). *Civil Protection and Risk Management. "The Greek Civil Protection System"*. Athens: National Center for Public Administration and Self-Government.
- Law 4662/2020 (Government Gazette 27 / A ' 7.2.2020). National Crisis Management and Risk Management Mechanism, restructuring of the General Secretariat for Civil Protection, upgrading of the civil protection volunteering system, reorganization of the Fire Brigade and other provisions. Available at: https://www.elinyae.gr/sites/default/files/2020-02/27%CE%91_2020.pdf
- Lekkas, E., & Andreadis, E. (2015). *Introduction to the theory of disaster and crisis management*. Athens.
- Loukaiti, N. (2021). Covid-19 Tracing Apps and Personal Data. *Information Law Journal* 2. Available online at: <http://ejournals.lib.auth.gr/infolawj/>
- Riza, E., Kakalou, E., Nitsa, E., Hodges-Mameletzis, I., Goggolidou, P., Terzidis, A., Cardoso, E., Puchner, K.P., Solomos, Z., Pikouli, A., et al. (2021) Appraisal of a Contact Tracing Training Program for COVID-19 in Greece Focusing on Vulnerable Populations. *International Journal of Environmental Researxh and Public Health*, 18. DOI:10.3390/ijerph18179257

Application of green economy principles in the post-crisis period in the EU

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Abstract: The paper deals with the application of green economy principles within the EU in the post-crisis period. It builds on previously published research on the impact of the economic crisis on a selected set of green economy indicators. The aim is to find out, on the basis of the selected indicators, how the application of green economy principles has evolved in the two periods under study – immediately after the economic crisis and in the present. The study is based on statistical analysis of six indicators in the pre- and post-crisis period: GDP, Unemployment, Productivity, R&D expenditure, Share of RES, CO₂ emissions. In all monitored indicators, taking into account EU-wide averages, a shift towards a greener economy can be observed. Correlation analysis clarified the basic relationships between the indicators. Based on the factor analysis, it can be said that countries do not show significant variations and there is no significant tendency to form clusters. This may mean that the current selection of indicators no longer fully explains the changes associated with the green economy.

Keywords: green indicators, indicator, green economy, sustainable development

JEL Classification: Q56, O18

1 Introduction

The concepts of the green economy, bioeconomy, and circular economy are considered the mainstream pathways for achieving sustainable development enabling meeting economic, environmental, and social goals (D'Amato et al., 2017). All these concepts are well-recognized and discussed among policymakers, researchers, and businesses, and implemented into practice (D'Amato and Korhonen, 2021). The green economy appeared as a new paradigm to overcome various crises, including the financial crisis of 2008, and market failures through a transformation into low carbon, resource efficient, and socially inclusive economy. The green economy presents a market-based approach, yet it involves reformed policies, adequate subsidies, and investments to improve human well-being and social equity while reducing environmental risks and ecological scarcity (UNEP, 2011). The terms like green growth, green jobs, and green deal are used to represent the greening of the economy and policy, in which the economy and society gets connected with the biosphere, and the importance of the natural factor is highlighted, and sustainable development can be achieved (Adamowicz, 2022). Although being launched into practice after the crisis in 2008, the efforts to revive and strengthen the economies through the green economy can be recently seen as a way to combat challenges such as the Covid-19 pandemic, energy crisis, Russian invasion of Ukraine, and general economic uncertainty (Siksnielyte-Butkiene et al., 2022). In economic practice, many countries and regions turn to clean energy, green financing and investments, green bonds (Yang et al., 2022), green innovations, advanced green technologies (Ying, Li and Yang, 2021), green buildings, green transportation, green infrastructure, green agriculture, etc. (Pan et al., 2018).

The green labelling of terms is an obvious form of distancing from the former black economy, where growth is based on excessive resource exploitation led by economic interests neglecting environmental damage and crises (Sun et al., 2020). In some studies, the traditional economy is not reflected as a black, but as a brown economy, where unlimited growth is based on intensive use of fossil and other natural resources, overproduction, and overconsumption, resulting in tremendous amounts of waste, pollution, and the overall harm to the environment, biodiversity, and future generations (Niemczyk et al., 2022; Prokopowicz, 2020). However, the problems of the conventional economy are not connected

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solely to the environment and future generations as the paradigm leads to uneven economic growth and current social inequality (Poltarykhin et al., 2018). A transition towards a green economy is perceived as an opportunity for mitigating climate change, improving resource efficiency, reducing biodiversity loss, as well as socio-economic risks arising from climate change (Ansah and Sorooshian, 2019), and achieving the Sustainable Development Goals (SDG), although some of the goals are largely ignored within the green economy frameworks and indicators, e.g., SDG 5 gender equality (Merino-Saum et al., 2018)

The purpose of the indicators of the green economy is to determine its extent and implementation in various countries. While measuring the green economy, the indicators must cover social, economic, and environmental dimensions, yet the selection of criteria to characterize the phenomenon depends on the definition of the green economy (Cudlínová, Vávra and Lapka, 2015). The indicators should focus on poverty eradication, economic prosperity, and ecological preservation simultaneously to trigger the green economy by integrating all dimensions (Khoshnava et al., 2019). Many international organizations including the UNEP, the Global Green Growth Institute, the World Commission for Environment and Development, the OECD, and the EU have constructed their indicators and index systems to evaluate the green economy (Wang et al., 2019). Most common approaches are based on dashboards of indicators, composite indicators, environmental footprints, or adjusted monetary methods covering not only economic but also environmental and social dimensions (Godlewska and Sidorczuk-Pietraszko, 2019). The researchers also focus on measuring the green economy by utilizing green GDP, green economy efficiency, green economy indexes (Wang et al., 2019), green credit, renewable energy investment (He et al., 2019), green investment (Tarkhanova et al., 2020), green infrastructure (Khoshnava, 2020), etc. Although the index systems differ in the set of indicators, in general they usually involve those for energy consumption, environmental quality, and economic growth (He et al., 2019).

The aim is to find out, on the basis of the selected indicators, how the application of green economy principles has evolved in the two periods under study – immediately after the economic crisis and in the present. To meet the objectives, the following research questions were set: 1. How have the values of the selected indicators changed across the selected periods? 2. Is there a statistically significant relationship between the indicators to explain their changes?

2 Methods

This study is based on statistical analysis of six indicators in the pre- and post-crisis period: GDP, Unemployment, Productivity, R&D expenditure, Share of RES, CO₂ emissions. The approach is based on the publication Cudlínová, Vávra & Lapka (2015). Using a statistical analysis of six selected indicators, the authors answer the question to what extent the principles of the ambitious green economy concept, introduced in response to the financial crisis, have been applied in the EU. The results showed that there has been a demonstrable increase in the material productivity of economies, an increase in R&D spending, an increase in the share of renewable energy and a reduction in CO₂ emissions. The negative phenomena were that for some countries GDP fell and unemployment rose. As an important result can be considered the findings of the correlation analyses that show a certain shift in the meaning of green economy principles (Cudlínová, Vávra & Lapka, 2015).

The same set of indicators was chosen for data analysis in this paper as in the previous study by Cudlínová, Vávra & Lapka (2015).

- GDP per capita
- Total unemployment rate
- Resource productivity
- Gross domestic expenditure on R&D
- Share of renewable energy in gross final energy consumption
- Greenhouse gas emissions per capita

Data were obtained from Eurostat. Two periods were selected: the post-crisis period and the present. The post-crisis period contains values from 2012. The present period represents the values of selected indicators from 2020 and 2019 in the case of GHG emissions per capita. The procedure was as follows. First, the change in indicator values was calculated for the two periods under review. Subsequently, correlation analyses were performed for the change between periods. Subsequently, the change in indicator values was subjected to factor analysis. IBM SPSS Statistics was used.

3 Research results

There were changes in six indicators in the two reporting periods. The first indicator was GDP per capita. Positive growth was recorded for all countries. The highest growth was recorded for Ireland (82%), Romania (54%), Lithuania (43%). On

the other hand, the lowest growth was recorded for Greece (1%), Italy (5%), Slovakia (5%). Across the EU, the indicator rose by 16% on average. The second indicator monitored was Total unemployment rate. The largest decrease was found out in Portugal (-9.6%), Ireland (-9.6%), Spain (-9.3%). On the other hand, an increase was found in Luxembourg (1.7%), Austria (0.8%), Sweden (0.3%). The EU-wide average was -3.8%. Resource productivity increased the most in the Netherlands (1.17 euro per kilogram), Ireland (0.97 euro per kilogram), Italy (0.71 euro per kilogram). On the other hand, the largest decreases were in Hungary (-0.3 euro per kilogram), Sweden (-0.07 euro per kilogram), Romania (-0.07 euro per kilogram). The EU average was 0.17 euro per kilogram.

The next indicator is Gross domestic expenditure on R&D. It is reported as a percentage of GDP. The largest increases were found in Belgium (1.24%), Greece (0.78%), Croatia (0.52%). On the other hand, the largest declines were found in Finland (-0.46%), Slovenia (-0.41%), Estonia (-0.33%). The EU average was 0.24%. Share of renewable energy in gross final energy consumption increased the most for Sweden (10.7%), Cyprus (9.8%), Finland (9.6%). In the case of Hungary, it even decreased (-1.7%). The smallest increase was recorded for Romania (1.7%) and Slovenia (3.5%). The EU average was 6.1%. Greenhouse gas emissions per capita fell the most for Estonia (-4.1), Luxembourg (-4.1), Malta (-3). On the other hand, the largest increases were for Latvia (0.6), Hungary (0.5), Lithuania (0.2). The EU average was -0.9.

In all monitored indicators, taking into account EU-wide averages, a shift towards a greener economy can be observed. Table 1 shows the correlations of changes in indicators between the observation periods. The results show that countries with higher GDP growth had lower R&D expenditure. This development was most pronounced in the case of Ireland. Further, states with larger unemployment declines or lower growth had larger GHG emissions. This special relationship can probably be explained by developments in Cyprus, Latvia, Lithuania, Portugal, where there has been a relatively significant decrease in unemployment and a simultaneous increase in GHG emissions. As the final statistical relation was discovered that states with higher resource productivity growth also have a larger increase in the share of renewables.

Table 1 Correlation analysis

	GDP	Unemployment	Resource productivity	R&D expenditure	Share of renewables	GHG emissions
GDP	--					
Unemployment	-0,186	--				
Resource productivity	0,310	0,020	--			
R&D expenditure	-0,384*	-0,114	0,112	--		
Share of renewables	0,085	0,052	0,394*	-0,072	--	
GHG emissions	-0,006	-0,525**	-0,140	0,363	-0,210	--

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

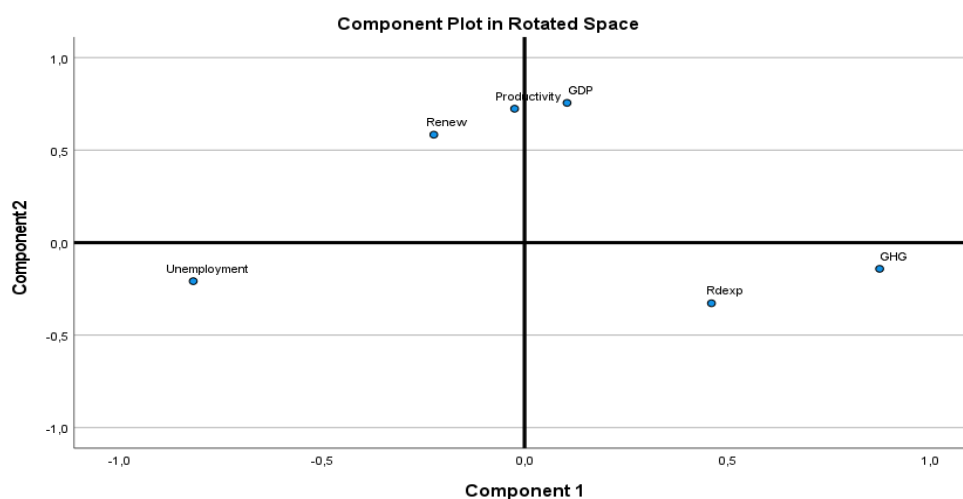
Source: Own processing

Factor analysis that would simplify and clarify possible hidden relationships between the observed variables is borderline valid, as the Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.441. Extraction was by principal component analysis (PCA), rotation by Varimax method with Kaiser Normalization. Only components with factor loadings greater than 0.3 are shown. Overall, the analysis explains 55.262% of the variability in the data. Table 2 shows, according to component 1, that as unemployment has low growth or falls, R&D spending rises, but GHG emissions also rise. Component 2 shows us that as GDP rises, resource productivity and the share of renewables also rise. Conversely, R&D spending has low growth or falls as GDP rises. Graphically, these relationships can be seen within Figure 1.

Table 2 Factor analysis - Rotated Component Matrix

	Components	
	1	2
GDP		0,755
Unemployment	-0,817	
Resource productivity		0,724
R&D expenditure	0,461	-0,328
Share of renewables		0,584
GHG emissions	0,876	
Cumulative % of variance	28,493 %	26,760 %

Source: Own processing

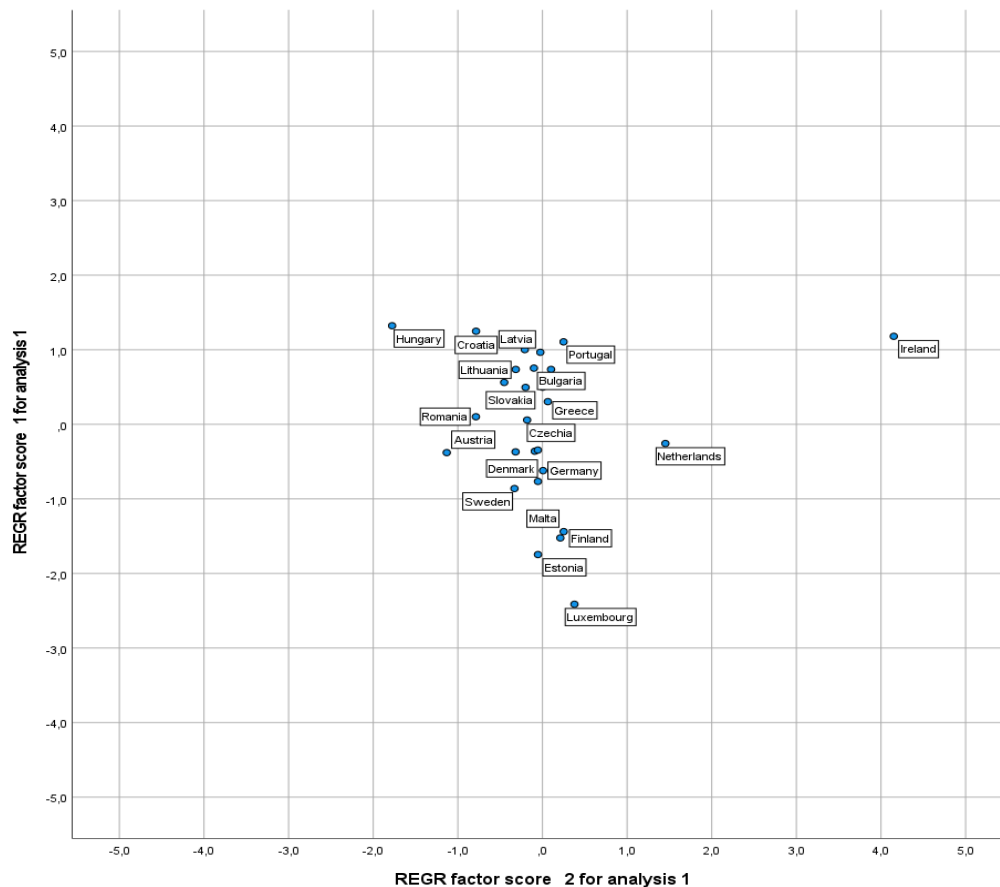
Figure 1 Factor analysis - results

Source: Own processing

In order to be able to use factor analysis to explain the differences between EU countries, factor scores calculated by regression method were used to plot all countries on a Figure 2. The figure shows at first glance that the states are in one big cluster. Only Ireland stands out. Compared to the original Cudlínová, Vávra & Lapka (2015) study, the countries here appear uniform in their development in the indicators under study and there are no significant deviations.

Ireland's position, which is significantly to the right of the chart, can be explained by high GDP growth and an increase in resource productivity according to component 2. On the other hand, R&D spending in this country has fallen. In contrast, the positions of Luxembourg and Estonia at the bottom of the graph can be explained by component 1. For both countries, there was a significant reduction in GHG emissions and there was a simultaneous increase in unemployment and a decrease in R&D spending.

Figure 2 Changes in indicators by country



Source: Own processing

4 Conclusions

Overall, the factors behind the changes have shifted. The original six indicators no longer adequately explain the transformation associated with the green economy. However, from a wider perspective, based on the EU averages, we may see positive development of the indicators towards a greener economy. The GDP, although being criticized, represents a traditional indicator for assessing economic growth and wealth of the nations and was increasing in all the EU countries. The economic growth is emphasized by many concepts of the green economy, and often mentioned as a goal of green economy. The resource productivity, which can be considered as an indicator representing the resource efficiency, therefore another goal of green economy, was not increasing in all the EU countries, yet on the EU average, it increased. Similarly, unemployment rate was increasing in few countries, but on the average, it was decreasing. The issue of employment and job opportunities, especially so-called green jobs, is also one of the crucial aspects of a shift towards moving to a green economy. Increasing job opportunities and lowering unemployment rate is perceived as a necessary step in order to overcome the socio-economic problems related to unemployment, support the social inclusion, and to enable the green transformation. The gross domestic expenditure on R&D was on the EU average increasing. R&D is essential to attain progress in knowledge, technologies, but also eco-innovations. The share of renewable energy in gross final energy consumption increased in all the EU countries except for Hungary, that it increases on an EU-average. Greenhouse gas emissions per capita fell on the EU average, although some countries experienced its increases. Greenhouse gas emissions need to be reduced over time to achieve the low carbon future, or net zero emissions, and to combat the climate crisis. Some interesting, and even two shocking relationships were observed by our analysis, such as that countries with higher GDP growth had lower R&D expenditures, countries with larger reduces of unemployment had larger GHG emissions, and countries with higher resource productivity had higher increase in the share of renewables.

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References

- Adamowicz, M. (2022). Green Deal, Green Growth and Green Economy as a Means of Support for Attaining the Sustainable Development Goals. *Sustainability*, 14(10), 5901. DOI: 10.3390/su14105901.
- Ansah, R., H., & Sorooshian, S. (2019). Green economy: Private sectors' response to climate change. *Environmental Quality Management*, 28(3), 63-69. DOI: 10.1002/tqem.21620.
- Cudlínová, E., Vávra, J., & Lapka, M. (2015). *Aplikace principů zelené ekonomiky v Evropské unii*. In J. Vávra, M. Lapka, & E. Cudlínová (Eds.) *Ekonomika v souvislostech* (55-81). Praha: Filozofická fakulta UK v Praze.
- D'Amato, D., & Korhonen, J. (2021). Integrating the green economy, circular economy and bioeconomy in a strategic sustainability framework. *Ecological Economics*, 188, 107143. DOI: 10.1016/j.ecolecon.2021.107143.
- D'Amato, D., Droste, N., Allen, B., Kettunen, M., Lähtinen, K., Korhonen, J., Leskinen, P., Matthies, B. D., & Toppinen, A. (2017). Green, circular, bio economy: A comparative analysis of sustainability avenues. *Journal of Cleaner Production*, 168, 716-734. DOI: 10.1016/j.jclepro.2017.09.053.
- Godlewska, J., & Sidorczuk-Pietraszko, E. (2019). Taxonomic Assessment of Transition to the Green Economy in Polish Regions. *Sustainability*, 11(18), 5098; DOI: 10.3390/su11185098.
- He, L., Zhang, K., Zhong, Z., Wang, D., & Wang, F. (2019). Green credit, renewable energy investment and green economy development: Empirical analysis based on 150 listed companies of China. *Journal of Cleaner Production*, 208, 363-372. DOI: 10.1016/j.jclepro.2018.10.119.
- Khoshnava, S. M., Rostami, R., Zin, R. M., Kamyab, H., Majid, M. Z. A., Yousefpour, A., & Mardani, A. (2020). Green efforts to link the economy and infrastructure strategies in the context of sustainable development. *Energy*, 193, 116759. DOI: 10.1016/j.energy.2019.116759.
- Khoshnava, S. M., Rostami, R., Zin, R. M., Štreimikienė, D., Yousefpour, A., Strielkowski, W., & Mardani, A. (2019). Aligning the Criteria of Green Economy (GE) and Sustainable Development Goals (SDGs) to Implement Sustainable Development. *Sustainability*, 11(17), 4615. DOI: 10.3390/su11174615.
- Merino-Saum, A., Baldi, M. G., Gunderson, I., & Oberle, B. (2018). Articulating natural resources and sustainable development goals through green economy indicators: A systematic analysis. *Resources, Conservation and Recycling*, 139, 90-103. DOI: 10.1016/j.resconrec.2018.07.007.
- Niemczyk, J., Sus, A., Borowski, K., Jasiński, B., & Jasińska, K. (2022). The Dominant Motives of Mergers and Acquisitions in the Energy Sector in Western Europe from the Perspective of Green Economy. *Energies*, 15(3), DOI: 10.3390/en15031065.
- Pan, S.-Y., Gao, M., Kim, H., Shah, K. J., Pei, S.-L., & Chiang, P.-C. (2018). Advances and challenges in sustainable tourism toward a green economy. *Science of The Total Environment*, 635, 452-469. DOI: 10.1016/j.scitotenv.2018.04.134.
- Poltarykhin, A. L., Alekseev, A. E., Kudryavtsev, V. V., Makhanova, T. A., Voronkova, O. Y., & Aydinov, F. T. (2018). Prospects for the Development of the Green Economy of Russian Federation. *European Research Studies Journal*, 21(4), 470-479. DOI: 10.35808/ersj/1135
- Prokopowicz, D. (2020). Implementation of the principles of sustainable economy development as a key element of the pro-ecological transformation of the economy towards green economy and circular economy. *International Journal of New Economics and Social Sciences*, 11(1), 417-480. DOI: 10.5604/01.3001.0014.3558
- Siksnelyte-Butkiene, I., Karpavicius, T., Streimikiene, D., & Balezentis, T. (2022). The Achievements of Climate Change and Energy Policy in the European Union. *Energies*, 15(14), 5128. DOI: 10.3390/en15145128.
- Sun, Y., Ding, W., Yang, Z., Yang, G., & Du, J. (2020). Measuring China's regional inclusive green growth. *Science of The Total Environment*, 136367, DOI: 10.1016/j.scitotenv.2019.136367.
- Tarkhanova, E.A., Chizhevskaya, E.L., Fricler, A.V., Baburina, N.A., Firtseva, S.V. (2020). Green economy in Russia: the investments' review, indicators of growth and development prospects. *Entrepreneurship and Sustainability Issues*, 8(2), 649-661. DOI:10.9770/jesi.2020.8.2(39).
- UNEP, U. (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication; A Synthesis for Policy Makers*. Nairobi: UNEP.
- Wang, M., Zhao, X., Gong, Q., & Ji, Z. (2019). Measurement of Regional Green Economy Sustainable Development Ability Based on Entropy Weight-Topsis-Coupling Coordination Degree—A Case Study in Shandong Province, China. *Sustainability*, 11, 280. DOI: 10.3390/su11010280.

- Yang, Q., Du, Q., Razzaq, A., & Shang, Y. (2022). How volatility in green financing, clean energy, and green economic practices derive sustainable performance through ESG indicators? A sectoral study of G7 countries. *Resource Policy*, 75, 102526. DOI: 10.1016/j.resourpol.2021.102526.
- Ying, L., Li, M., & Yang, J. (2021). Agglomeration and driving factors of regional innovation space based on intelligent manufacturing and green economy. *Environmental Technology & Innovation*, 22, 101398. DOI: 10.1016/j.eti.2021.101398.

Public administration reform and regional development in the Czech Republic after twenty years of corrections

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Abstract: This paper focuses on public administration reform in the Czech Republic in terms of supporting regional development. The whole system was legislated two decades ago, in 2000. The paper focuses on three issues: (1) territorial public administration and its corrections, (2) institutionalisation of regional development support, and (3) cohesion regions and changes in their institutional set-up. Territorial public administration and regional development in the Czech Republic are closely related to the so-called combined model of public administration, in which the tasks of state administration are taken over at the regional and local level by self-government bodies, which perform them in a delegated capacity. The paper asks to what extent the combined model has been successful in the Czech Republic for over two decades.

Keywords: public administration reform, combined model, regional development, strategic documents, cohesion regions, regions with concentrated state support

JEL Classification: H10, H75, H79, R58

1 Introduction

Public administration reform was part of the significant political, economic, and social changes in the 1990s. The Czech Republic became an independent unitary state in January 1993. However, it had legally existed since 1969, when the Czechoslovak state became a federation. The extensive changes in the central administration, which began immediately after the November 1989 events, were mainly related to the restoration of pluralist democracy and the transition from directive economic planning to a market economy. Amendments to the so-called Competence Act (Act No. 2/1969 Coll.), which provides for horizontal coordination of the central state administration, led to the abolition of some ministries and other state bodies and established offices according to new needs.

Another problem was the legal status of civil servants, which until the end of the 1980s was practically no different from that of any other employees. In addition to the civil service, it was also essential to reform the training of civil servants, which until the late 1980s had been rather ideological. An integral part of the civil service reform was the preparation for accession to the European Union, which became one of the priority objectives of Czech society after 1989.

A specific problem was territorial public administration and local politics (Balík 2009; Čmejrek 2008). From the end of the 1940s until 1990, the territorial public administration represented a three-tier system of regional, district, and local (or municipal) national committees.² Although these were formally elected bodies, there was no plurality in elections; voters could elect only National Front candidate lists. The subordination of lower-level national committees to higher-level national committees also contradicted the principles of self-government. In practice, the national committees functioned not as self-governing bodies but as organs of state administration. Like other bodies and authorities, they were subject to the leadership mechanism of the Communist Party enshrined in the Constitution.

In 1990 the system of national committees ceased to exist. Self-government was restored at the municipal level (Act No. 367/1990 Coll.). Citizens elected their municipal councils to replace the former national committees. As for the other administrative levels, disputes over the higher territorial self-governing units (VÚSCs) delayed the reform for several years. Whether the Czech Republic would switch to a provincial or regional system became a subject of political disputes and remained undecided for a long time.

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² The three-tier system of administrative bodies consisted of local, district and regional committees, which were called national committees. This may lead to misunderstanding, as the term *national* here does not refer to the administration level. The term *regional* causes similar problems later in the text, as the Czech Republic has created self-governing regions at the NUTS III level and cohesion regions at the NUTS II level. In addition, the text refers to regions with concentrated state support, which are defined at different levels, e. g., at the district or municipal level.

Moreover, although the decision was already in favour of establishing self-governing regions, it was unclear how many self-governing regions would be established and what specific form they would take. Creating 14 NUTS 3 units (13 regions and the capital Prague) was a compromise. However, some experts criticised it for its potential weakness and the considerable size differences between them. In addition, the new regional demarcation did not respect the historical borders of Bohemia and Moravia.

Due to the dispute over the VÚSCs, district offices were provisionally created at the district level in 1990 as state administration bodies (Act No. 425/1990 Coll.), which were to operate only until the creation of the VÚSCs. The period extended over a decade - until the end of 2002. Decision-making mechanisms in territorial public administration in the 1990s suffered from an incomplete territorial hierarchy of state and local government, unclear competence relations between the various institutions and actors, and an inefficient system of local government whose competencies overlapped with those of the state administration. After the abolition of the regional national committees, regional planning was highly problematic, as the government could not sufficiently coordinate and control development at the district level due to the excessive number of districts. On the other hand, municipalities had virtually no lobbying power at the national decision-making level, which was too high for their needs.

From the view of the functioning of territorial public administration and regional development, the relationship between the state administration and local government was essential. Although in the 1990s, a separate model was initially envisaged in which both state and local self-government would operate in the territory, the concept of a combined model in which the tasks of state administration in the territory are performed by local self-government bodies in a delegated capacity eventually prevailed. The so-called combined model's introduction has a significant impact on the functioning of public administration and the institutional set-up of regional development.

2 Methods

The paper is methodologically based on the study of documents. The initial source of information is the laws related to the reform of the territorial public administration and the support of regional development. It is not only the large package of laws from 2000, when the first phase of the territorial public administration reform ended, but also later amendments and other legislation that corrected the setting of territorial public administration. The paper also compares the medium-term regional development strategies of the Czech Republic over the past two decades. Two aspects are mainly at stake here: the definition of the regions with concentrated state support and the functioning of the cohesion regions.

Research results

3.1 Reform of territorial public administration

The reform of territorial public administration began to take a more concrete form only in the late 1990s. Its first phase started with the approval of Constitutional Act No. 347/1997 Coll., on creating higher territorial self-government units (VÚSCs). This law established 13 self-governing regions (excluding the capital city of Prague). These were smaller regions compared to the regions that had existed since 1960. After the decision on the VÚSCs, it was also possible to establish NUTS II regions, the so-called cohesion regions necessary for compatibility with EU regional policy. Acts 129 and 130/2000 Coll. gave institutional form to the regional level of territorial public administration. At the same time, Act No 128/2000 Coll. amended the municipal structure. In addition, Act No 248/2000 Coll. was approved, which regulated the involvement of the state administration and local authorities in supporting regional development.

The second phase of the reform of the territorial public administration started after 2000 and culminated in late 2002 and early 2003. Its main objective was to develop the decentralisation process. The state administration previously exercised many competencies that could be transferred to local governments, either in their autonomous or delegated competencies. As of 31 December 2002, the district offices were terminated, and their tasks were mainly transferred to self-governing authorities - both to regions and municipalities with extended competence.

The reform of the territorial public administration had its critics. Most of them pointed to the unsystematic nature of the reform. As M. Hampl (2005: 99) wrote: "Instead of a comprehensive and integrated solution, time-separated partial changes were implemented, which became the subject of competition between political parties." On the other hand, we must not overlook the efforts to address the system's shortcomings over the last two decades. This concerns, in particular, the supervision and control of territorial public administration. The 2006 amendment (No 234/2006 Coll.) fundamentally overhauled the entire management and control system.

Small rural municipalities represent a significant problem for territorial public administration. The traditional fragmentation of the Czech settlement structure deepened after 1989. The number of municipalities increased by almost 50% in a short time. Some of the municipalities that became independent had only a few hundred, sometimes only a few dozen inhabitants. Small municipalities had considerable problems in providing local administration and public services.

Therefore, in 1994, the conditions for a local referendum on separating a part of a municipality were tightened. According to Act No 152/1994 Coll., a municipality with less than 300 inhabitants could no longer be formed by separating a part of a municipality. In 2000, Act No 128/2000 Coll. on Municipalities raised this limit to 1 000 inhabitants. At that time, however, municipalities with fewer than 1 000 inhabitants already accounted for almost 80 % of all municipalities. Financing rural municipalities was a significant difficulty. Smaller rural municipalities were so underfunded that they could not exercise their right to self-government. Two amendments to the law in 2007 and 2012 (Act No. 377/2007 Coll., Act No. 295/2012 Coll.) brought some remedy (Provazníková 2015, Čmejrek and Čopík 2015, Kameníčková 2015, Kopřiva, Čopík and Čmejrek 2017).

The problems of territorial public administration relate mainly to the so-called combined model, in which local government performs state administration tasks at the local and regional levels. The division of municipalities according to the exercise of delegated competencies is unclear and incomprehensible for citizens, and the separation of autonomous and delegated competencies is indefinite in several areas. Over the past two decades, there have been efforts to address the lack of administrative capacity of small municipalities by creating associations of municipalities along the French model. However, it is essential to point out the differences in the local government systems in the two countries and the limits of the Czech combined model.

3.2 Institutionalising regional development

Regional development received its institutional form two decades ago in Act No. 248/2000 Coll. on Support for Regional Development. The Act regulates the competencies of administrative authorities, regions and municipalities. It creates conditions for the coordination and implementation of economic and social cohesion. The fundamental basis for state support for regional development is the Regional Development Strategy. The law defines it as a medium-term government document that formulates the state's approach to supporting regional development, provides the necessary background, and sets development objectives and principles for elaborating regional development programmes. The medium-term horizon of the document is defined by law as a period of 3-7 years; in practice, it has always been seven years in the two decades since 2000.

A fundamental prerequisite for state support for regional development has become the definition of state-aided regions. According to the law, the Ministry primarily proposed regions with concentrated state support. Three types of regions created this category: (1) structurally affected regions, (2) economically weak regions, and (3) rural regions. In addition, the Regional Development Strategy should have defined the category of other regions. These are, for example, border regions, former military areas, regions affected by natural disasters, regions with a higher average unemployment rate than the average level in the Czech Republic, and the like.

In practice, however, the definition of regions with concentrated state support has encountered difficulties from the beginning. The first problem arose in rural regions. Already in 2000, immediately after the adoption of Act No 248/2000 Coll., a detailed analysis showed that rural regions essentially overlapped with economically weak regions. For this reason, the 2000 Regional Development Strategy defined only two types of fully supported regions - structurally affected and economically weak regions (RDS 2000). The 2006 Regional Development Strategy for 2007-2013 included regions with above-average unemployment among the fully supported regions (i.e., instead of rural regions) (RDS 2006: 106).

The regional development strategies defined regions with concentrated state support at the district level. The Regional Development Strategy approved by the government in 2000 identified ten districts as structurally affected regions and ten as economically weak regions. However, district-level administration was no longer supposed to exist after 2002. The Regional Development Strategy of the Czech Republic for the period 2007-2013 from 2006 defined structurally affected and economically weak regions at the level of districts. However, it also defined regions with above-average unemployment at the level of municipalities with extended competence (RDS 2013: 140n). The Regional Development Strategy of the Czech Republic for the 2014-2020 period already defined regions with concentrated state support consistently at the level of municipalities with extended competence and designated them as economically distressed (RDS 2013: 140n).

The Regional Development Strategy of the Czech Republic 2021+ (RDS 21+) came up with a completely new approach. Its distinctive feature became the territorial dimension, which distinguishes five categories of territories: (1) metropolitan areas, (2) agglomerations, (3) regional centres and their rural hinterland, (4) structurally affected regions, and (5) economically and socially vulnerable territories. The three metropolitan areas consist of the areas of the largest cities - Prague, Brno and Ostrava. The agglomerations are the ten remaining regional cities and their hinterland. The regional centres are cities with a population of over 15 000 and their catchment areas. There are three structurally affected regions: Karlovy Vary, Ústí nad Labem and Moravia-Silesia. The economically and socially vulnerable areas have worse living conditions, demographic problems, higher unemployment, and other factors that require special efforts to strengthen development potential (RDS 21+).

3.3 Cohesion regions - the Achilles heel of regional development

The functioning of the cohesion regions has proved to be the most severe problem in the area of regional development support as envisaged by Act No. 248/2000 Coll. In four cases, two NUTS III regions formed a NUTS II cohesion region and three NUTS III regions in one occurrence. In all these cohesion regions, regional councils were established. The NUTS III regional councils elected their members from among themselves. Each region was represented on the Council by ten members. The Council also set up a Regional Development Committee to monitor and evaluate the implementation of the support provided by the Funds. However, the form of the Committee was very vague. As regards the three cohesion regions, which are identical to the self-governing regions, all tasks were to be performed by the regional Council in delegated competence.

This system was corrected by Act No. 138/2006 Coll. on Public Procurement. The changes consisted primarily of a new form of regional councils. Each Regional Cohesion Council (except Prague) now had a statutory seat and consisted of three bodies: a committee, a chairman and an office. The self-governing regions were represented on the Committee by only eight representatives instead of ten, but the decision-making mechanism was retained. In the three cohesion regions, which were identical to NUTS III regions, the NUTS III regional council set up a committee of 15 representatives. Another body of the Regional Cohesion Council was its chairman, whose position was defined much more precisely than in the original law. The third body was the Regional Council Office. The amendment also sought to fill in other gaps in the system, such as the revenue and expenditure of the Regional Council's budget, conflicts of interest, and the status of the office director and officials (Act No. 138/2006 Coll.).

However, even this corrected institutional form of the cohesion regions was unsuccessful. Act No. 251/2021 Coll. abolished the Regional Councils of Cohesion Regions and their bodies. The newly established Centre for Regional Development of the Czech Republic took over the agenda of the regional councils of cohesion regions. The Centre is a state-funded organisation with the right to manage state property, and special laws govern its activities. The Director General heads this service office and is the service authority. The superior service authority of the Centre is the Ministry of Regional Development, which performs the function of the founder. The Statute approved by the Minister for Regional Development regulates the detailed conditions of the Centre's activities and its organisational structure. Based on Act 251/2000 Coll., a monitoring system was established, and the Council for EU Funds was created as an advisory body to the government. All these changes are a clear departure from the combined model of public administration in regional development. State administration is taking the place of bodies made up of regional self-governments.

4 Conclusions

Two decades ago, the Czech Republic saw the culmination of a territorial public administration reform, which included regional development institutionalisation. A study of legislation and other documents shows that the mechanisms set up were insufficient and have been gradually corrected over two decades. As far as local self-government is concerned, the corrections concern mainly to control and financing. In regional development, the definition of state-aided regions and the mechanisms for using EU funds have changed significantly. Cohesion regions (NUTS II), initially under regional self-government control, have yet to prove institutionally viable. After several modifications, the state administration had to take control of their functioning.

Over the last two decades, developments have exposed the weaknesses of the so-called combined model of territorial public administration in the Czech Republic. As regards the NUTS II cohesion regions, the practice has forced a retreat from the combined model of public administration. In territorial self-government, the combined model can fulfil its function. Legislative amendments have improved the situation as regards financing, supervision, and control. However, small rural municipalities with low administrative capacity and low levels of public services are a significant problem. It is questionable whether a satisfactory solution can be found for small rural municipalities under the combined public administration model.

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References

- Act No 128/2000 Coll. Zákon č. 128/2000 Sb. o obcích (obecní zřízení).
- Act No 152/1994 Coll. Zákon č. 152/1994 Sb. o volbách do zastupitelstev v obcích.
- Act No 248/2000 Coll. Zákon č. 248/2000 Sb. o podpoře regionálního rozvoje.

Act No. 138/2006 Coll. Zákon č. 138/2006 Sb., kterým se mění některé zákony v souvislosti s přijetím zákona o veřejných zakázkách.

Act No. 2/1969 Coll. Zákon č. 2/1969 Sb., o zřízení ministerstev a jiných ústředních orgánů státní správy.

Act No. 251/2021 Coll. Zákon č. 251/2021 Sb., kterým se mění zákon č. 248/2000 Sb., o podpoře regionálního rozvoje.

Act No. 295/2012 Coll. Zákon č. 295/2012 Sb., kterým se mění zákon č. 243/2000 Sb., o rozpočtovém určení výnosů některých daní územním samosprávným celkům a některým státním fondům (zákon o rozpočtovém určení daní).

Act No. 367/1990 Coll. Zákon č. 367/1990 Sb. o obcích (obecní zřízení).

Act No. 377/2007 Coll. Zákon č. 377/2007 Sb., kterým se mění zákon č. 243/2000 Sb., o rozpočtovém určení výnosu některých daní územním samosprávným celkům a některým státním fondům (zákon o rozpočtovém určení daní).

Act No. 425/1990 Coll. Zákon č. 425/1990 Sb. o okresních úřadech.

Balík, S. (2009). *Komunální politika. Obce, aktéři a cíle místní politiky*. Praha: GRADA Publishing, Praha.

Čmejrek, J. & Čopík, J. (2015). Risk management of rural municipalities as a limit of their basic self-governing functions. *Proceedings of the Conference Agrarian perspectives XXIV*, Prague, 99-108

Čmejrek, J. (2008). *Obce a regiony jako politický prostor*. Praha: Alfa Nakladatelství.

Constitutional Act No. 347/1997 Coll. on the Creation of Higher Territorial Self-Governing Units.

Hampl, M. (2005). *Geografická organizace společnosti v ČR: Transformační procesy a jejich obecný kontext*. Praha: UK v Praze, Přírodovědecká fakulta.

Kameníčková, V. (2015). 'Jsou české obce ohroženy dluhem? (Are Czech municipalities endangered by debts?)', *Moderní obec*, 3, 12

Kopřiva, R., Čopík, J. & Čmejrek, J. (2017). Mechanismy rozhodování o investičních záměrech a rozpočtech obcí. *Sociológia, Slovak Sociological Review*. 49 (5), 588-594.

Provazníková, R. (2015). *Financování měst, obcí a regionů. Teorie a praxe*. Praha: GRADA Publishing.

RDS 2000. Strategie regionálního rozvoje ČR na roky 2001-2006. Ministerstvo pro místní rozvoj ČR.

RDS 2006. Strategie regionálního rozvoje ČR na roky 2007-2013. Ministerstvo pro místní rozvoj ČR.

RDS 2013. Strategie regionálního rozvoje ČR na roky 2014-2020. Ministerstvo pro místní rozvoj ČR.

RDS 2021+. Strategie regionálního rozvoje ČR 2021+. Ministerstvo pro místní rozvoj ČR.

The influence of economic disparities of regions on political polarization in Czech Republic

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Abstract: The aim of the paper is to prove a hypothesis concerning the causality of economic well-being and political polarization in the state. The causality is proven in all regions of the Czech Republic on the observed data set, from 1993 to the present. The evidence was provided by expressing the economic well-being by three indicators, i.e., gross domestic product per capita, unemployment and disposable income per capita in combination with the development of a created polarization index. This index depends on the left-right ideological party division combined with election results in the Chamber of Deputies of the Parliament of the Czech Republic for regional districts. Socio-demographic indicators of the development of individual regions were used as control variables. These include, the average state of the population, the share of university-educated people in the average state of the population, age indicators, the population density of a given region, or voter turnout in a given election year. The most important variable of the economic well-being influencing the development of polarization is the disposable income of households. The proof is accomplished by quantitative economic analysis using the Least Squares Method.

Keywords: polarization, politics, economic well-being, Czech Republic, gross domestic product, disposable income, unemployment, political economics

JEL Classification: D72, E61, I31, P16

1 Introduction

The state's political development is closely linked to its economic situation and vice versa. In the world, there can be found less economically developed states, characterized by weak or corrupt governments, with limited freedom (democratic) political process. The situation of these countries is improving rather slowly. On the contrary, in the developed parts of the world, generally functioning democracies can be observed, where citizens find their representation and the political process is relatively functional, as well as the economies. The Czech Republic is specific in this respect. A sovereign state in Central Europe, which experienced periods of suffering after the First Republic and its economic boom, first after the creation of the Protectorate of Bohemia and Moravia and the occupation of the borderland, followed by decades of economic (and societal) disintegration under the government of the Soviet Union. The economic boom of the 1990s and the newly acquired freedom and democracy were the foundation stones of the development of the modern political situation of the state.

The aim of this paper is to evaluate to what degree, in conditions of higher economic prosperity (represented by economic well-being), political representation and therefore society is less polarized and vice versa, whether regions showing lower economic prosperity are more prone to the choice of more extremist, more polarized, political representatives in given time period (from 1993 to 2021) and given space (NUTS 2 regions of the Czech Republic). The aim defined will be examined in the context of the theory of political cycle.

Literature review

The question of what polarization is, is best answered comprehensively with the help of the work of DiMaggio et al. (1996), dealing with the definition of polarization as such. Polarization expresses the degree of disagreement (different, even opposite opinions) of two or more subjects. As a rule, it is not possible to simplify polarization only to bipolar agreement or disagreement with a given argument, it is necessary to establish the degree of the strength of polarization. Not only the state but also the process can be considered as polarization. State polarization expresses the maximum theoretical value of the degree of disagreement with a given argument, polarization as a process shows the development of such disagreement or differences of opinion over time. This paper deals with the development of polarization and especially the reasons for such development.

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Significant polarization affects voters' attitudes towards politics, disgust and general disinterest in political affairs come to the word, same as the detachment from the views of a previously preferred party (which can eventually lead to the central voter's theorem, a process of how polarization returns to its beginning state) and lower turnout (Fiorina et al., 2005). Herherington (2001) opposes these views, arguing that polarization is positive in terms of clearly identifying voters with elected parties, because these parties do not seek to reach the centre voters and, conversely, design their programs so that they do not overlap with other parties. Even according to Wilson (2020), it is not proven that the non-polarized situation (i.e., the domination of the central parties) has better socio-economic results in all cases. Binder (1999) and Jones (2001) say that the polarization of the political spectrum undermines trust in the state's political system and can block the legislative process. This is a problem especially for minority governments based on strong compromises, where each party sets its own terms and exercises its right of veto.

The idea of the connection between polarization and economic prosperity is based mainly on the research of Funke et al. (2016). This work demonstrates the theory of the impact of financial crises on political polarization, by analysing the last 140 years of elections in Europe. The main benefit of this work is the finding that financial crises cause political uncertainty due to the fragmentation of government majorities. On average, after the crisis, voters are turning to the far right (an increase in votes of 30% on average, compared to the original values).

According to Han (2015) the political polarization of the parties depends on two factors - increasing income inequality and institutional flexibility. Increased income inequality (and the consequent reduction in economic well-being) is creating a demand for more extreme political leaders and shifting the arguments of political parties to more extreme positions. On the contrary, this shift is smaller if the political system is limited by fewer political parties, i.e. less competition and a less liberal environment. Thus, in a system characterized by many parliamentary and broad party coalitions (for example the Czech Republic after year 2010), polarization is more likely to occur than in bilateral systems (e.g. the United Kingdom). Regarding the definition of economic well-being, according to Večerník (2015), its indicators can be considered, for example, GDP per capita or disposable household income. GDP per capita and unemployment can be described as a macro-economic view of measuring subjective well-being, disposable income as a micro-economic view.

Xiao (2015) proposes gross domestic product as the primary indicator of economic well-being. According to his work, it should develop in a positive correlation with well-being. Xiao also includes income, expenses, debt and other owned assets in its consumption indicators. This work will use simplification, in the form of disposable income, from which the other three components are financed. The economic well-being of the consumer is positive if the consumer has subjectively sufficient disposable income and is able to maintain it over time.

After examining the context of political polarization, it is necessary to set it in the context of the theory of the political cycle. The theory is based on periodic fluctuations of fiscal policy depending on the election cycle. An interesting overview of the existing literature and findings is provided by Shi and Svensson (2003). This approach is based on the rational and strategic behaviour of politicians and voters, politicians influence fiscal policy for their re-election and try to stimulate the economy before the elections, sometimes at the cost of increasing the national debt (according to their responsibility and ideological direction. Rational voter behaves in this way, because short-sighted policies have an effect thanks to the signalling effect, as voters have imperfect information about the characteristics of a potential government or party and automatically consider them capable and high-quality based on their communication. According to their work, left-wing parties are not reluctant to solving the problem of unemployment, even at the cost of increased inflation. Similarly, Martinez (2009) proves that governments influence economic conditions at the end of their term, rather than at the beginning. Voters only watch performance, if the performance is good, according to the voter, it will be the same in the future. At the same time, a moral hazard-based approach shows up, as instead of electing a more competent government, voters lean towards a government that ensures greater intervention in the economy for their benefit. As a rule, political cycles are examined through the development of GDP, or the ratio of taxes vs spending. Bojar (2017) reveals that not only the ideological position of the voter, but also his socio-economic background influences the voter within the political cycle. The lower classes are sensitive to a change in the pre-election fiscal policy of the government, especially with regard to the expenditure side of the budget. The work uses economic indicators from the year preceding the election, as voters are influenced by the latest economic results, based on the theory of the political cycle.

In a follow-up, according to Azzimonti (2009), the polarization of society has a direct effect on the government's acceptance of short-sighted economic solutions. This leads to low levels of investment, which are closely linked to economic growth. The greater the degree of polarization, the greater the inefficiency. Opposing groups, whose views are fundamentally different due to high polarization (even in terms of economics), want to enforce their own view of fiscal policy. The government is usually confronted by the opposition, which is trying to bring the second electoral camp to its side. Dissatisfied voters can be silenced by increased government spending, lower taxes and deficit funding. In the long

run, this leads to pushing out the private investment and to two possible scenarios. Either the current (usually the following) government will take advantage of the cuts and starts tightening its policy to prevent further budget deficit growth, which is accompanied by an economic slowdown, or it will continue a similar irresponsible policy until the system is on the verge of collapse. It is likely that the electoral camps will eventually unite and choose the ‘golden mean’ that will bring up otherwise unpopular belt tightening anyway

The research mentions many points that support the theory of the connection of the economic well-being of voters and their decision-making in the electoral process. The individual differences (and especially their discrepancies) of the works are the reason for the further analysis that this work provides. Based on previous research, GDP per capita, household disposable income per capita and unemployment were selected to describe the relationship between economic well-being and polarization. GDP is a suitable general indicator of the development of the economy, i.e., the overall economic well-being in a given region. The development of disposable income best reflects the living conditions of households and the population, and unemployment as it is also directly related to the living conditions of the population, especially their livelihood and job stability may be the reason for electoral spill overs in the electoral process.

2 Methods

This work uses data from the ParlGov project (Döring and Manow, 2022), which deals with the division of individual political parties on various ideological spectra, and data from the Czech Statistical Office, providing both the results of elections to the Chamber of Deputies of the Czech Parliament at regional level (14 Czech regions at NUTS 2 level) same as the necessary economic indicators at the regional level. This work uses its own index for evaluation of the extent of political polarization, based on the left-right political spectrum, which is still proving to be the most used spectrum for political analysis. Although the left-right division is spoken of as outdated, (thanks to the rise of new ‘catch-all’ parties whose agenda is populist, flexible, and unstable on the spectre), combined with given dataset is considered as sufficient.

The hypothesis states that the dependence of political polarization on the economic well-being of the studied regions of the Czech Republic exists, more precisely on the regional level. Data from the ParlGov project are used, concerning the determination of given parties on the left-right ideological spectrum – the extreme left-wing parties are given the value of –5 by the experts of the project, and the extreme right-wing parties of +5 and are divided into individual groups according to the left-right spectrum. The data are then transformed into a polarization index by the author, separately for each region, where for each year the cumulative voting results of the group are multiplied by the polarization value (on the ideological spectrum) of the group of parties in absolute value, which represents the “weight of polarization”. Then all the values of given year and region are added up. Based on this, a polarization index is created for the given region and the given election year. The result of the index is divided by one hundred for greater clarity. These data will then be analysed by the OLS method together with selected indicators of economic well-being.

The economic indicators used in this work are GDP per capita, net disposable household income per capita and unemployment in the region. The data are drawn from the Czech Statistical Office. Regional accounts are used, for NUTS 2 regions (regions of the Czech Republic since their establishment in 2000 with backward calculation of data from the establishment of Czech Republic in 1993). These data correspond methodologically to the European System of Accounts (ESA 2010), are comparable and harmonized. The data are calculated by the workplace method, i.e., the results of units are placed in the regions according to the actual place of the unit operation. Furthermore, the economic results of units operating in several regions are calculated on the basis of the number of employees in the given region and the indicator of disposable household income relates to the place of residence of households (Czech Statistical Office, 2022). The paper further uses 5 control variables. These are socio-demographic variables that have influence on the election results and thus on political polarization. The source of the data comes from the Czech Statistical Office (2022) aswell. Namely, they consist of the voter turnout of given region and election year, the average state of population, the share of university-educated persons in the average state of the population, population density and the share of population of outer age groups in the average state of population (voters aged 20 to 29 and 65 years and older). The share of university-educated persons was created by including the population census data (which takes place every 10 years since 1991). The annual data were not available, so these were added according to the natural movement of the population per data of the CZSO. The use of socio-demographic control variables, namely education variables, is supported by the works of Hayo and Seifert (2003), Stanig (2013), who also use age variables. Hayo and Seifert (2003) also include population density (namely community size). Population state, voter turnout and population density are used by e.g. Lindqvist and Östling (2010). Turnout and education are further mentioned by Doležalová et al. (2017). All 5 control variables are also used in this context by Finseraas and Vernby (2014).

The paper uses a regression model for all the studied regions of Czech Republic of the following form: $Polarization_{i,t}$ as an explained variable where $i = 1, 2, \dots, 14$ for the regions of the Czech Republic, $t = 1992, 1996, \dots, 2021$ for the election years (9 observations). The basis of polarization index is explained before. α_i is the constant, $\beta_{j,i,t}$ the regression coefficients and ε_i the random component. GDP_i represents gross domestic product per capita in CZK of the year previous to the year of the elections according to the Czech Statistical Office data (same as the following variables). $Unemp_i$, representing unemployment values of the previous year of elections, and $Disp\_income_i$, representing household disposable income per capita in CZK as well of the previous elections. $Turnout_i$ represents control variable voter turnout in percentage, Av_pop_i the average state of population of a given year, $Dens_i$ the density of population in persons per square kilometre of region, $University_i$ the share of university educated population on the average state of population in percentage and $Outer\_age_i$ the share of outer age groups of voters in the average state of population in percentage. Variables GDP , $Disp\_income$, Av_pop are logarithmized due to greater clarity of the results and simpler analysis using the OLS method.

$$\begin{aligned} Polarization_{i,t} = & \alpha_i - \beta_{1,i,t}GDP_i + \beta_{2,i,t}Unemp_i - \beta_{3,i,t}Disp\_income_i \\ & + \beta_{4,i,t}Turnout_i + \beta_{5,i,t}Av\_pop_i - \beta_{6,i,t}Dens_i \\ & - \beta_{7,i,t}University_i + \beta_{8,i,t}Outer\_age_i + \varepsilon_i \end{aligned} \quad (1)$$

The work assumes the same premise for each of the regions. Polarization will be negatively affected by the value of gross domestic product per capita. Therefore, if GDP per capita drops, the polarization indicator will increase. The indicator of household disposable income per person will show the same inclination and explanation. On the contrary, the impact of the unemployment rate will be expected to be positive. The higher the unemployment, the higher the indicator of the polarization of society. For the control variables, lower voter turnout increases political polarization, as more opinionated and motivated voters go to the elections and mainly extreme parties benefit from that kind of movement. Higher average population state leads to the same result, higher population density occurs in regions with greater urban development, where it is possible to expect less extreme opinions (larger cities usually vote more moderately), a higher proportion of university educated people will lead to a decrease in polarization, as university-educated people tend not to agree with the ideas of the extreme right and left, and finally a larger share of outer age groups will lead to an increase polarization, as these age groups are prone to choose more extreme positions based on benefits offered to them by given parties.

3 Research results

Regarding the results, the most convincing models are models 3 and 6, which include the variable of disposable income. Model 6 is chosen as the final model, which shows fewer problems with statistical verification, namely both models fail the RESET test and the nonlinearity tests, which is most likely due to the low number of observations (126 observations). However, model 3 also fails the autocorrelation tests and model 6 shows higher values of the coefficient of determination (0,68 for model 3 and 0,69 for model 6). GDP variable and disposable income are not used in the models together, as strong multicollinearity between these two variables exists, which is due to the similar basis of these variables. The unemployment variable is not significant in any of the models, whether it is used alone or in combination with another variable. Instead of the share of extreme age groups, the share of only the 65+ age group was also tested, which, however, can be problematic in the Czech Republic, due to the tendency of the older population to choose populist parties, which cannot be properly identified on the left-right spectrum, as they are positioned in the middle positions of the ideological spectrum. This variable was eliminated after the Q-Q graph check, which showed an error with the data. Due to this problem, models with and without the *Outer_age* variable were tested.

Table 1 Estimation of the linear regression models – the influence on political polarization.

	Coefficient and significance (*)				
	Model 1	Model 2	Model 3	Model 4	Model 5
Const	1.91973***	0.593703	2.58061***	2.35441***	1.70155***
GDP	−0.169790**	-	-	−0.109035	-
Unemp	-	0.00333478	-	-	−0.000207350
Disp_income	-	-	−0.271192***	-	-
Turnout	0.000814174	0.00301617**	0.000142679	0.000208467	0.00103419
Av_pop	0.215988***	0.267230***	0.188335***	0.186399***	0.213306***
Dens	0.000120616***	0.000126771***	9.45849e-05***	0.000118016***	0.000122835***
University	−0.0322505***	−0.0381785***	−0.0287094***	−0.0314108***	−0.0354737***
Outer_age	-	-	-	−0.0187704**	−0.0224166***
	Model 6	Model 7	Model 8	Model 9	Model 10
Const	3.05864***	1.86502***	2.53760***	2.35175***	3.04318***
GDP	-	−0.166538**	-	−0.109117	-
Unemp	-	0.00287631	0.00302040	7.66607e-05	0.000461787
Disp_income	−0.225951***	-	−0.269590***	-	−0.226547***
Turnout	−0.000550007	0.00127830	0.000609850	0.000222521	−0.000465706
Av_pop	0.157742**	0.212571***	0.184108***	0.186390***	0.157664**
Dens	9.52144e-05***	0.000118344***	9.22247e-05***	0.000117963***	9.48418e-05***
University	−0.0274339***	−0.0312598***	−0.0275871***	−0.0313868***	−0.0272860***
Outer_age	−0.0168227**	-	-	−0.0187182**	−0.0165101*

Data source: Czech Statistical Office (Czech Statistical Office, 2022); Own processing

It is possible to confirm the dependence of political polarization on the economic well-being of the region if the economic well-being is defined mainly by the disposable income of households (it plays a role in both chosen models 3 and 6). Model 6 has 69 % of explained polarization values, which is satisfactory for given economic and sociographic data and it can be concluded that the influence of disposable income on political polarization cannot be rejected. The results of economic well-being defined by gross domestic product are also convincing, but with a lower degree of explained polarization values and with less significance (model 1 and 7). Unemployment values are not significant and cannot be included in the given definition of economic well-being. Regarding the chosen model 6, the polarization is affected by disposable income, in a negative direction, when an increase in disposable income by one percent leads to a decrease in the average value of polarization by 0.23, which corresponds to the given theory.

As for the control variables, when the average state of the population increases by one percent, the average polarization value increases by 0.16. When the population density increases by 1 person per square kilometre of the region, compared to the theory mentioned above, the value of the polarization index increases by 0.000096. This is an almost negligible effect, but it's important to mention, especially if it doesn't fit the theory. This effect might take place for a similar reason, why the age variable 65+ was discarded – regions with a lower population density (usually less urban development) are inhabited by older population, which is in recent years in the Czech Republic inclined to choose populist movements, which occupy the central positions of the left-right spectrum. A similar explanation can be used for the variable of a larger share of outer age groups, where the older group 65+ predominates, and therefore when the share increases by 1 percentage point, the polarization decreases by 0.02 of the index value. According to the theory, an increase in the share of university-educated people by 1 percent leads to a decrease in the polarization index by 0.03 of the value. The variable Turnout is not significant, since the agitation of political parties in the Czech Republic is most likely not reflected in increased voter turnout. Increased values of the voter turnout can be observed after the collapse of the Soviet Union and the independence of the Czech Republic, when emphasis was put on the democratic values of the state and citizens went to the elections regularly, and gradually this participation decreased and stabilized.

It could be said that economic prosperity was not perfectly defined, as can be seen in the potential problems with multicollinearity between GDP and disposable income and with unemployment, which is not significant in any of the models. The problem is found in the fact that disposable income is partly contained in the country's gross domestic product and only one of these variables should have been used.

The results of the work are in accordance with the work of Sacks et al. (2010), whose research confirms the connection between higher disposable income and subjective indicators such as happiness, satisfaction with life, but also with the economic well-being (which is defined slightly differently in his work). Fuentes and Rojas (2001) and Diener and Biswas (2002) develop the idea of connecting disposable income with economic well-being with the satisfaction of basic needs.

The dissatisfaction of basic needs is followed by lower economic well-being (which is defined from a subjective point of view, rather than based on objective economic data).

4 Conclusions

The economic well-being definition, represented mainly by disposable income, can be confirmed with some of the reservations mentioned above. The tested hypothesis, i.e., the confirmation of the connection between political polarization and economic well-being of regions of the Czech Republic since its formation in 1993 cannot be rejected. The relation between economic well-being and political polarization suggests that lower economic prosperity is associated with an increased degree of polarization. The findings correspond to the political cycle theory, as it is possible that the political establishment will seek to stimulate the economy in order to get re-elected. This alternative way of researching the reactions of voters to the previous performance of political representation can be interesting for further research into the political cycle, when through polarization there can be observed the irrational reaction of voters to the extremes of the spectrum depending on their programs, statements or short-sighted fiscal decisions regardless of their qualifications and previous responsible governance. Suitable for further research in the field of political cycle theory could be research on the basis used by this work, but based on the data of the Manifesto project (Lehmann et. al, 2022), which instead of a static left-right division of parties on the spectrum introduces an evaluation on the spectrum for each election separately, according to election programs, where current influences and promises of the politicians are best manifested.

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References

- Azzimonti, Marina and Matthew Talbert (2014). Polarized business cycles. *Journal of Monetary Economics*. 67, 47–61. DOI:10.1016/j.jmoneco.2014.07.001
- Binder, Sarah A. (1999). The Dynamics of Legislative Gridlock, 1947–96. *American Political Science Review*. Cambridge University Press, 93(3), 519–533. DOI:10.2307/2585572
- Bojar, Abel (2017). Do Political Budget Cycles Work? A Micro-Level Investigation of Pre-Electoral Budgeting and Its Electoral Consequences. *Electoral Studies*, 45, 29–43. DOI: 10.1016/j.electstud.2016.11.007.
- Czech Statistical Office (2022). Database and methodical instructions. *Czech Statistical Office*. <https://www.czso.cz/csu/czso/domov>
- Diener, Ed and Robert Biswas-Diener (2002). Will Money Increase Subjective Well-Being? *Social Indicators Research*. 57(2), 119–169. DOI:10.1023/A:1014411319119
- DiMaggio, Paul, John Evans and Bethany Bryson (1996). Have American's Social Attitudes Become More Polarized? *American Journal of Sociology*. 102(3), 690–755. <https://www.jstor.org/stable/2782461>, DOI: 10.1086/230995
- Doležalová, Jitka, Vlastimil Havlík, Antonín Slaný, a Petra Vejvodová (2017). Economic Factors Determining the Electoral Success of Far-Right and Far-Left Parties in the EU Countries. *Society and Economy*. 39(1): 27–48. DOI:10.1556/204.2016.001.
- Döring, Holger and Phillip Manow (2022). Parliaments and governments database (ParlGov): Information on parties, elections and cabinets in modern democracies. Development version. *Project ParlGov*. <http://www.parlgov.org/#documentation>
- Finseraas, Henning, a Kåre Vernby (2014). A Mixed Blessing for the Left? Early Voting, Turnout and Election Outcomes in Norway. *Electoral Studies*. 33: 278–91. DOI: 10.1016/j.electstud.2013.07.003.
- Fiorina, Morris, Abrams J. and Jeremy Pope (2005). Culture war? The myth of a polarized America. *Pearson Longman*.
- Fuentes, Nicole and Mariano Rojas (2001). Economic Theory and Subjective Well-being: Mexico. *Social Indicators Research*. 53(3), 289–314. DOI:10.1023/A:1007189429153
- Funke, Manuel, Moritz Schularick and Christoph Trebesch (2016). Going to extremes: Politics after financial crises, 1870–2014. *European Economic Review*. 88, SI: The Post-Crisis Slump, 227–260. DOI:10.1016/j.eurocorev.2016.03.006
- Grechyna, Daryna (2020). Mandatory spending, political polarization, and macroeconomic volatility. *European Journal of Political Economy*. 101–990. DOI:10.1016/j.ejpoleco.2020.101990
- Han, Sung Min (2015). Income inequality, electoral systems and party polarization. *European Journal of Political Research*. 54(3), 582–600. DOI:10.1111/1475-6765.12098
- Hayo, Bernd, a Wolfgang Seifert (2003). Subjective Economic Well-Being in Eastern Europe. *Journal of Economic Psychology*. 24(3): 329–48. DOI: 10.1016/S0167-4870(02)00173-3.
- Hetherington, Marc (2001). Resurgent Mass Partisanship: The Role of Elite Polarization. *American Political Science Review*. 95, 619–631. DOI:10.1017/S0003055401003045

- Jones, David R. (2001). Party Polarization and Legislative Gridlock. *Political Research Quarterly*. SAGE Publications Inc, 54(1), 125–141. DOI:10.1177/106591290105400107
- Lehmann, Pola, Burst, Tobias, Matthieß, Theres, Regel, Sven, Volkens, Andrea, Weßels, Bernhard and Zehnter, Lisa (2022). The Manifesto Data Collection. *Manifesto Project. Version 2022a* (WZB). DOI:10.25522/manifesto.mpps.2022a
- Lindqvist, Erik and Robert Östling (2010). Political Polarization and the Size of Government. *American Political Science Review*. Cambridge University Press, 104(3), 543–565. DOI:10.1017/S0003055410000262
- Martinez, Leonardo (2009). A Theory of Political Cycles. *Journal of Economic Theory*, 144(3), 1166–86. DOI:10.1016/j.jet.2008.10.006.
- Sacks, Daniel W., Betsey Stevenson and Justin Wolfers (2010). Subjective Well-Being, Income, Economic Development and Growth. *National Bureau of Economic Research*. DOI:10.3386/w16441
- Shi, Min, and Jakob Svensson (2003). Political Budget Cycles: A Review of Recent Developments. *Nordic Journal of Political Economy* 29, 67–76.
- Stanig, Piero (2013). Political Polarization in Retrospective Economic Evaluations during Recessions and Recoveries. *Electoral Studies*, Special Symposium: The new research agenda on electoral integrity, 32(4): 729–45. DOI:10.1016/j.electstud.2013.05.029.
- Vecernik, Jiri (2014). Subjective Well-Being in the Czech Republic and Central Europe: Macro- and Micro-Determinants. *Politická ekonomie*. 62, 249–269. DOI: 10.18267/j.polek.949
- Wilson, Anne E, Victoria A Parker and Matthew Feinberg (2020). Polarization in the contemporary political and media landscape. *Current Opinion in Behavioral Sciences*. 34, Emotion, Motivation, Personality and Social Sciences, 223–228. DOI:10.1016/j.cobeha.2020.07.005
- Xiao, Jing Jian (2015). Consumer Economic Wellbeing. New York, NY: Springer, *International Series on Consumer Science*, 3–21. DOI:10.1007/978-1-4939-2821-7_1

Challenges and Opportunities for the Economy

Development of passenger transport performance in the Czech Republic - an opportunity for carpooling

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Abstract: Personal transportation is an issue that deserves interest in research activities. There are plenty of situations necessary to deal with. The first one is transportation modes, and the second trend of so-called “de-urbanisation”, which means moving citizens from cities to small towns and villages. This trend very often causes an increased number of individual car trips and, at the same time, the decreasing trend in using public transportation modes. All mentioned circumstances lead to the necessity of finding new approaches how solving situations. One of them is the carpooling system. The goal of the research and this paper is to analyze passenger transport performance by mode and find possible consequences with economy performance. The key data used for analyses will be the total passenger transport performance. It was found out that the development of transportation performance corresponded with economic cycles measured by GDP.

Keywords: carpooling system, transport performance, economic cycles, transportation service

JEL Classification: G32, E01, R40

1 Introduction

Insufficient public transport services, characterised by a certain number of bus and train connections, are a threat especially in small municipalities with lower population density, which are primarily dependent on the financial resources of the region. In order to improve the transport needs of the citizens of under-served municipalities, the application of a carpool system becomes an interesting solution for improving the quality of transport services, especially in the less populated parts of the region.

In the context of carpooling (sometimes also called ridesharing), the approach is generally positive and has high potential in the future, and increasing positive attitudes towards carpooling are predicted (Becker et al., 2017). However, the carpooling system has its limitations. Carpooling poses some risk for the passenger who is not in control of the driving, but also for the driver who is carrying an unfamiliar person in his/her private car. The emphasis on safety, freedom, and privacy consequently reduces the willingness to carpool (Javid et al., 2017). However, the convenience of driving when the driver is alone in the car, the increasing number of car owners, and the difficulty of finding passengers with adequate timing and routes keep the carpooling system low (Anthopoulos & Tzimos, 2021).

The availability of transport links reflects the degree of opportunity and quality of connections between locations or socio-geographical parts of countries and continents. The main prerequisite should be the improvement of the development of transport to-transport, which partly lies beyond the capabilities of transport operators and partly overlaps the competences of infrastructure agencies. It is an approach to the construction and modernisation of transport infrastructure with the general objective of creating sufficient capacity for the growing demand for transport and with the specific objective of creating the conditions for alternative transport systems that will, in their consequences, relieve the burden of growing road transport intensities on the environment and reduce the generally increasing risks of transport for users (Zelený, 2007). Technology is a key enabler of online platforms for ride-sharing systems that facilitate the process of trip matching and lead to an increase in the services offered (Anthopoulos & Tzimos, 2021).

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1.1 Mobility management

Mobility, as the potential of movement, finds its realisation not only in movement as such, but also in means of transport and traffic routes. It is an expression of people's ability and need to move. It is a set of intentions, strategies and choices (Canzler, Kaufman, Kesselring, 2008). Among the factors influencing mobility, Chlaň, Kudláčková (2004) include the following factors:

- Socio-economic factors such as transport supply, housing availability, employment level, availability of recreation places, availability of shopping places, disposable real income, supply and availability of jobs, economic potential of the region, political situation in the area, age structure of the population of the area, lifestyle, etc.
- demographic factors such as infrastructure, education level of the inhabitants of the area, co-communication possibilities, spatial layout, possibilities of alternative modes of transport
- transport factors such as demand for transport, performance of transport infrastructure, organisation of transport services in the territory, conditions of operation of individual modes of transport, functioning of the internal market, constraints on the construction of new infrastructure, quality of transport, safety and reliability of transport, etc.
- - environmental factors, such as environmental impacts of transport, environmental protection, the costs attributed by the public to environmental impacts of transport, congestion, systematic promotion of environmentally friendly modes of transport, etc.

Mobility management is defined as "smart travel organization", where the traveller can reach his/her destination easily and with minimal obstacles. Mobility can be understood in different ways and as movement through different types of space, which can be physical, digital or social space (Schwanen et al., 2015). The goal is to maintain high volumes of accessibility while significantly reducing the negative effects of transport on people and the environment. This is a demand-driven approach in transport, requiring new collaborations and a range of tools to promote changes in attitudes and behaviour towards sustainable modes (Schmeidler, 2010). Sustainable modes of transport are defined as walking and cycling, carpooling (paid hitchhiking), car-sharing and public transport. Compared to mobility management, transport system management is mainly characterised by its supply-oriented approach. In addition, it seeks to optimise the capacity of transport corridors through telematics, pricing systems, etc., and focuses more on end-output solutions, whereas mobility management precedes this approach

1.2 Transportation performance and carpooling system

Transport infrastructure, including the road network, is a fundamental and necessary condition for access to mobility. But equally important is the provision of transport services to this infrastructure. It cannot be assumed that every citizen can have their own means of transport and, in particular, children, the elderly and the disabled are often dependent on public transport. This is particularly a problem in peripheral border locations with low population density and an outdated public transport system (Baran & Augustyn, 2021). Quality public transport and thus quality accessibility form part of the fulfilment of citizens' right to access mobility (Schmeidler, 2010). Transport performance is closely related to housing, employment, education, trade and services. It is the solution of these basic human needs that influences the organisation and the way of ensuring their accessibility from the transport point of view (Kudláčková, Chlaň, 2004). Transport performance can be effectively influenced by economic instruments such as charging for the use of roads or internalisation of external costs in transport. A mix of legislative and fiscal instruments, investment policy, subsidies and national and regional development measures is necessary for better decision-making in the field of sustainable mobility (Kudláčková, Chlaň, 2004).

Carpooling simply means a system of carpooling based on an agreement between two or more people to travel together (Gheorghiu & Delhomme, 2018). In the context of mobility management, it is the organization of carpooling by cars or minibuses, with the main objective of increasing vehicle occupancy and also offering flexible time frames, where drivers and co-drivers themselves choose group departures according to their needs. An important side effect is the reduction in the number of trips made by individuals who are transported from the same or a nearby source to a common destination (Aguilera & Pigalle, 2021). The development of carpooling includes several benefits at the societal and individual level. At the societal level, carpooling significantly reduces traffic and air pollution at the individual level by reducing the cost and length of trips for users as it can also reduce the number of cars on the road (Wang et al., 2019). Thus, it is clear that ridesharing leads to savings in fuel, insurance and vehicle maintenance, and not infrequently, time savings. A further benefit is then the reduction of negative impacts from transport on the air. Carpooling is a complementary measure to the whole system of alternative transport, which is offered as part of the commuting of employees or other target groups in a

given locality (Plíšková, 2007). Carpooling is most often used through websites or applications not only abroad but also in the Czech Republic.

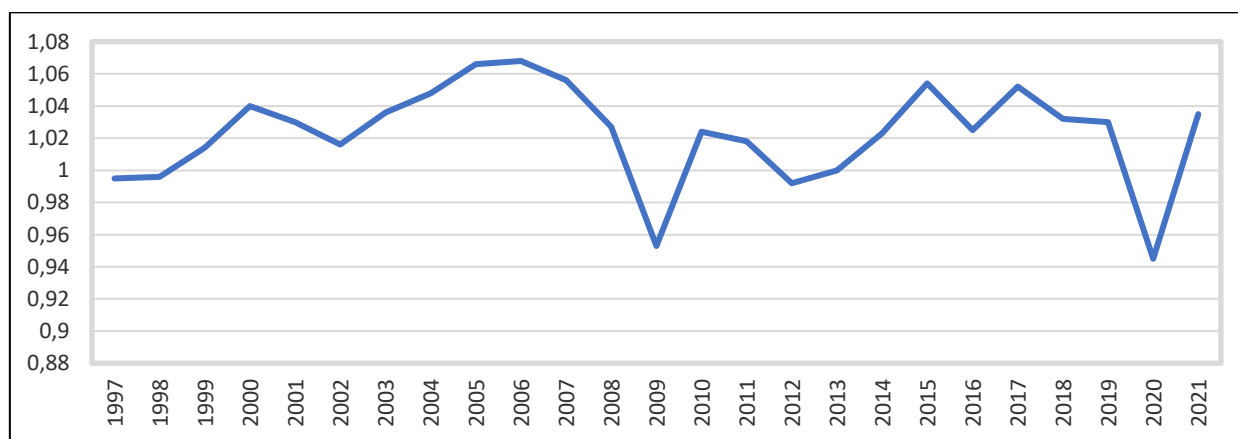
We analyzed in pervious paragraphs mobility management, transportation performance and carpooling system. There are consequences with economic cycles. The reason is quite simple. The right way to analyze any economics data in time period, in our case transportation performance, is to consider economics performance of the country. Obviously, the most common indicator used for this purpose is GDP. Economic cycle is going to be represented by GDP growth rate in period 1997 – 2021.

2 Methods

The goal of the research and this paper is to analyze passenger transport performance by mode and find possible consequences. Furthermore, to analyze the context of changes in economic performance (in different phases of the business cycle in the Czech Republic) and changes in passenger transport performance by mode. The results will be used of the kind of prove or evidence for application new transportation modes.

The data were drawn from both national accounting and the transport yearbook of the Czech Republic, for the period 1997 - 2021. Based on GDP (year-on-year volume indices), intervals where GDP growths increased and intervals where GDP growths decreased were constructed (Figure 1).

Figure 1 GDP growth rate



Source: Own processing

Consequently, the relationship between GDP development and passenger transport performance was analysed. The relationship between the development of GDP and the different types of passenger transport was examined in more detail by means of correlation coefficients, a measure of correlation that expresses a linear dependence between two variables and takes values from -1 to 1. Attention was paid in particular to the period before the Covid-19 crisis, the period of the covid crisis, which continues with the crisis associated with the Ukrainian war and the energy crisis.

The average growth rates for each interval were determined using the geometric mean

$$\bar{k} = \sqrt[n]{k_1 \cdot k_2 \cdot \dots \cdot k_n} \quad (1)$$

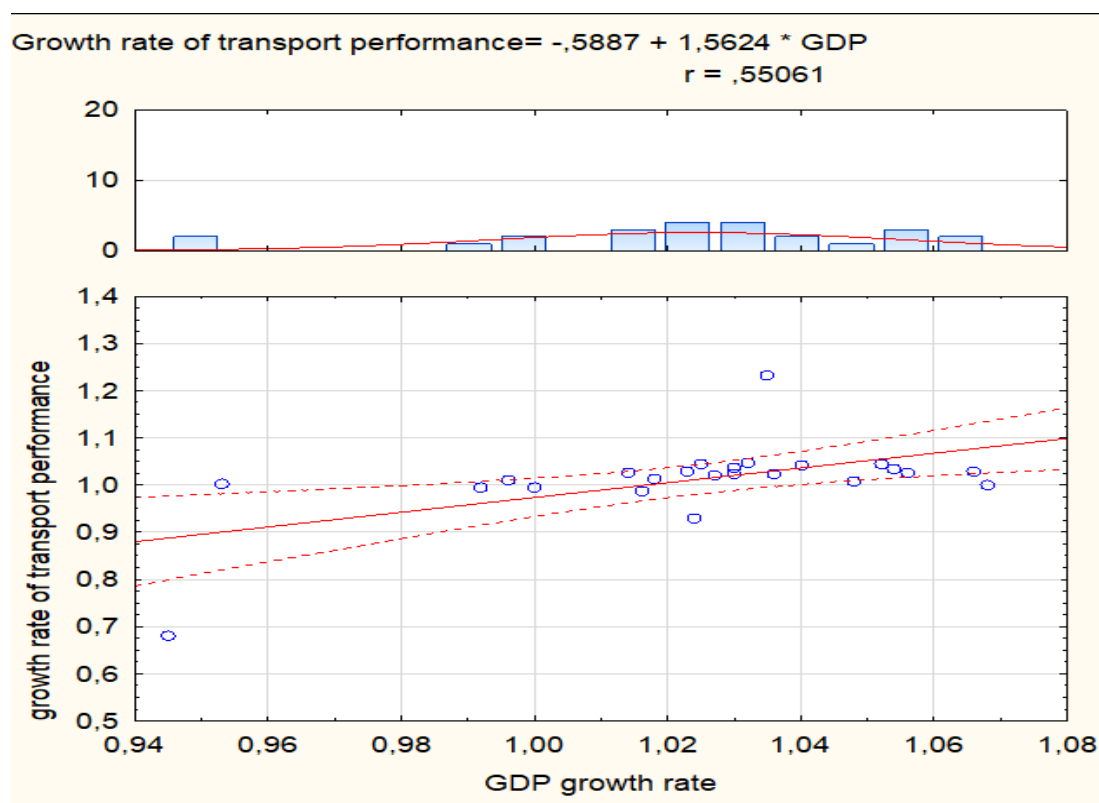
where:

k_i are GDP volume indexes, n is the number of years in the period..

3 Research results

The relationship between the change in passenger transport performance and the change in GDP was verified through a dot plot including the expression of a regression equation with the calculation of the correlation coefficient (Figure 2).

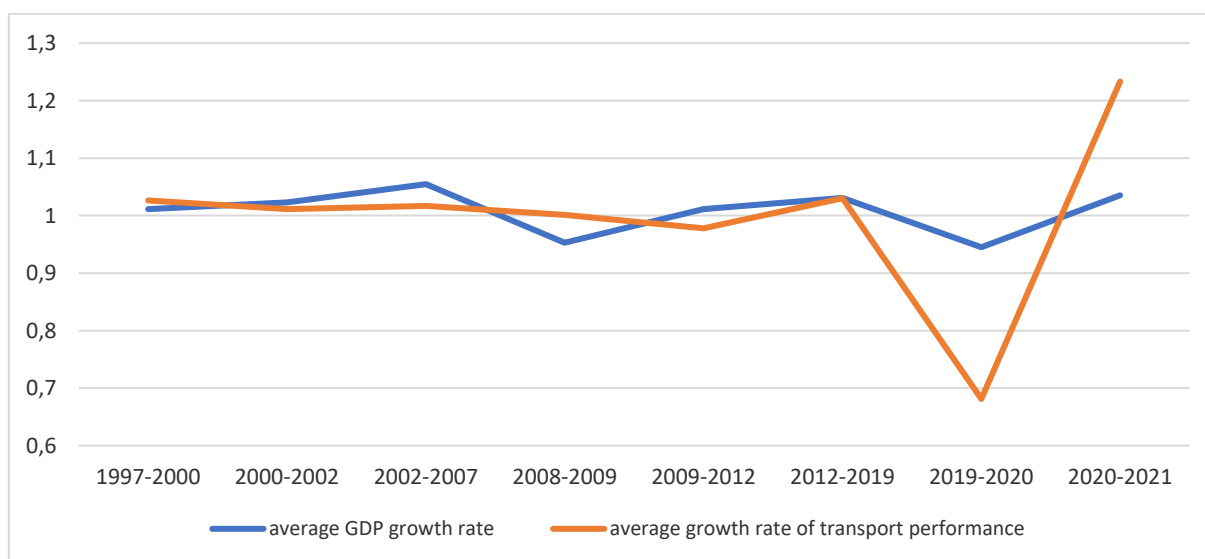
Figure 2 Dot plot of the relationship between growth in passenger transport performance and GDP growth



Source: Own processing

Figure 2 shows that there is a direct linear relationship between growth in passenger transport performance and GDP growth (excluding the effect of prices). This linear dependence is moderately strong, as indicated by the correlation coefficient. If we focus on the intervals that indicate the increases or decreases in GDP, i.e. the growth or decline of the Czech economy, it is clear from Figure 3 that these changes take place in the same direction for the variables under study, but with different intensities. Different intensities can be observed especially in the recent periods related to the Covid-19 crisis and the subsequent slight recovery before the Ukraine-related crisis and the energy crisis.

Figure 1 Average growth rates of GDP and passenger transport performance



Source: Own processing

A more detailed analysis that focuses on the relationship between the change in transport performance by mode and the change in GDP (Table 1) indicates that the strongest statistically significant direct linear relationship was found, as expected, for public transport (correlation coefficient 0.597), which includes rail transport (correlation coefficient 0.619), bus transport (correlation coefficient 0.536).

Table 1 Correlation coefficients of GDP and selected variables

Indicator	Correlation coefficient
Total transport capacity	0.551
Rail transport	0.619
Bus transport	0.536
Air transport	0.433
Inland waterway transport	0.128
Urban public transport	0.462
Total public transport	0.597
Individual car passenger transport	0.401

Source: Own processing

A statistically insignificant dependence of GDP development was confirmed for inland waterway transport and individual car passenger transport. Individual car passenger transport is not only related to journeys to work and thus to the creation of added value in the enterprise, but people are usually transported for other purposes (to the doctor, to the authorities, to school).

Next, attention was focused on the evolution of passenger transport performance by type in the period before the covid crisis, during the covid crisis and then in the last period under review (Table 2).

Table 2. Growth rate of transport performance by mode of transport

period	Total transport capacity	Rail transport	Bus transport	Air transport	Inland waterway transport	Urban public transport	Total public transport	Individual car passenger transport
2012-2019	1.030	1.060	1.023	1.015	0.978	1.016	1.025	1.034
2019-2020	0.681	0.610	0.516	0.158	0.742	0.415	0.418	0.849
2020-2021	1.233	1.023	0.992	2.277	1.304	0.951	1.098	1.276

Source: Own processing

It is clear from Table 2 that all passenger transport performance by type increased slightly prior to the covid crisis, i.e. during the period of economic growth (Figure 3), irrespective of the type of passenger transport, followed by a large drop in passenger transport associated with the closed economy during the “covid period”. Air transport, public transport and urban public transport experienced the highest drops. In what can be described as the post-Covid period, passenger transport performance increased by 23.3%, but public passenger transport only recorded a 9.8% increase. The highest increase can be observed in individual car transport, with 27.6%. This annual increase is significantly higher than the annual growth rate in the period before the financial crisis. This reflects the higher interest of people in individual car transport, whether for various reasons such as higher safety in terms of infection, higher flexibility, etc. It is clear from this analysis that shared transport and its further expansion is important. Particularly in communities with lower transport services, it can be an advantage for citizens when travelling not only to work, but also e.g. to the doctor, to school, etc.

4 Discussion and conclusions

Now, there is the place for research question. How and what can we derive from previous part where we got results of analyses. The answer is quite simple. It would be very unwise not to develop new ways of transportation modes. One of these is ridesharing or better known as carpooling. This mode has different ways of applications but we can actually make the list of advantages but also disadvantages:

Benefits of carpooling:

- Carpools save money by sharing the cost of driving one car. Driving in one car saves on fuel, tolls, parking and vehicle maintenance,
- carpooling eases the burden on the road,
- reduces environmental pollution,

- reduces the stress of driving for those who are passengers,
- provides new social contacts,
- faster travel than using public transport without changing trains,
- comfort for the driver and passengers,
- some companies offer more convenient parking spaces for carpoolers.

Disadvantages of carpooling

- Drivers bear the burden of any lawsuit from passengers in the event of an accident,
- the passenger doesn't know the driver in advance, nor the level of his driving skills. Mutual trust between driver and passenger is necessary.

Given advantages and disadvantages are compilation of authors own ideas and research papers by authors like Bruglieri et al., (2011), Pukhovskiy et al., (2011), Tahmasseby et al., (2016).

Acknowledgement

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References

- Aguilera, A., & Pigalle, E. (2021). The future and sustainability of carpooling practices. An identification of research challenges. *Sustainability* (Switzerland), 13(21). DOI:10.3390/su132111824.
- Anthopoulos, L. G., & Tzimos, D. N. (2021). Carpooling platforms as smart city projects: A bibliometric analysis and systematic literature review. *Sustainability* (Switzerland), 13(19). DOI:10.3390/su131910680.
- Baran, M., & Augustyn, D. J. (2021). The Evaluation of Transport Exclusion in the Peripheral Cross-Border Areas of Central Europe in the Context of Applicability of Information-Based Carpooling. *Sustainability*, 13(6), 3440. DOI: 10.3390/su13063440.
- Becker, H., Ciari, F., & Axhausen, K. W. (2017). Comparing car-sharing schemes in Switzerland: User groups and usage patterns. *Transportation Research Part A: Policy and Practice*, 97, 17–29. DOI: 10.1016/j.tra.2017.01.004.
- Bruglieri, M., Ciccarelli, D., Colorni, A., & Luè, A. (2011). PoliUniPool: a carpooling system for universities. *Procedia-Social and Behavioral Sciences*, 20, 558-567.
- Canzler, W., Kaufman, V., Kesselring, S. (2008). *Tracing Mobilities: Towards a Cosmopolitan Perspektive*. Aldeshot: Ashgate.
- Gheorghiu, A., & Delhomme, P. (2018). For which types of trips do French drivers carpool? Motivations underlying carpooling for different types of trips. *Transportation Research Part A: Policy and Practice*, 113, 460–475. DOI: 10.1016/j.tra.2018.05.002.
- Javid, M. A., Mehmood, T., Asif, H. M., Vaince, A. U., & Raza, M. (2017). Travelers' attitudes toward carpooling in Lahore: Motives and constraints. *Journal of Modern Transportation*, 25(4), 268–278. DOI: 10.1007/s40534-017-0135-9.
- Kudláčková, N., Chlaň, A. (2004). *Faktory ovlivňující mobilitu*. In: Faktory trvale udržitelné mobility a přístupnosti k dopravním službám v osobní dopravě: sborník příspěvků. Pardubice: Univerzita Pardubice. 81-93.
- Plíšková, R. (2007). *Cyklistika a mobilita*. Konference národní strategie rozvoje cyklistické dopravy ČR. 2007 [cit. 2019-06-11]. Dostupné z: <http://www.cyklostrategie.cz/file/7-1-08-pliskova-cdv-nastroje-managementu-mobility/>.
- Tahmasseby, S., Kattan, L., & Barbour, B. (2016). Propensity to participate in a peer-to-peer social-network-based carpooling system. *Journal of Advanced Transportation*, 50(2), 240-254.
- Pukhovskiy, N. V., & Lepshokov, R. E. (2011, May). Real-time carpooling system. In *2011 International Conference on Collaboration Technologies and Systems (CTS)* (pp. 648-649). IEEE.
- Schmeidler, K. (2010). *Mobilita, transport a dostupnost ve městě*. Ostrava: Key Publishing.
- Schwanen, T., Lucas, K., Akyelken, N., Cisternas Solsona, D., Carrasco, J.-A., & Neutens, T. (2015). Rethinking the links between social exclusion and transport disadvantage through the lens of social capital. *Transportation Research Part A: Policy and Practice*, 74, 123–135. DOI: 10.1016/j.tra.2015.02.012
- Wang, Y., Gu, J., Wang, S., & Wang, J. (2019). Understanding consumers' willingness to use ride-sharing services: The roles of perceived value and perceived risk. *Transportation Research Part C: Emerging Technologies*, 105, 504–519. DOI:10.1016/j.trc.2019.05.044.
- Zelený, L. (2007). *Osobní přeprava*. Praha: ASPI.

Unethical behaviour in Australian federal politics

Roberto Bergami¹

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Abstract: Whilst it is generally accepted that politics and ethics are an uneasy match at times, there is still an expectation from the electorate that politicians elected to positions of public power behave in the best interest of the nation and its constituents. Such notions have come under attack in Australia during the term of the previous federal government. Between 2019 and 2022 an unprecedented level of unethical behaviour by public officials has been on display, with accountability and transparency featuring very low in decisionmaking processes. A string of scandals that has plagued the previous government have included the questionable distribution of government funding to sporting bodies and the building of car parks in hand-picked electorates, with the aim of strengthening the chances of re-election. Other grants have also come to be questioned, including the award of nearly half a billion dollars to a small foundation after the tender process was bypassed. The latest saga involved the previous Prime Minister (PM) secretly amassing an extra five ministries in secret, in cahoots with the Governor General (the monarchical representative), who himself became embroiled in a controversial financial grant allocation after personally lobbying the PM for the award. Unethical behaviour appears to be on the increase and there is a need to take action to prevent the further erosion of public trust in government officials. This paper highlights major events of concern during the last term of government, and concludes by suggesting a range of remedies, such the establishment of a federal anti-corruption body, the legal codification of the role of the Governor-General, and enhancing ministerial standards through regulations.

Keywords: ethics, politics, public officials, politicians, transparency, accountability

JEL Classification: D73, D71

1 Introduction

The focus of this paper is on events that have occurred at the Australian federal political level during the course of the Morrison government, focusing in particular, between the period 2019 - 2022. This is not a party political paper, as the issues discussed herein would equally apply to any political party in power at the time. The intention of this paper is to draw attention to gaps in governance legislation and regulation that have enabled individuals to behave in a questionable manner, one that appears to lack ethical considerations and is shrouded in an absence of transparency and accountability. In this context, the paper aims to provide suggestions for future generic remedies to the current controversies, regardless of which political party may rule in the future.

As the events discussed in this paper are contemporary, there is a dearth of information available in the public domain, making a formal literature review impossible. Virtually all of the reporting to date has been via the media providing summary briefs lacking in-depth analysis.

By way of background, to provide a greater understanding of the decision-making process in Australian federal politics, a summary of the Australian culture, according to Hofstede's (2022) theory, is given at Figure 1. Aspects of the Australian culture will be referred to later in the paper.

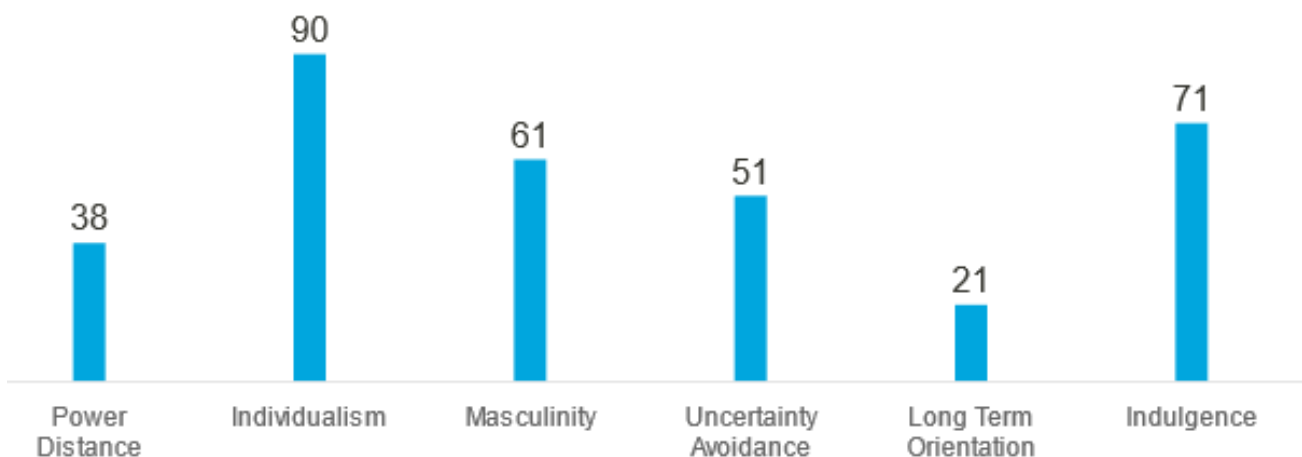
Hofstede's (2022) six dimensions for Australia are summarised below:

1. **Power distance** „is defined as the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally“. Australian culture, with a score of 38, has a low power distance with a hierarchical structure of convenience with high flow formal and informal communications between different layers of organisational structure;

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2. **Individualism** is „the degree of interdependence a society maintains among its members. It has to do with whether people’s self-image is defined in terms of “I” or “We”. In Individualist societies people are supposed to look after themselves and their direct family only“. Australia is a highly individualistic society as reflected by the high score of 90. Cynically, in the eyes of some, it may be argued this is the ideal environment for politicians who tend to look after themselves;
3. **Masculinity** „indicates that the society will be driven by competition, achievement and success, with success being defined by the “winner” or “best-in-the-field.” This value system starts in school and continues throughout one’s life – both in work and leisure pursuits. Australia, with a score of 61, has a masculine society, meaning the goal is to ‘win’ in life, in a ‘winner takes all’ approach. This is perhaps well suited to politicians who enjoy winning against opposition;
4. **Uncertainty avoidance** is the „way that a society deals with the fact that the future can never be known: should we try to control the future or just let it happen? ... The extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid these“. Although uncertainty avoidance does not feature particularly high in Australian culture with a score of 51, recent events in federal politics may well shake the belief that institutions that are capable of avoiding ambiguity do exist;
5. **Long term orientation** „describes how every society has to maintain some links with its own past while dealing with the challenges of the present and future, and societies prioritise these two existential goals differently. Normative societies which score low on this dimension, for example, prefer to maintain time-honoured traditions and norms while viewing societal change with suspicion“. Australia falls into this category, with a low score of 21, consequently, they have a strong concern for establishing the absolute truth, have respect for traditions, low emphasis on saving for the future, and are motivated in achieving quick results. The quest for the truth has probably been seen in the resulting exposure of controversial political decisions, and the quick result approach is seen in some government programs; and
6. **Indulgence** is “the extent to which people try to control their desires and impulses, based on the way they were raised“. Indulgence indicates relatively weak control, whereas restraint indicates strong control. Australia, with a score of 71, has an indulgent culture meaning there is a tendency to materialise desires and impulses for enjoying life and having fun. This means they generally have a positive attitude, are optimistic and regard leisure time, act as one pleases and spend money as they wish as being important aspects of their life.

Figure 1 The six dimensions of Australian culture



Source: <https://www.hofstede-insights.com/country-comparison/australia/>

Having provided an overview of the Australian culture, the next section considers various definitions of ethics as they may apply to politics.

2 Ethics

A definition of ethics is the focus on „the creation of a moral compass” (Natale & Libertella, 2016, p. 35). Indeed Ristovski (2017) argues that „morality and ethics as social categories are crucial for generating a sound political culture in any

society. Through the process of political socialization these categories influence not only the culture in a nation, but its political ideologies as well“ (p. 91). Dictionary definitions of ethics ("Cambridge ", 2022; "Dictionary," 2022) also reflect a focus on ethics as being a guiding philosophy; principles of conduct governing an individual or a group; a set or system of moral issues or aspects; the discipline dealing with what is good and bad and with moral duty and obligation; a consciousness of moral importance; and the study of what is morally right and wrong, or a set of beliefs about what is morally right and wrong. Morality is, therefore, one of the central tenets of ethics and, consequently, so is ethical behaviour.

The focus of this paper is to highlight a series of questionable decisions that were taken under the Morrison Liberal government, consequently, it is important to define governmental unethical behavior. „Unethical behaviour in government is viewed as a situation where there is fraudulent or dishonest conduct or improper behaviour by people who are in positions of power. Bribery, extortion, embezzlement, the use of legislated powers by government officials for illegitimate private gain, nepotism, rent seeking, etc, are some examples for unethical behaviour in government“ (Aktan, 2015, p. 63). According to Roth (2004) „ethics and politics are normally considered domains that do not mix. In fact, domains that have little to do with one another“ (p. 1), yet, there is a need for these domains to meet, for otherwise we fail to meet the basic principle of utilitarianism, which is that „the right thing to do is whatever will promote the greatest happiness of the greatest number of people“ (p.51). As governments run the nation and their decisions affect the population at large, these processes ought to consider core ethical principles, in order to avoid corrupt behaviour. This is necessary because „political corruption affects each nation-state differently, but the outcomes are nominally the same: a deficit of public trust, weakened government institutions and undermined political systems“ (de la Rama M. J., Lester M. E., & Staples, 2022, p. 1) .

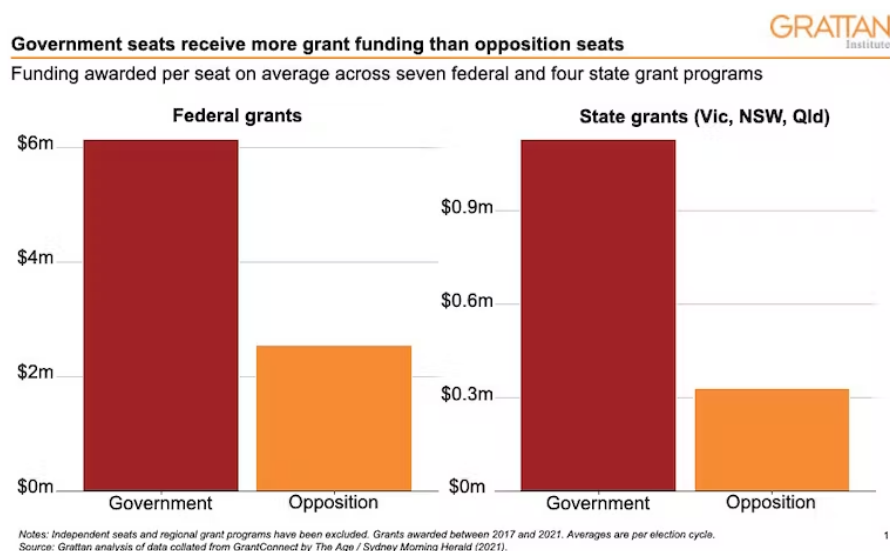
„The legitimacy of corruption cannot be analysed without simultaneously addressing the legitimacy of public office or entrusted power“ (Kolstad, 2012, p. 242). It is known that politicians are presented with difficult decisions that, at times, requires them to prioritise and take courses of action that should, at least in theory, result in the best outcome for the nation and the electorate. Yet, at times, this may not be so as, among other things, lobbying interests influence politicians. It is also known that politicians have a strong desire to remain in power, and that means being re-elected. It is perhaps this desire that contributes to the development of unethical behaviour, with one of the most popular Australian methods used to retain power being pork barrelling, discussed in the next section.

3 Pork barrelling

Pork barrelling is the „use of public resources to target certain voters for partisan purposes – for example, by spending public money in particular electorates to try to win more votes rather than spending those funds where they are most needed. Using grants to buy votes is one of the most visible forms of pork-barrelling. Grants processes often allow substantial ministerial discretion with little transparency“ (Griffiths, Stobart, & Wood, 2022), and described as „an ideal vehicle for delivering pork“ (Connolly, 2020, p. 29).

Both sides of politics use pork barrelling, but whoever is governing has discretionary power to decide where funding is channelled. As shown in Figure 2, government grants at both federal and state levels favour the incumbent, regardless of which party is in power. For example, NSW has a Liberal (right wing) government, whereas Victoria and Queensland have Labor (left wing) governments.

Figure 2 Government grants allocations



Source: <https://grattan.edu.au/news/pork-barrelling-is-a-waste-of-taxpayer-money-heres-how-to-stop-it/>

However, during the course of the previous Morrison government, it would appear that pork barrelling reached new heights. A number of decisions were made that were considered scandalous, once their details emerged. Due to length constraints, this paper concentrates on what were arguably the two most contentious discretionary funding decisions on separate federal grant government allocations: the sports grants and the car park grants.

3.1 Sport grants rorts

This funding scheme, amounting to 100 million Australian dollars, was devised and put in place just prior to the 2019 election, in what was subsequently recognised as being an exercise of voter influence in marginal seats. In fact the government „had kept sending out grants while in caretaker mode, after the election was called (in breach of caretaker conventions)“ (Napier-Raman, 2020). An investigation by the Auditor-General, found that „the award of grant funding was not informed by an appropriate assessment process and the successful applicants were not those who had been assessed as most meritorious“ (Auditor-General (Cth), 2019, p. 6). This “scandal was particularly controversial as 43% of approved grant applications were in fact ineligible to receive funding” (McIlroy, 2020). Therefore, two concurrent issues emerged: a breach of the caretaker conventions and the skewness of the grants allocation. The fallout from this scandal was the resignation of the responsible minister, not because of alleged improper behaviour over the funding scandal, but rather, over an undeclared membership to a gun club that was deemed to be a “conflict of interest”. The minister in question was subsequently reinstated to a senior position in the Morrison government – a ‘no-fault behaviour’ approach in full display.

3.2 Commuter car park rorts

This was a 660 million Australian dollars commuter car park administration fund, found to have been ineffectively administered. „The minister had distributed the grants with “inadequate assessment” for eligibility. The auditor-general’s report found 77% of the commuter car park sites selected were in Coalition [Liberal government] electorates, rather than in areas of real need with congestion issues. Damningly, none of the 47 project sites selected for funding commitment were proposed by the department. This suggests there has been extensive ministerial interference in the funding decision-making” (Ng, 2021). This provided a clear example of pork barrelling, so much so that this program was commonly referred to in the media as ‘car porks’ in an obvious reference to vote buying behaviour. In fact, most of the promised car parks were “promised in Melbourne’s east and south-east where the Liberal Party was defending a string of marginal electorates in 2019” (Wright & Curtis, 2022).

4 Other questionable events

Apart from the pork barrelling examples outlined above, other events have also highlighted questionable behaviour, as outlined below.

4.1 French submarine deal

Australia had chosen France’s Naval group as the successful bidder for new electric-diesel submarines over alternative bidders from Germany and Japan. The project had started, but was cancelled by the Morrison government in favour of a

new deal with the UK and the US - the AUKUS pact. The decision to terminate the Naval deal was shrouded in secret and the rationale provided for scrapping the French deal was that Australia needed to increase its stealth with a new generation of submarines, which, incidentally were going to be nuclear powered. This was a monumental event, by default, it meant that Australia had become a nuclear power overnight, without any discussion about this in the broader community. The scrapping of the French deal cost the Australian taxpayer 555 million Euro – not an insignificant sum. Additional to this cost is the uncertainty of the nuclear submarine availability which is projected not to occur until 2040, leaving Australia with a 20 year defence gap. By the time 2040 comes around, who knows whether the currently designed and planned submarines will still be a good choice, or whether submarines will be redundant as a defence mechanism.

4.2 Secret ministries

After the defeat of the Morrison government in 2022, it was revealed that „between March 2020 and May 2021, Morrison appointed himself minister of health, finance, home affairs, treasury and industry — moves that appeared to have given him powers equal to the ministers already appointed to those positions“ (Associated Press, 2022). This process went against all conventions and good principles of governance. Morrison explained that as he took no active decision-making in those portfolios, it was not a matter for concern and, in any case, he did it because of the Covid-19 pandemic, although by 2021 there was little, if any, in the way of emergency powers in place. The fact that the ministries were approved in secret has to be questioned – there is no transparency, but a high degree of personal control that seems to have been exercised in these circumstances. Given ministerial posts require the approval of the Governor-General (the Queen's/King's representative, as Australia has a monarchical constitution), their surrounding secrecy brings into question the role and purpose of the Governor-General's office. Apparently there is no Governor-General diary entries for these ministerial appointments, in itself a curious situation – why all the secrecy? Morrison has demonstrated tendencies of complete control during his tenure as Prime Minister and he defended his actions by claiming that „as prime minister, he was responsible for everything — “every drop of rain, every strain of the virus, everything that occurred over that period of time ... I believed it was necessary to have authority, to have what were effectively emergency powers, to exercise in extreme situations that would be unforeseen, that would enable me to act in the national interests” (Associated Press, 2022). One has to question whether the claim that a human is responsible for natural events like drops of rain or virus strains, are credible, or whether they represent a Messiah complex – an appropriate question given Morrison espoused strong religious faith, in itself a curious point, given that some of his alleged actions, such as lack of transparency and looseness with the truth may have contradicted principles of Christian values. There is no accusation against the individual, just observations of concern.

4.3 Governor-General personal lobbying

It was discovered that the Governor-General, through personal lobbying, had managed to get an allocation of 18 million Australian dollars from Morrison for a foundation called Australian Future Leaders Program. „The foundation came under intense scrutiny during former Mr Morrison's final month in office, with the government confirming the funding was awarded without a competitive tender to a charity that didn't appear operational and which did not have a website, staff or an office“ (Robertson, 2022). Why would the Governor-General personally lobby for such an organisation? Is there a link between this and the secret five ministries? There is no accusation, but these circumstances leave one to wonder about the behind the scenes machinations. It is extraordinary that an allocation of public funding could be done in such a manner. The Albanese Labor government, who won the 2022 election, has now confirmed that the funding for that (non-existent) entity has been withdrawn.

5 Conclusion and recommendations

Under the Morrison government, Australians have witnessed a spate of questionable political decision-making processes, demonstrating a lack of ethical fortitude, little transparency and a web of mis-truths and obfuscations, all designed to maintain control and secrecy over processes and behind the scene machinations.

No doubt, much of this was driven by the desire to remain in power, but also by the short-term orientation and individualism aspects of the Australian culture. In summary, this may be simply reduced to: I will look after myself now and will not be too concerned about others or the future. Both of these aspects do not augur well for sustainability and an improvement of the status quo to the benefit of Australian society. An increased suspicion of politicians' behaviour and a concurrent decrease in government and democratic principles has taken place and these matters need to be addressed and reversed. Among other things, the wasteful disbursement of taxpayer money on ill-conceived grants and questionable decisions on other matters outlined in this paper have essentially robbed taxpayers the opportunity of better healthcare and education opportunities. Australia now sits at its lowest historical point on Transparency International's Corruption Perception Index, and no longer in the top 10 category. This cannot be good for the nation's reputation, and it may increasingly become the target of international bad actors, seeking to exploit corruption possibilities. Therefore, to begin

a period of cultural influence for the better, based on the examples of questionable behaviour highlighted in this paper, the following recommendations are offered:

1. The code of conduct for parliamentarians be codified through laws or regulations, imposing greater transparency on behaviours and possible conflicts of interest disclosures, as well as penalties for breaches of these laws/regulations, in order to avoid future questionable behaviour, such as secret ministerial appointments;
2. All grants projects above a certain base line, for example 10 million dollars, be subject to parliamentary multi-party oversight, to ensure there is no repeat of past grant-skewing to influence voters;
3. All matters of national interest, such as defence spending, be subject to a parliamentary multi-party panel review prior to approval, to avoid a repeat of the submarine debacle;
4. A federal anti-corruption commission be established with broad-based powers to investigate public officials and third parties, through public hearings as necessary. The inclusion of third parties is necessary as these may influence politicians' behaviour and may stand to gain illegitimately from political decisions. This body should be independently funded and only subject to multi-party government oversight, to ensure no party political interference occurs; and
5. The role of the Governor-General should be codified via an act of parliament, to ensure clarity on the authority and responsibilities this office has, especially due to the extraordinary current powers this office can wield – for example in 1975 an elected Australian Prime Minister was deposed through the powers exercised by this office, but to date no codification of such powers exist. The alternative is to change the constitution and make Australia a republic, thereby removing this office altogether.

References

- Aktan, C. A. (2015). Ethics in government: Anti-corruption measures. *International Journal of Social Sciences and Humanity Studies*, 7(2), 63-89.
- Associated Press. (2022, 17 August 2022). Critics slam former Australian leader's decision to give himself secret powers. *Los Angeles Times*.
- Auditor-General (Cth). (2019). *Award of Funding under the Community Sport Infrastructure Program. Report No. 23*. Canberra, ACT, Australia: Commonwealth of Australia.
- Cambridge (2022). Cambridge, UK: Dictionary.com, LLC.
- Connolly, S. (2020). The Regulation of Pork Barrelling in Australia. *Australasia Parliamentary Review*, 35(1), 24-53.
- dela Rama M. J., Lester M. E., & Staples, W. (2022). The Challenges of Political Corruption in Australia, the Proposed Commonwealth Integrity Commission Bill (2020) and the Application of the APUNCAC. *Laws*, 11(1), 1-27. DOI: 10.3390/laws11010007
- Dictionary. (2022). Springfield, MA, USA: Merriam-Webster, Incorporated.
- Griffiths, K., Stobart, A., & Wood, D. (2022, 22 August 2022). Pork-barrelling is unfair and wasteful. Here's a plan to end it. Retrieved from <https://grattan.edu.au/news/pork-barrelling-is-a-waste-of-taxpayer-money-heres-how-to-stop-it/>
- Hofstede, G. (2022). Hofstede's insigh country comparison Australia. Retrieved from <https://www.hofstede-insights.com/country-comparison/australia/>
- Kolstad, I. (2012). Corruption as a violation if distributed ethical obligations. *Jounral of Global Ethics*, 8(2-3), 239-250.
- McIlroy, T. (2020, 13 February). Hundreds of Sports Projects Were Ineligible, Says Auditor-General. *The Australian Financial Review*. Retrieved from <https://www.afr.com/politics/federal/later-hundreds-of-sports-projects-were-ineligible-says-auditor-general-20200213-p54017>
- Napier-Raman, K. (2020, 22 December). It was the biggest political scandal of the year. Yet somehow, no one was to blame. Retrieved from <https://www.crikey.com.au/2020/12/22/sports-rorts-oral-history-part-two/>
- Natale, S. M., & Libertella, A., F. (2016). Higher education and wealth equity: Calibrating the mora compass empathy, ethics and the trained will. *Journal of Academic Ethics*, 14, 35-47.
- Ng, Y.-F. (2021, 1 July). Another day, another rorts scandal – this time with car parks. How can we fix the system? . Retrieved from <https://theconversation.com/another-day-another-rorts-scandal-this-time-with-car-parks-how-can-we-fix-the-system-163645>
- Ristovski, L. (2017). Morality and ethics in politics in the contemporary societies. *Journal of Liberty and International Affairs*, 2(3), 83-93.
- Robertson, J. (2022, 7 September). Government overturns \$18 million grant to charity linked to Governor-General. *The New Daily*. Retrieved from <https://thenewdaily.com.au/news/politics/2022/09/07/governor-general-charity-scrapped/>

- Roth, W.-M. (2004). UnpPolitical Ethics, UnEthical Politics. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 5(3), 1-16.
- Wright, S., & Curtis, K. (2022, 3 March). Frydenberg abandons \$65m of car parks in his own seat.

Measurement of digital performance by composite indexes: Analysis of member states EU

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Abstract: Digitalization, digital performance and transformation have become remarkable phenomena as of late. Digital transformation helps increase digital competencies and creates an ecosystem with more technologically advanced products and services, thus becoming an important prerequisite for the competitiveness of economies. However, this transformation has an impact not only on economies, but also on society as a whole, and therefore it has become a complex topic that is being addressed by various European and national agendas. Various development policies are being formed, and the effects of digital transformation on the socio-economic sphere are being examined as technological progress brings with it not only great challenges and opportunities, but also threats to society, economies and individual businesses. In order to assess the level of digital transformation, the European Union processes a number of different composite indicators. This paper concentrates on digital performance and its measurement through selected composite indicators (DESI, EIDES). The aim of this paper is to examine the relationships between these composite indicators and productivity rate (represented by GDP per capita and Total Factor Productivity). Using this analysis, it is possible to capture the position of the Czech Republic within EU member states and form recommendations for improving its position.

Keywords: digitalization, digital performance, composite indexes, EIDES, productivity

JEL Classification: O33, O40

1 Introduction

Technological progress and the swift development of modern technologies is changing the world and impacting the competitive position of individual sectors of the economy and whole countries, business models and the behavior of those participating in market processes (Marszalek & Ratajczak-Mrozek, 2022). Thanks to the massive and global emergence of new technologies, value chains are changing, and new innovative business models are being formed. Digitalization (also sometimes dubbed “the digital revolution”) is reshaping almost every part of both company and private life and transforming society (TWI2050, 2019; Vor dem Esche & Hennig-Thurau, 2014). It includes the integration of digital technology not only into economies and namely businesses, but also into all areas of society while fundamentally changing the way in which individuals function (Henriette et al., 2015). In the context of the development of business models, operations and markets, digitalization is viewed in terms of the opportunities that new technologies provide, as it enables various new forms of cooperation between businesses and the individualization of products and services; it also creates new forms of relationships between businesses and clients or employees and brings along new business opportunities (Rachinger et al., 2019). It is becoming the driving force for companies, markets and regions in sustaining competitiveness or growth. Technologies thus have a fundamental influence on the development of society as a whole and the behavior of individual economic entities. The term “digital economy” is used in the sense of a resource for sustaining competitiveness, economic growth and development (Palacká et al., 2021; Miethlich et al., 2020). However, the digital economy also has a more general meaning, e.g. the World Bank (2016) characterizes it as a system of economic, social and cultural relations that are based on digital technologies.

The paper presented here deals with the issue of measuring digital performance with the use of composite indicators. The paper is structured in the following manner: Firstly, the theoretical basis concerning the issue of digitalization, technological progress, digital technologies, digital transformation, etc. is established. Subsequently, applied methods

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and procedures used in the analytical section of this paper are presented. This is followed by a section depicting the primary results and the opening of a discussion on the issue at hand. The Conclusion summarizes the collected findings and outlines issues concerning future development.

The EU processes a whole score of composite indicators through which it assesses the degree of digitalization. Achievement of the established goals of Europe's digital transformation is to be ensured by the "Path to the Digital Decade" program (European Commission, 2021a), a part of which is a monitoring system that stems from the Digital Economy and Society Index (DESI) composite indicator. This index assesses digital performance and measures the progress of EU countries in fulfilling the goals for 2030 (European Commission, 2022b).

Nonetheless, questions remain as to the relationship between the digital performance of individual countries presented via selected composite indicators and their productivity. The goal of this paper is to explore the relationships between selected composite indicators (DESI, EIDES) and the degree of productivity represented by GDP per capita and Total Factor Productivity indicators. Attention will be given namely to the Czech Republic and its position.

2 Theoretical Background

Three terms often appear in relation to technological progress and the development of modern technologies – digitalization, digitization and digital transformation – which sometimes tend to be interchanged. Vor dem Esche & Hennig-Thurau (2014) define digitalization as: *"a major change process with enormous "disruptive power" that effects not only the area of information and communication, but also products, services and distribution channels."* Parida et al. (2019) view digitalization as *"the use of digital technologies to innovate a business model and provide new revenue streams and value-producing opportunities in industrial ecosystems"*. Gartner's Glossary (2021) defines digitalization similarly, viewing it as *"the process of moving to a digital business"*, in which digitalization means the *"use of digital technologies to change a business model and provide new revenue and value-producing opportunities"*. However, digitalization impacts all sectors and companies without exception, and even despite the fact that its impact and effect can vary (Marszalek & Ratajczak-Mrozek, 2022), it has become crucial for securing competitiveness (and in some sectors even survival) into the future (Caputo et al., 2021). This does not only concern business entities, sectors or markets; digitalization also includes the integration of various technologies into our daily lives, e.g. smart devices, mobile devices, smart homes, smart cities or smart mobility. It thus has a broad socio-economic impact. For this reason, digitalization is also viewed as a major driver of growth and sustainability (Bleicher & Stanley, 2017). It should not be equated to digitization, which means the transition from analogue to digital format (Gartner's Glossary, 2021). This deals merely with the digital conversion of existing documents and data, in which we digitize information, not a process. The meaning of digitalization (which thanks to the possibilities of digital technology makes it possible to collect large amounts of data, analyze them, establish trends and provide valuable information for more qualified decision making) is thus much broader and can be identified with qualitative change and specific transformation (Marszalek & Ratajczak-Mrozek, 2022). The term digital transformation is then used as a label for strategic transformations focusing on organizational changes realized via digitalization projects with the goal of enabling significant business improvements (Warner & Wäger, 2019). As Bloomberg (2018) summarizes these differences, we digitize information, but we digitalize the processes and roles on which the operation of a business stands, and we digitally transform a business and its strategy; from a different point of view, digitization and digitalization are about technologies, whereas digital transformation from a business's point of view is about the client.

Digital transformation based on modern technologies is becoming a multidisciplinary issue that various national and international companies focus on in the context of opportunities and benefits, but also potential threats. Even the European Union sees digital solutions as fundamental in ensuring the renewal of Europe and its competitiveness in the global economy. Therefore, digital transformation is one of the EU's priorities. The report on shaping the digital future of Europe (European Parliament, 2021) calls for the utilization of opportunities of a united digital market, improvement of the use of artificial intelligence and the support of digital innovations and skills. In addition to instating technologies and the necessary infrastructure, the acquisition of digital skills is becoming a crucial prerequisite for further development and success. The EU's digital strategy aims to ensure that the digital transformation benefits the wider public and businesses while helping to achieve its goal of a climate neutral Europe by 2050 (European Commission, n.d.a). In 2021, the European Commission presented its vision and the direction of Europe's digital transformation up to 2030, in which it proposes a so-called "Digital Compass" for the digital decade in the EU. This compass has four basic dimensions (European Commission, n.d.b):

- Skills – 20 million specialists in the field of information and communication technologies, equality between men and women, basic digital skills among at least 80% of the population.

- Digital transformation of businesses - instating technologies (75% of companies in the EU using Cloud / AI / Big Data); innovators (growth support for quickly developing businesses and financing to double the number of “unicorn-grade” businesses in the EU); in the later phase, over 90% of small and medium-sized enterprises will achieve at least a basic level of digital intensity.
- Secure and sustainable infrastructures – connectivity (Gigabit for everyone, 5G networks), cutting-edge semiconductors (doubled EU share in global production), data – Edge and Cloud (10,000 climate-neutral highly secure edge nodes), connectivity (first computer with quantum acceleration).
- Digitalization of public services – key public services 100% online, e-Health (access to medical records for 100% of citizens), digital identity (80% of citizens using digital identification).

Digital technologies should be a benefit to society and competitiveness in the long-term, and therefore they play a fundamental role in all EU policies while also receiving financial support. The Digital Europe program, which was adopted in April 2021, is the EU’s first financial instrument focused specifically on bringing technology to businesses and people. It aims to invest in digital infrastructure so that strategic technologies can help boost Europe’s competitiveness and green transition, as well as ensure technological sovereignty. The Horizon Europe and Connecting Europe Facility programs also allocate significant funds for the development of digital progress. The EU's plan for economic recovery demands that member states allocate at least 20% of the €672.5 billion Recovery and Resilience Facility to digital transition (European Parliament, 2022).

3 Methods

In this study, we focus on the relationship between composite indexes reflecting digital performance and productivity in member countries of the EU. There are different indexes of digital transformation, e.g. the Digital Adoption Index (DAI), Enabling Digitalization Index (EDI), Digital Economy and Society Index (DESI), European Index of Digital Entrepreneurship Systems (EIDES), Digitization Index (DiGiX), etc. Two composite indicators – DESI and EIDES – were chosen for our analysis, as they are not only some of the newest and most widely-used composite indexes at the EU level at present, but they also have a relatively sophisticated and well-described methodology. For the purposes of this study, productivity is measured via two indicators – GDP per capita and Total Factor Productivity. Data were obtained from the World Bank, namely GDP per capita; PPP (constant 2017 international \$) was collected from the World Bank database and transformed into a log for the purposes of the analyses. The TFP level at current PPPs was collected from the Penn World Table version 10.0.

The Digital Economy and Society Index (DESI) is composed of four primary components: Human Capital, Connectivity, Integration of Digital Technology and Digital Public Services. For its calculation, a total of 32 indicators were observed. EU countries are found to perform very differently in terms of having the digitalized framework conditions for entrepreneurship. Unfortunately, DESI does not sufficiently reflect this heterogeneity between individual countries, and therefore the need arose to seek out methods to measure both the physical and digital conditions for stand-up, start-up and scale-up ventures in the EU Member States. This led to the creation of the European Index of Digital Entrepreneurship Systems (EIDES), which responds to the need for a tool to better understand and appraise the extent of the digital entrepreneurial ecosystem. Specifically, EIDES is an attempt to measure both the physical and digital conditions for stand-up, start-up and scale-up ventures in EU countries and the UK. EIDES has a total of eight primary components: culture, informal institutions; formal institutions, regulation, taxation; market conditions; physical infrastructure; human capital; knowledge creation and dissemination; finance; networking and support. Over 110 indicators are entered into calculating this indicator.

With regard to the aforementioned facts and consideration to the relatively high linear dependency between DESI and EIDES (corr= 0,864), greater attention was paid to the EIDES indicator in the analytical section. As a supplement to this, the relationship between EIDES and the ability of individual EU member-state economies to transition was analyzed. At the same time, the ability to transition is captured by the Transitions Performance Index (TPI) indicator. This index measures a country’s transition to fair and prosperous sustainability. Relationships between composite indicators and productivity are captured using bivariate correlations. Furthermore, the strength of association is presented graphically using scatter plots.

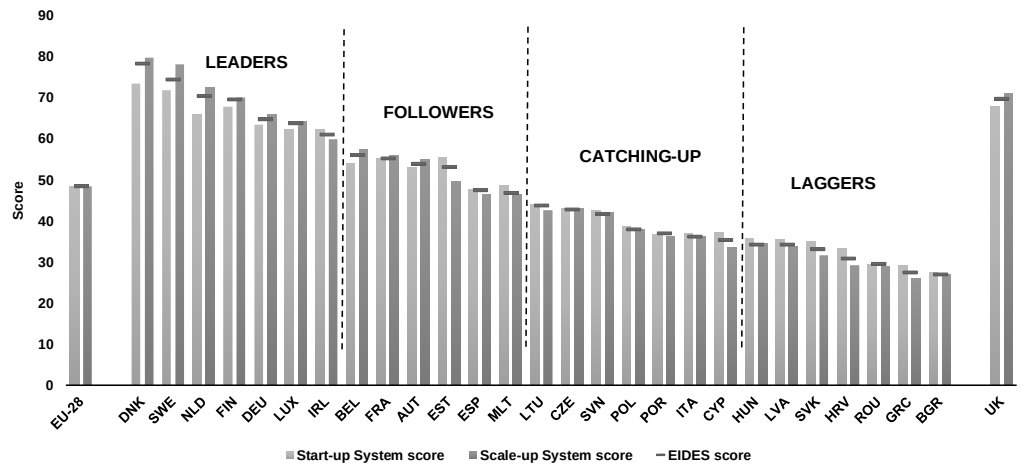
4 Research results

If we look at the Czech Republic in the last DESI report (European Commission, 2022b), we find that the strongest performance is in the dimension of Human Capital. Since 2017, the Czech Republic has made relatively solid progress in its overall DESI score, which grew slightly more than expected by convergence curve, meaning that its score improved

at a marginally higher pace than the score of the Union as a whole. Compared to 2021, the Czech Republic’s ranking improved in Digital Public Services and Connectivity but worsened in Integration of Digital Technology.

For market conditions, large countries tend to exhibit higher scores because of their larger domestic markets. However, Sweden, Denmark and Ireland stand out in spite of their smaller domestic markets, ranking alongside the UK and Germany. The Czech Republic is performing well in the Catchers-up group. For the Knowledge Creation and Dissemination pillar, Netherlands ranks on top, followed by Germany and the United Kingdom. The Czech Republic stands out among the bottom half of the pillar ranking (for more, see Autio et al., 2020). Figure 1 provides a summary of EU member states and their ranking into groups according to EIDES scores.

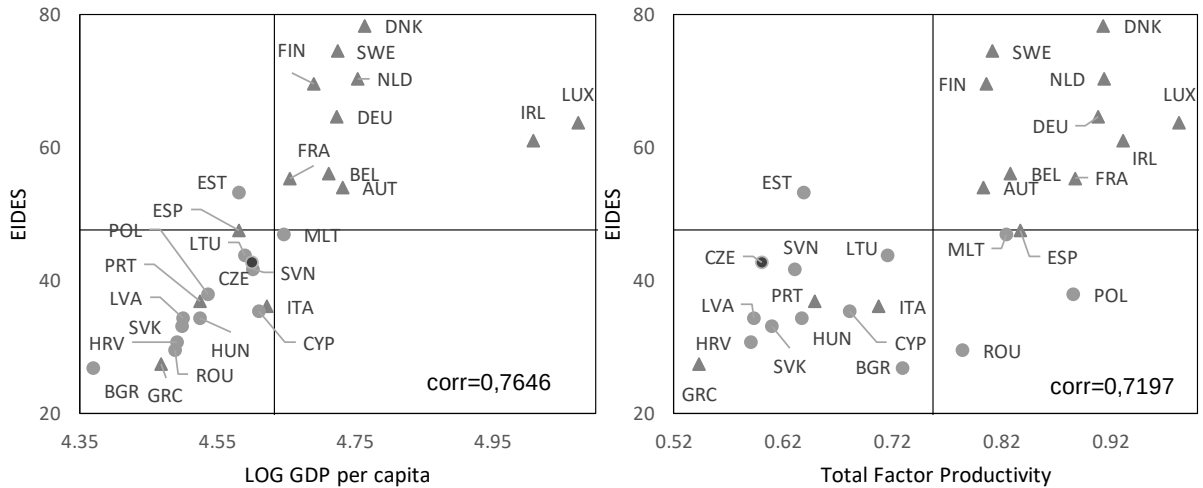
Figure 1 EIDES score by country, 2020



Source: based on data from Autio et al. (2020)

As was already mentioned, productivity and economic growth are important for boosting competitiveness, socio-economic development and tackling poverty. The relationship between digital performance and productivity is depicted using bivariate correlations between EIDES and GDP and total productivity cost – see Figure 2.

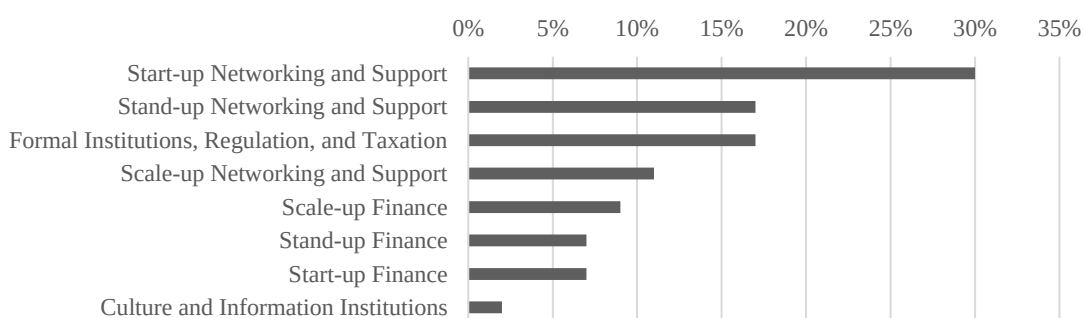
Figure 2 Bivariate correlations between EIDES and productivity



Source: based on data Autio et al. (2020) and World Bank (2022)

The figure shows the existence of a moderately strong linear dependency between EIDES and indicators representing productivity. According to European Commission (2022a), there is a secular stagnation in productivity growth despite the huge potential of the ICT revolution. This productivity puzzle is partly explained by increasing productivity polarization, declining business dynamism and the high cost of human capital for firms adopting new digital technologies. EIDES offers possible scenarios of policy optimization simulation: The allocation of additional resources among pillars to reach a 10% increase in EIDES score – see Figure 3.

Figure 3 The Czech Republic's policy optimization simulation: Allocation of additional resources among pillars to reach a 10% increase in EIDES score

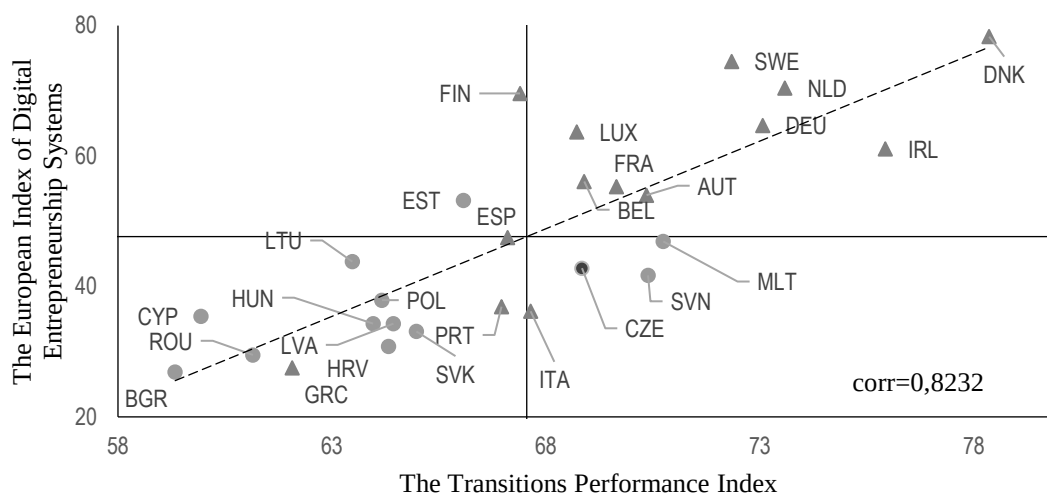


Source: based on data Autio et al. (2020)

It is advisable to allocate resources primarily to Networking and Support (start-up, stand-up and scale-up), i.e. to improve attitudes towards entrepreneurs, strengthen external support for start-ups and also support clusters and value chain development. Improvements in the state of formal institutions, regulation and taxation are also important for the Czech Republic, i.e. important formal institutions and tangible structural conditions (e.g. education level of the population; quality of regulations and entrepreneurship policy interventions; and the availability of resources for entrepreneurship) are important for entrepreneurial activity. Furthermore, the country should support automation, robotization and the use of digital technologies, which are factors targeted by the system program in the area of innovations called The Country for the Future, which is financed by the Czech Ministry of Industry and Trade.

In order for these changes to take place, it is also important to monitor the degree to which the economy is capable of moving towards being sustainable. The Transition Performance Index (European Commission, 2021b) was created in order to capture the ability to transition. The relationship between EIDES and TPI is depicted in Figure 4.

Figure 4 Bivariate correlations between EIDES and TPI



Source: based on data Autio et al. (2020) and European Commission (2021b)

The figure shows a relatively strong positive linear dependency between EIDES and TPI. The results of the TPI scores for the Czech Republic make it evident that it belongs to the group of countries in so-called “strong transition”. According to the European Commission (2021b) at the global level, the United Kingdom, Malta, Slovenia, France, Czech Republic, Italy, Japan and Estonia have room for improving their economic transition. There is also room for improvement in the Czech Republic in the area of Proportion of People with ICT Skills, and the country should also focus on heightening the ratio of women in ICT and women employed in the area of R&D, as the Czech Republic has one of the lowest ratios of female researchers among EU member states. Unfortunately, the Czech Republic has a relatively low output per worker. Generally speaking, the country should implement new elements on the labor market with the goal of solving the insufficient offer there – this primarily concerns adopting new digital technologies and utilizing shared work spaces or part-time work.

Exploring the relationships between digital transformation and economic growth is of fundamental importance, and for this reason a score of authors have devoted themselves to this research. For example, Aly (2020) confirmed a positive relationship between the digital transformation index and economic development, labor productivity and job employment. On the other hand, however, it is necessary to consider the time needed for technological progress to manifest itself in the growth of various economies, as pointed out by Park and Choi (2019).

5 Conclusions

Modern technologies have a fundamental effect on the development of the entire society, and it is therefore, necessary to examine their influence and to deal in particular with their impact on economic growth. The development of the selected composite index showed a shift in digitalization in the Czech Republic. Further calculations confirmed the positive relationship between digital performance and productivity. Therefore, it is possible to join the argument that digitalization and digital transformation are important factors enabling the acceleration of development and ensuring economies' growth and competitiveness.

The analysis clearly shows the existence of a moderately strong positive linear relationship between digital transformation and productivity. Despite the massive potential of the digital revolution, there is a secular stagnation in productivity growth. In addition to digital transformation, the economies of the EU should focus on their overall ability to transition, as economies that are successful in adopting new digital technologies and economic transitioning can successfully heighten their productivity. Opportunities are visible in the Czech Republic in the support and development of the following areas: attitudes toward entrepreneurs, strengthening external support for start-ups, and supporting clusters and value chain development. It is also important for the Czech Republic to improve the state of formal institutions, regulation and taxation. In terms of strengthening the economic transition, the Czech Republic should – in addition to adopting new digital technologies – focus on other possibilities of dealing with an insufficient work force on the labor market and also heightening the ratio of ICT employees while also taking the gender dimension into account.

Investments in new technologies and infrastructure, increasing digital competencies, and the development of innovation ecosystems, knowledge transfer and networking continue to be key prerequisites for developing the digital economy. However, for a successful transformation and further progress, it is no less important monitor and measure the digital performance of individual countries regularly and set possible recommendations for particular areas of digitalization for the future.

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References

- Aly, H. (2020). Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or a blessing? *Review of Economics and Political Science*. DOI:10.1108/REPS-11-2019-0145.
- Autio, E., Szerb, L., Komlósi, É., & Tiszberger, M. (2020). *EIDES 2020: The European Index of Digital Entrepreneurship Systems*, Nepelski, D. editor(s), Luxembourg: Publications Office of the European Union. DOI:10.2760/150797.
- Bleicher, J., & Stanley, H. (2017). Digitization as a catalyst for business model innovation a three-step approach to facilitating economic success. *Journal of Business Management*, 12, 62-71.
- Bloomberg, J. (2018). *Digitization, Digitalization, And Digital Transformation: Confuse Them at Your Peril*. Forbes. <https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/>
- Caputo, A., Pizzi, S., Pellegrini, M. M., & Dabic, M. (2021). Digitalization and business models: Where are we going? A science map of the field. *Journal of Business Research*, 123, 489-501. DOI:10.1016/j.jbusres.2020.09.053
- European Commission (n.d.a). *A Europe fit for the digital age. Empowering people with a new generation of technologies*. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en
- European Commission (n.d.b). *Europe's Digital Decade: digital targets for 2030*. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en
- European Commission. (2021a). *Shaping Europe's digital future*. <https://digital-strategy.ec.europa.eu/en/library/proposal-decision-establishing-2030-policy-programme-path-digital-decade>
- European Commission.(2021b). *Transitions Performance Index 2021*. <https://ec.europa.eu/assets/rtd/tpi/2021/index.html>

- European Commission. (2022a). *Science, Research and Innovation Performance of the EU 2022 Report*. https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/science-research-and-innovation-performance-eu-2022-report_en
- European Commission (2022b). *The Digital Economy and Society Index Report*. <https://digital-strategy.ec.europa.eu/en/policies/desi>
- European Parliament (2021). *Report on shaping the digital future of Europe: removing barriers to the functioning of the digital single market and improving the use of AI for European consumers*. https://www.europarl.europa.eu/doceo/document/A-9-2021-0149_EN.pdf
- European Parliament (2022). *Digital transformation: importance, benefits and EU policy*. <https://www.europarl.europa.eu/news/en/headlines/priorities/digital-transformation/20210414STO02010/digital-transformation-importance-benefits-and-eu-policy>
- Gartner's Glossary (2021). Digitalization. <https://www.gartner.com/en/information-technology/glossary/digitalization>
- Henriette, E., Feki, M., & Boughzala, I. (2015). The Shape of Digital Transformation: A Systematic Literature Review. *MCIS 2015 Proceedings*. Paper 10. <http://aisel.aisnet.org/mcis2015/10>
- Marszałek, P., & Ratajczak-Mrozek, M. (2022). Introduction: Digitalization as a Driver of the Contemporary Economy. In Ratajczak-Mrozek, M., & Marszałek, P. (Eds.), *Digitalization and Firm Performance*, 1-15. Palgrave Macmillan.
- Miethlich, B., Belotserkovich, D., Abasova, S., Zatsarinnaya, E., & Veselitsky, O. (2020). Digital economy and its influence on competitiveness of countries and regions. *Revista ESPACIOS*, 41(12).
- Olczyk, M., & Kuc-Czarnecka, M. (2022). Digital transformation and economic growth – DESI improvement and implementation. *Technological and Economic Development of Economy*, 28(3), 775–803. DOI: 10.3846/tede.2022.16766.
- Palacká, A., Krechovská, M., & Číž, J. (2021). Sustainability Concept in the Digital Age: New Opportunities for Companies. In *SHS Web of Conferences Volume 115 (2021) Current Problems of the Corporate Sector 2021*.
- Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing Literature on Digitalization, Business Model Innovation, and Sustainable Industry: Past Achievements and Future Promises. *Sustainability*, 11.
- Park, H., & Choi, S.O. (2019). Digital innovation adoption and its economic impact focused on path analysis at national level. *Journal of Open Innovation: Technology, Market, and Complexity*, 5(3), 56.
- Rachinger, M., Rauter, R., Müller, C., Vorraber, W., & Schirgi, E. (2019). Digitalization and its influence on business model innovation, *Journal of Manufacturing Technology Management*, 30(8), 1143-1160. DOI:10.1108/JMTM-01-2018-0020.
- TWI2050 - The World in 2050. (2019). *The Digital Revolution and Sustainable Development: Opportunities and Challenges*. Laxenburg, Austria: International Institute for Applied Systems Analysis.
- Vor dem Esche, J., & Hennig-Thurau, T. (2014). *German Digitalization Consumer Report*, Digitalization Think: Lab, Research Report No. 2.
- World Bank. (2016). *World Development Report 2016: Digital Dividends*. Word Bank Group.
- World Bank. (2022). *World Development Indicators*. <https://databank.worldbank.org/source/world-development-indicators>

Determinants of economic policy concepts within the implementation of the circular economy

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Abstract: The implementation of the circular economy, as an integral support for sustainable development, is the result of established economic policy in the macroeconomic and microeconomic dimensions. In its essence, the creation of the mentioned policy represents a mix of interlinked goals of economic, social, ecological, global, regional, etc.. For this reason, the basic initial determinants of the conceptual economic-political strategy lie mainly in the sociological and political aspects of the formation of society in developed market economies since the second half of the 20th century until the onset of Industry 4.0. From a sociological point of view, from the mentioned period, this society took on a whole range of attributes, such as consumer, informational, risky, etc. From a political point of view, the concepts of economic policy within the framework of the implementation of the circular economy represent the reduction of undesirable phenomena accompanying this social development. For the reasons cited above, the article is prepared with an interdisciplinary approach of economics, economic policy theory, sociology and political science.

Keywords: circular economy, sustainable development, economic policy, economic growth

JEL Classification: A14, B41, Q01

1 Introduction

The implementation of the circular economy is undoubtedly a phenomenon that has gained popularity together with the environmental movement and also the requirements for the protection and creation of the environment. The importance of the implementation of circular technologies is fully in the context of sustainable development in the period of the onset of the Industry 4.0 era. In this era, it is certain that the desired economic growth also brings with it dark sides, such as the pressure to obtain new raw materials. Therefore, one of the priorities of sustainable development is to solve the growing amount of waste, the devastation of nature, and the waste of energy resources. A paradigm shift can be brought about by the application of the principles of a circular economy, where waste is perceived as a resource. In this context, the circular economy represents a concept that can work better not only with valuable materials, but also uses shared services and new consumption models that reduce pressure on primary resources. Its essence lies in technological applications within the framework of connecting material flows and maintaining their value in the cycle for as long as possible. Following the example of natural ecosystems, it proposes closing material flows in functional and never-ending cycles, drawing energy from renewable and sustainable sources and creating sustainable products and services. Materials that would thus become waste in the existing linear economy are reused or recycled.

In this way, the circular economy contributes to the quality growth of the environment and human life by increasing the efficiency of production. According to the concept of sustainable development, the implementation of circular technologies represents an effect in three dimensions: economic, ecological and social (Androniceanu, Kinnunen & Georgescu, 2021). In this way, it fulfills several positive goals of all interested economic entities, so its focus is multifunctional. Therefore, it is the subject of theoretical interest of social economy, which also focuses on issues of protection and creation of the environment in its main areas. In practical activities, the implementation of circular

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technologies across sectors and areas of life is based on the theoretical concept of the state's economic policy in the macroeconomic and microeconomic (within enterprises, sectors, municipalities, etc.) dimensions.

2 Methods

Today's society is affected by the phenomenon of consumerism probably like never before. Consumption has expanded from the area of material goods to the area of intangible goods. At the same time, the consumptive way of life has penetrated the interior of people who already live, think and exist consumptively. Is the consumer lifestyle a threat to society or, on the contrary, a means to its improvement and further development? Answers are sought for this question. Consumption is analyzed and evaluated from several interrelated perspectives. It is an economic, sociological, philosophical and ecological point of view. Certain answers can be found in the implementation of the circular economy. Its concept, in support of sustainable development, arose as a reaction to the significant uncontrollable dynamics of the linear nature of material flows in almost all areas of production. The paradigm shift in its implementation represents a concept that can work better not only with valuable materials, but also uses shared services and new consumption models that reduce pressure on primary resources.

For these reasons, the use of methods of analysis, comparison, synthesis and generalization prevails in the process of understanding the reality of observed phenomena and processes within the paradigm change. The interdisciplinary approach of social sciences and humanities (especially economics, economic policies, sociology, political science of ecology) is also applied to the current development trend of implementing the circular economy in connection with the emerging era of Industry 4.0.

3 Research results

3.1 Sociological factors to the challenges of circular economy implementation

Since roughly the 1960s, the social space of Western economies has been characterized by the adjective "post-industrial". This means the phase of social development, for whose economy the main input and benefit is no longer from the secondary economic sector, but from the tertiary sector, which is mainly services (Gershuny, 2003). The very name post-industrial evokes some progress after the industrial phase, where it was mainly about the mass production of goods. Subsequently, this company acquires other attributes, namely consumption and risk.

If it is a consumer society, its second wave dates from the early 1980s, and from the mid-1990s, the phenomenon of globalization entered the mentioned way of life of the society, which to a certain extent facilitated the population following this way of life in their consumption habits on a global scale. To a certain extent, it can be stated that the consumer society arises at the moment when the problem ceases to be how to produce products, but how to get people to consume them (Lipovetsky, 2007).

From an economic point of view, the consumption type of society is characterized by an excess of supply over demand. It is not a problem for businesses to produce and deliver a large amount of commodities to the market, but to sell this amount. Mass production is beneficial for companies, because in a large number of products they can more easily minimize fixed costs, which would unnecessarily increase the price of the final product. The stage of overproduction is followed by the stage of massaging the public (potential consumers) with advertising campaigns, a well-thought-out marketing strategy and other persuasive practices. In this way, competition operates on the market along the lines of identical, substitutable and completely interchangeable commodities. The advantage for producers is the fact that consumers have the ability to consume more than they actually need, so they often do not examine their consumer willingness, but what quantity of products they can bear (volume discount sales strategy). The mentioned type of society is diagnosed by the Norwegian social anthropologist Thomas Hylland Eriksen with the "big wolf syndrome", which is voracious and greedy (Eriksen, 2010). In these contexts, one can see the dysfunctional signs of a consumer society on the quality of life, which is related to the production of waste as a by-product of consumption. Thus, consumerism is "a vain society, oriented exclusively to "beautiful appearance" and fast consumption," it plunders nature, and in the end, like a boomerang, its very products return to it - in the form of waste - in which it drowns and - drowns (Goodwin, Nelson, Ackerman & Weisskopf; 2008).

When following the development of a risky society, one can start from historical sciences, which will confirm the considerable courage and riskiness of human existence in all epochs of social development to date. On the basis of interdisciplinary analyzes of the social sciences and humanities within the framework of the investigation of the processes of the creation and development of civilization and culture, it can be stated that all the risks of human existence have been woven primarily into the biological dispositions of man and subsequently into his socialization since the beginning of civilization (Šetek & Petrách, 2017). A clear proof of this is the results of the development of industrial society since the last third of the 18th century, when the production of wealth is linked to increasing risks. This trend prevails even with the onset of the era of Industry 4.0 technologies in the second decade of the 21st century. In essence, this is a new phase

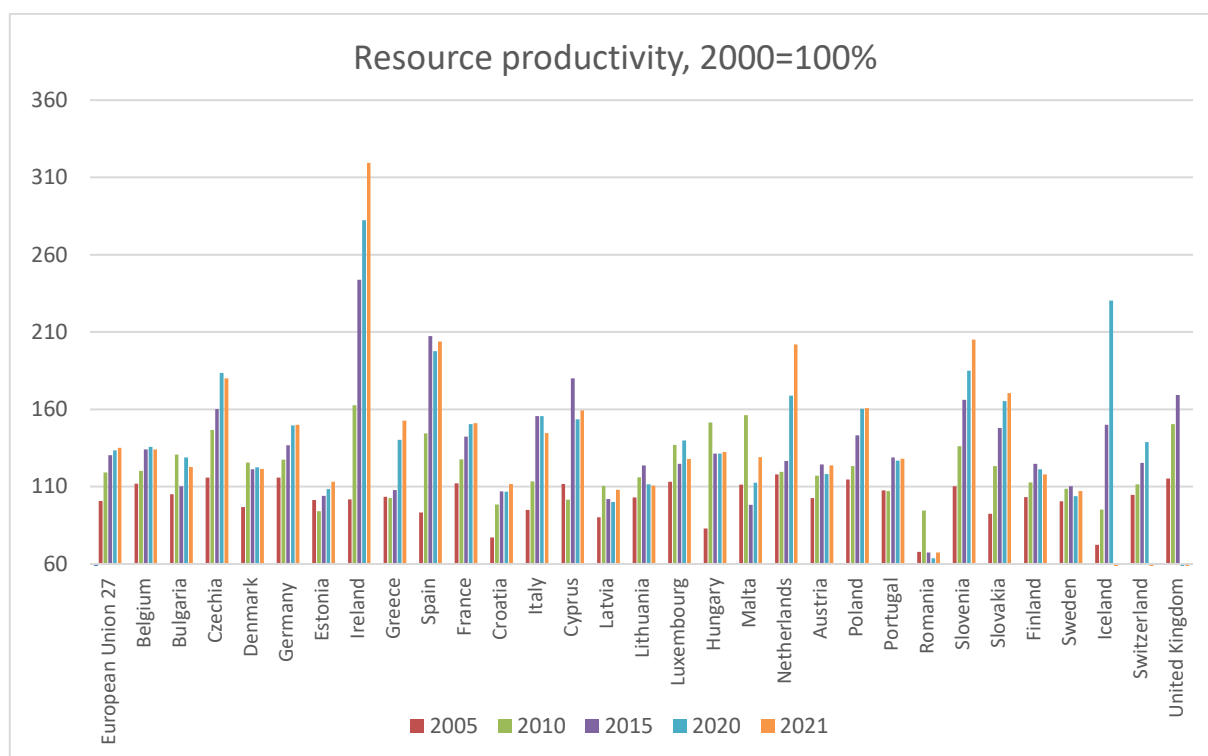
of industrialism, where the dimension of consequences and danger comes into conflict with institutionalized criteria (Jarvis, 2007). As a result, institutions fall into a bizarre contradiction, on the one hand acting as guarantors of security, but on the other hand legalizing practices that are covertly or openly disastrous. In this type of society, risks and dangers are externalized, individualized, trivialized and morally pacified (Krahmann, 2011). They stand out from the authorities and institutions at the expense of individuals, nature itself and future generations. An institutionalized view of the world, modernization and the advancement of technology lead to a separation of the world of institutions from the natural world of people, with the "society of individuals". Risks and dangers go beyond the institutionalized regulatory system; the expression of this is the ecological crisis, the collapse of rationality.

Thus, despite all its strained rationality, industrial society produces its opposite - an irrational threat to man and nature. This gives it another adjective "risky". This is a situation operating across the institutional boundaries of politics and economics. The essence of accompanying risks lies in the secondary externalized consequences of production, research, development and innovation falling under the responsibility of politics, not economics (Sørensen, & Christiansen, 2012). The economy is therefore irresponsible for what it causes. Politics is responsible for that over which it has no control, but it is still ascribed responsibility for the secondary consequences of economic processes. The essential fact of this central contradiction is precisely how and by whom risks are defined – these definitions of risk activate responsibility, not to obscure them, but rather to use them to regain and strengthen democratic and parliamentary influence.

3.2 Circular economy as an integral part of the sustainable development strategy

The concept of a circular economy within the rational use of natural resources consists in environmental protection, which has been a government economic policy strategy in developed countries since the 1960s. In its essence, it is also an appropriate reaction to the above-mentioned type of consumer and risky society. A significant impetus to environmental protection activities came from publications that dealt with human impact on the environment and predicted catastrophe caused by the complete depletion of resources or excessive pollution. These include *Silent Spring* (Carson, 1962), *The Population Bomb* (Ehrlich, 1968) and especially the *Limits to Growth* report of the Club of Rome (Meadows & Randers, 2012), which drew attention to the conflict between limited resources and exponential economic and population growth.

Since the above-mentioned period, ecological issues have fundamentally become an interdisciplinary thematization of the relationship between society and the environment, nature and lifestyle, and the associated possible social, political and economic consequences of ecological problems. In this way, a link was created between the economy and the environment, from which raw material resources enter the economy and serve as a repository for the generated waste. In this context, a relatively new field of environmental economics emerged. The aforementioned field usually perceives the level of environmental protection and economic growth as contradictory quantities, where in order to support one, the other must be reduced. However, there are also various currents of thought that differ in their understanding of the environment and in the recommended tools for its protection, and this is precisely the circular economy (Jonášová, 2018). Its essence lies in technological applications within the framework of connecting material flows and maintaining their value in the cycle for as long as possible. Materials that would thus become waste in the existing linear economy are reused or recycled. In order for the implementation of the mentioned technologies to be possible, it is necessary to take these facts into account already in the design and production phase.



Source: Eurostat, 2022

Improving resource productivity is a path to reducing environmental impacts as well as a path to relative independence of growth and resource extraction. As shown in Fig. Resource productivity in a time horizon of 20 years, in the case of all member countries, it is not possible to talk about its permanent growth, even if a definite trend is visible. Nevertheless, the productivity of resources grows much more slowly than, for example, the productivity of labor and energy inputs.

3.3 The principle of decentralization in the framework of the economic policy decision in the dislocation of circular technologies

It is waste, as a part of renewable resources, whose properties are particularly suitable for the decentralized production of energy commodities (mainly electricity and thermal energy), which, of course, requires more of their construction near settlements. This leads to the inevitable interaction of the investor with local businesses and residents. For this reason, the dislocation of circular technologies within the region depends on the technology of local industrial and agricultural business entities on the one hand and consumers on the other. It is therefore not possible to think in the dimensions of a circular economy if the pace of resource extraction creates uncertainty for future generations as to whether they will be able to exist within the same production and consumption parameters as in the present (Velenturf, Archer, Gomes, Christgen, Lag-Brotons, & Purnell; 2019). For that reason, it is necessary to use the energy of renewable sources, which also includes the potential of waste, which under other conditions would represent a source of environmental devastation. From the point of view of the region's economic policy, it depends on strategic decisions on the choice and deployment of appropriate circular technologies for the energetic and ecological use of waste.

When talking about decentralization, one can think of different areas of life in society. It can be about the decentralization of political power, production and economic processes, institutions, etc.. It is logical, because the development of industrial technologies and the accumulation of capital represents the "vanguard" of the accelerated movement of modern societies and their direction. Perhaps the most significant of the social sciences with their knowledge in this "construction of a new world" is the economics field (Egorov & Harstad, 2017). This confirms many theoretical concepts. It is a theory of free markets, which, according to Friedrich August von Hayek, represent decentralized systems whose results are shaped without the explicit agreement of those who are guided primarily by prices (Hayek, 1993). Then, for example, the economic historian Gabriel Kolko claims that in the middle of the 20th century, due to the constant entry of new competitors into the market, businesses were highly decentralized and competitive, thereby preventing their monopolization (Kolko, 2008). The term "appropriate technology" according to Erich Friedrich Schumacher cannot be neglected, when it is a generally recognized term for powerful, energy-efficient, environmentally friendly and, above all, decentralized technology (Schumacher, 2000). The use of "appropriate technology" means the alternative of transferring capital-intensive technologies from developed countries to less developed ones (Holub, 2007). In the last twenty years of the 20th century, one can see reflections on decentralization movements within the framework of futurological studies of

the studio (Toffer, 1990; Naisbitt, 1992), when the key topics were mainly ecological issues. It is logical, since many of the ecologists' arguments for decentralization refer to the model that the organization of biological systems represents for the organization of a prospective human society. Therefore, the most common argument with biological analogies is based on the principle of species diversity, i.e. diversity applied within the framework of management (Grant, 2012).

Based on the theoretical concepts cited above, decentralization is always a response to the problems of large centralized systems. For example, the typical process of decentralization after the collapse of centrally planned economies since the early 1990s aims to solve problems such as a decline in economic performance or the need for citizens to have a greater share of participation in local politics. For this reason, the decentralization process involves changing established procedures, structures and practices so that the government is more interested in the costs and benefits of its decisions, it is not just a transfer of some power from the central government to the regional governments. In the spirit of these facts, four basic goals of decentralization can be formulated:

1. Participation is associated with the participation of a wider range of individuals in decision-making, democracy, equality and the transfer of powers from central authority to local authorities.
2. Diversity, when the participation of diverse political opinions, civic groups, etc., leads to better decisions than the central authorities would be able to make on the basis of limited information.
3. Efficiency lies in the elimination of excessive bureaucracy, thereby enabling faster responses to solving unexpected problems and improving awareness of local problems. However, decentralization is more effective if its components are not too complex (capable, intelligent).
4. Solving a conflict situation (Hegewisch & Larsen, 1996).

There are different ways of starting the decentralization process. It can be initiated from the center of power - top-down or from individuals or regions bottom-up (Chandler, 1956). A special case is the so-called type of mutually desirable decentralization, where the central government works in cooperation with the regions. In this context, we can also talk about the application of the constructive principle of subsidiarity, from the point of view of the conceptual content and reflection of the integration tendencies of the circular economy and regional policy. The aforementioned principle is therefore necessary for the regulation of the division of powers between the central and regional levels. Within the framework of decision-making on the dislocation of circular technologies, respect for the aforementioned principle guarantees the degree of independence of a lower authority in relation to a higher authority, i.e. regional political representation in relation to the central government.

3.4 The position of economics in the dispute of economic growth within circular implementations

The economies of all current successful countries have a market character. Some of the prerequisites for the successful functioning of market mechanisms are also prerequisites for effective environmental protection, such as a clear definition of ownership rights and obligations. In other cases, however, the market fails in this regard. For many services and goods provided by the natural environment and natural resources, the market does not exist at all (or only works imperfectly), so it cannot lead to an adequate price, and natural resources are undervalued. It is also unable to include in prices (internalize) external costs caused by environmental damage. In these cases, it is necessary to apply certain measures on the part of the state, leading, for example, to the application of the "polluter pays" principle. Using environmental fees or taxes, based on this principle, the external costs of preventing or eliminating environmental damage are internalized (Bag, Sahu, Kilbourn, Pisa, Dhamija & Sahu, 2021).

Any even slightly informed interpretation of sustainable development will certainly not fail to emphasize that among its several basic dimensions is the economic dimension. Nevertheless, one still occasionally hears of the dispute between "economy" and "ecology". In fact, the authors of such words have in mind either the old dispute between economic growth and the protection of the environment and nature, or even more, the dispute between two specific social groups, between "ecologists" and "economists". Economists are most often considered economic theorists, practical politicians working in this area or representatives of various economic activities. Within the concept of sustainable development, there is no theoretical dispute between ecological and economic principles. Many economists, on the other hand, contributed significantly to the development of this concept. A typical example is John Hicks, who in his classic definition of income as "the maximum amount a person can consume in a week and still be as well off at the end of the week as at the beginning" (Hicks, 1946) gets straight to the point: income based on capital spending is not sustainable and therefore cannot be considered income at all (Hicks, 1946). One of the goals of sustainable development is generally considered to be the achievement of "healthy", "sustainable" or "clean" economic growth.

Economic growth, as a key objective of any macroeconomic economic policy, reflects an increase in the level of gross domestic product. It is a necessary condition for permanent sustainability. However, it is necessary to ask yourself a few

questions. Is continued economic growth possible? Is this growth desirable even if possible? In the search for answers to the above questions, the elementary question here is whether economic growth automatically leads to an increase in well-being. Within the framework of general post-materialism in advanced market economies, a tendency to emphasize the importance of other goods is beginning to show, where the quality of the environment takes precedence. It is logical because one of the important qualities of a comprehensively understood standard of living is precisely the quality of the environment, which the contemporary growth indicator does not take into account (Graczyk-Kucharska, 2021; Hofmann, 2022). The traditional enumeration of the gross domestic product has a limited explanatory power, as it does not allow expressing the "ecological demand" of economic growth.

The growth of the gross domestic product should therefore condition the growth of well-being, however, reality shows that the correlation between this indicator and the mentioned phenomenon is not very close (Serageldin, 1996,a). Much of what creates well-being is not captured by the indicated indicator, and on the contrary, a number of items that tend to reduce well-being are included in it. Clear proof of this is the situation in developed market economies at the end of the 20th century, when there was permanent economic growth, however, the indicator of net economic well-being showed a rather stagnant tendency (Serageldin, 1996,b). Meadows' book from the early 1970s already proves the long-term unsustainability of economic growth based on the extensive use of resources regardless of environmental impacts (Meadows & Randers, 2012). However, the current nature of economic growth is still induced by an increase in the consumption of almost all non-renewable and renewable resources.

Based on the above facts, the question arises about the required standards of "healthy" economic growth. When searching for answers, it is necessary to free ourselves from purely economic thinking about the meaning of achieving an annual increase in the quantity of goods produced. It is therefore not only about growth in the sense of quantity, but also of quality. Not every growth associated with a higher material level is necessarily positive growth. For this reason, an approach to its alternative definition, i.e. growth as a means of effective environmental protection and elimination of inequalities, is also necessary. In these contexts, it is necessary to take into account the fact that the costs of eliminating ecological damage and the damage itself cannot contribute to increasing economic growth and this is not necessarily associated with a parallel depletion of resources or an increase in pollution (Serageldin, 1996,a). The experience of the most developed countries proves that a high degree of ecosystem protection does not limit economic growth, provided certain conditions are met. Empirical studies prove that the higher the share of gross domestic product per capita, the lower the negative effects on the environment per unit of gross domestic product. One of the conditions can be identified as the process of structural changes that weaken the role of ecologically demanding industries and thereby contribute to an absolute or relative decrease in ecological devastation.

Based on the facts mentioned above, it can be concluded that long-term economic growth and environmental protection are not opposing elements (Bauwens, 2021), but rather parts of one system that must be perceived as mutually complementary and not confrontational. There is no compelling good reason why sufficient environmental protection should be rejected because of the negative effect on economic growth. It must also be accepted that the level of the environment is a limiting factor in ensuring economic growth in any conditions, and its protection is not an inefficient expenditure of human, material and financial resources, but rather an expression of belief in a better future.

4 Conclusion

Proponents and opponents of the implementation of circular technologies as part of a sustainable development strategy usually differ in how they evaluate the macroeconomic effects of environmental measures. In particular, the opponents argue that the effects of strict regulatory instruments in particular necessarily limit the overall economic performance and especially the competitiveness of the industry. However, actively promoting the implementation of the circular economy is all the more difficult, as it has to compete for the "spot in the limelight" of attention in sharp competition with other problems that humanity is currently facing. In the global dimension, these are mainly war conflicts, natural disasters and other related economic problems of the national and global economy. It is logical, as the mentioned problems are directly transferred to national dimensions (e.g. price growth of energy commodities and subsequent inflationary development in connection with war actions in Ukraine after February 24, 2022), etc.. In this respect, however, it is already possible with satisfaction at least to state that issues of sustainable development are already a completely legitimate element of a whole series of important negotiations at the world level, therefore we can speak of the emergence of a global environmental policy. This also brings appropriate incentives for applied economic policy in the area of circular economy implementation. In order to achieve economic growth labeled as sustainable, it will be necessary for one part of humanity to give up its current advantages in favor of the disadvantaged. Enforcing these changes will require enough political will to solve the problems and implement sustainable principles into real economic realities. Economic growth in accordance with the concept of sustainable development is not an unrealistic demand.

On the basis of the facts cited above, it is certain that, within the framework of economic theory, the assessment of economic progress and development on the basis of traditional macroeconomic criteria will probably gradually be abandoned, when some will probably lose their importance or be supplemented by other indicators. The subject of criticism can primarily be the gross domestic product, whose increasing growth can also be caused by extremely adverse environmental events and the necessity to eliminate their consequences. Another similar example can be labor productivity, it may turn out that "material", "spatial" or "energy" productivity is more important than human labor productivity.

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References

- Androniceanu, A., Kinnunen, J., & Georgescu, I. (2021). Circular economy as a strategic option to promote sustainable economic growth and effective human development. *Journal of International Studies*, 14(1).
- Bag, S., Sahu, A. K., Kilbourn, P., Pisa, N., Dhamija, P., & Sahu, A. K. (2021). Modeling barriers of digital manufacturing in a circular economy for enhancing sustainability. *International Journal of Productivity and Performance Management*.
- Bauwens, T. (2021). Are the circular economy and economic growth compatible? A case for post-growth circularity. *Resources, Conservation and Recycling*, 175.
- Carson, R. (1962). *Silent spring*. 25th ed. Boston: Houghton Mifflin Co.
- Egorov, G. & Harstad, B. (2017). Private Politics and Public Regulations.. *Review of Economic Studies*, 84 (4), 1652-1682.
- Ehrlich, P. R. (1968). *The population bomb*. Ballantine, New York.
- Eriksen, T. H. (2010). Syndrom velkého vlka. *Hledání štěstí ve společnosti nadbytku*. Brno, Doplněk.
- Gershuny, J. (2003). *Changing times: Work and leisure in postindustrial society*. Oxford University Press on Demand.
- Goodwin, N., Nelson, J. A., Ackerman, F., & Weisskopf, T. (2008). Consumption and the consumer society. *Global Development and Environment Institute*, 126.
- Graczyk-Kucharska, M. (2021). Human Resources Responsibilities in Logistic System of Waste Management for Sustainable Growth and Circular Economy. *European Research Studies*, 24, 221-233.
- Grant, C. (2012). Analogies and links between cultural and biological diversity. *Journal of Cultural Heritage Management and Sustainable Development*.
- Hayek, F. A., (1993). Principy liberálního společenského řádu. In JEŽEK, Tomáš (ed.). *Liberální ekonomie. Kořeny euroamerické civilizace*. Praha: Prostor, 1993a, 77- 93.
- Hegewisch, A., & Larsen, H. H. (1996). Performance management, decentralization and management development: local government in Europe. *Journal of Management Development*.
- Hicks, J. R. (1946). Value and capital, 1939. *Mathematical Appendix*, 311312.
- Hofmann, F. (2022). Circular Economy and economic (de-) growth? Let's shift the baselines!. *Resources, Conservation and Recycling*, 187, 106604.
- Chandler, A. D. (1956). Management decentralization: An historical analysis. *Business History Review*, 30(2), 111-174.
- Jarvis, D. S. (2007). Risk, globalisation and the state: A critical appraisal of Ulrich Beck and the world risk society thesis. *Global society*, 21(1), 23-46.
- Jonášová, S. (2018): About circular economy not only in the Czech Republic. In: *Circular Czech Republic. Circular economy as an opportunity for successful innovation of Czech companies*. Praha. Institut cirkulární ekonomiky, 25 - 27.
- Kolko, G. (2008). *Triumph of Conservatism*. Simon and Schuster.
- Krahmann, E. (2011). Beck and beyond: Selling security in the world risk society. *Review of international studies*, 37(1), 349-372.
- Lipovetsky, G. (2007). *Paradoxní štěstí: esej o hyperkonzumní společnosti*. Prostor.
- Naisbitt, J. (1992). *Global Paradox: The bigger the word economy, the more powerful smallest players*. AvonBooks.
- Meadows, D., & Randers, J. (2012). *The limits to growth: the 30-year update*. Routledge.
- Resource productivity. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/cei_pc030/default/table?lang=en
- Serageldin, I. (1996, a). Sustainability and the wealth of nations: First steps in an ongoing journey.
- Serageldin, I. (1996,b). Sustainability as opportunity and the problem of social capital. *The Brown Journal of World Affairs*, 3(2), 187-203.
- Schumacher, E. F. (2000). *Malé je milé, aneb: Ekonomie, která by počítala i s člověkem*. Brno: Doplněk.

- Sørensen, M., & Christiansen, A. (2012). *Ulrich Beck: An introduction to the theory of second modernity and the risk society*. Routledge.
- Toffler, A. (1990). *Future Shock*. New York: Bantam Books.
- Šetek, J. & Petrách F. (2017). *National Security in the Context of Global Economy*. 17th International Scientific Conference Globalization and Its Socio-Economic Consequences. Rajecké Teplice, Slovak republic. 2315-2323.
- Velenturf, A. P., Archer, S. A., Gomes, H. I., Christgen, B., LAG-Brotons, A. J., & Purnell, P. (2019). Circular economy and the matter of integrated resources. *Science of the Total Environment*, 689, 963-969.
- Eurostat, 2022.

Impacts of COVID-19 on customer behavior along green logistics operations: A conceptual framework

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Abstract: Numerous studies evaluated how customer behavior has changed during the COVID-19 pandemic. There have been no studies on the impacts of the Covid-19 pandemic on green logistics operations in the Vietnam context, this study aims to fulfill this gap by exploring the reasons for fundamental change. The main results of this research are a) a literature review in microeconomics and green logistics operations are examined; b) a conceptual framework and its hypotheses to survey the impacts of covid-19 on consumer behavior along with green logistics operations to strengthen the Vietnam economy during and after the pandemic, are developed. The future research agenda is outlined to use structural equation modeling to evaluate and validate the proposed hypotheses of the model.

Keywords: consumer behavior, covid-19, logistics, microeconomics, structural equation modeling

JEL Classification: C12, C83, D00, D01, L80

1 Introduction

Due to the extensive economic integration, the Vietnamese economy was heavily affected by the COVID-19 pandemic but also exhibited considerable resilience. What makes the difference in Vietnam?

The context of Covid-19 and anti-epidemic efforts have formed resilient Vietnamese consumers who are optimistic about the economy. Although, the GDP growth for 2020 at 2.91%, the lowest outturn in at least two decades and far below the 6.76% average during 2015 - 2019, despite the unpredictability of the global economic and political situation, which harms the socioeconomic development of the majority of nations, Vietnam's socioeconomic position in the first half of 2022 still showed rather encouraging results in a variety of disciplines. In comparison to other nations in the region and throughout the world, the economy's growth rate of 6.42% is impressive. Other positive economic indicators include macroeconomic stability and inflation which are kept under control. Essential goods supply and demand were ensured².

However, the socio-economic situation in Vietnam still has a lot of problems, notwithstanding the successes. Although the Covid-19 epidemic has been controlled in Vietnam, with new variants, there may be complicated developments in the world. In addition, the global economy grew less quickly due to supply chain disruptions, high costs for essential goods, rising global inflation, the energy crisis, etc. As a result of its extensive openness, the Vietnamese economy nevertheless faces many challenges and is impacted in a variety of ways by the complex and unpredictable global political environment.

Different from the stability of macroeconomics, this study surveys the impact of covid-19 on the changes in microeconomy factors such as consumer preferences or behavior. Evaluating how customer satisfaction has changed during the COVID-19 pandemic is one of the most interesting topics on COVID-19. Numerous studies addressed this problem (Addo et al., 2020; Baicu et al., 2020; Ahmed et al., 2021; Bae and Chang, 2021; Brandtner et al., 2021; Prasetyo et al., 2021). For example, Brandtner et al. (2021) focused on understanding the impact of COVID-19 on the customer end of retail supply chains in Austria. Prasetyo et al. (2021) determined factors influencing customer satisfaction and loyalty during the new normal of the COVID-19 pandemic in Indonesia. Baicu et al. (2020) deployed research on the impact of the COVID-19 crisis on consumer behavior in Romania. Ahmed et al. (2021) investigated the context of the COVID-19 pandemic, and its consequences for employee unproductive behavior at work were examined. Bae and Chang, (2021) highlighted “untact” tourism as a health-protective behavior stemming from individuals’ perceptions of COVID-19 risk.

The research gap is that has no studies on the impacts of the Covid-19 pandemic on green logistics (GL) operations in the Vietnam context, this study fulfills this gap and develops a conceptual framework to survey the impacts of covid-

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² <https://www.gso.gov.vn/en/data-and-statistics/2022/07/press-conference-to-announce-the-socio-economic-situation-in-the-2nd-quarter-and-6-months-of-2022/>

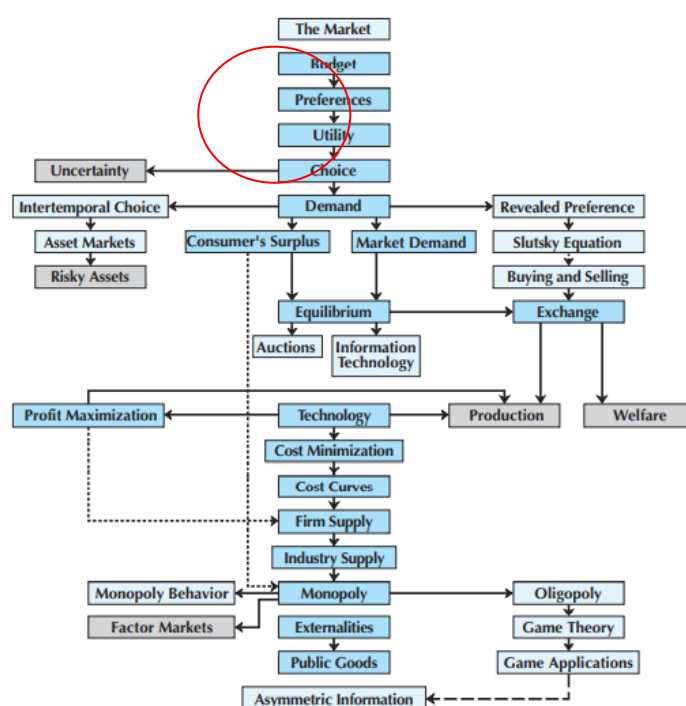
19 on the consumer preferences and behavior along green logistics operations to strengthen the Vietnam economy both micro- and macro-metrics.

2 Literature Review

2.1 Microeconomics background

There are many paths to economic enlightenment (Variant, 2014). A good grasp of microeconomics is vital for decision-making. Microeconomics deals with the behavior of individual economic units including consumers, workers, investors, and enterprises. It reveals how industries and markets operate and evolve, why they differ from one another, and how they are affected by government policies and global economic conditions. By contrast, macroeconomics deals with aggregate economic quantities, such as GDP, unemployment, and inflation. This study focuses on the core of microeconomics - the behavior of consumers, including customer preferences, budget constraints, and customer choices (see Figure 1), that is the basis for the analysis of green logistics operations in Vietnam's economy.

Figure 1 The core modular structure of microeconomics



Source: Varian, R. H. Intermediate Microeconomics a Modern Approach. 9th revised edition, 2014

2.1.1 Customer preferences

It is a practical way to describe the reasons people might prefer one goods to another. To understand the preferences, we try to answer some questions.

How can a consumer with a limited income decide which goods and services to buy? How a consumer might compare different groups of items, namely, the market basket, available for purchase? Will one basket be preferred to another basket, or will the consumer be indifferent between the two baskets?

Moreover, how does one customer's demand also depends on the demands of other people? It would be improved if we incorporated more realistic and detailed assumptions regarding human behavior. It is the objective of the new field of behavioral economics (Variant, 2014).

2.1.2 Budget constraints

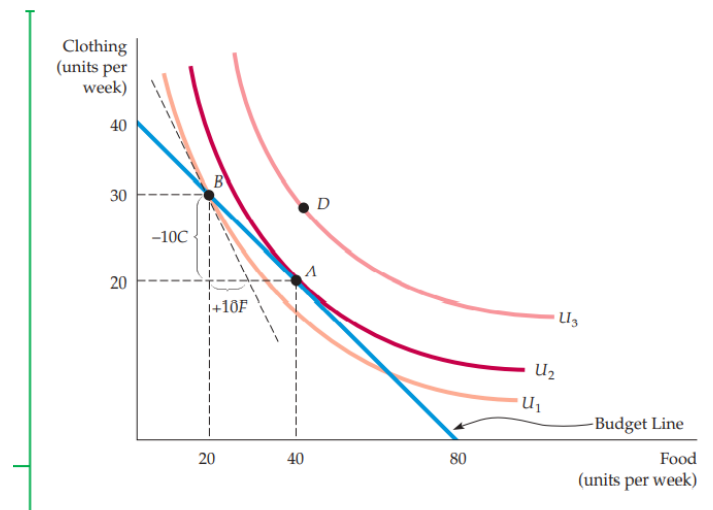
The next concern is the budget. Consumers also consider prices due to limited incomes which restrict the number of goods they can buy. What does a consumer do in this situation? Answering this question by putting consumer preferences and budget constraints together in subsection 2.1.3.

2.1.3 Customer choices

Given their preferences and limited income, consumers choose to buy combinations of goods that maximize their satisfaction. These combinations will depend on the prices of various goods. Thus, understanding consumer choice will help us understand the demand on how the quantity of a good that consumers choose to purchase depends on its price.

To understand, for example, a consumer has an income of \$80 and considers a market basket of food and clothing with unit prices of \$1 and \$2, respectively. The number of clothing and food in baskets A, B, and D is (40; 20), (20; 30), and (42; 28) correspondingly. Figure 2 illustrates the solution to the consumer's choice.

Figure 2 Consumer satisfaction optimization

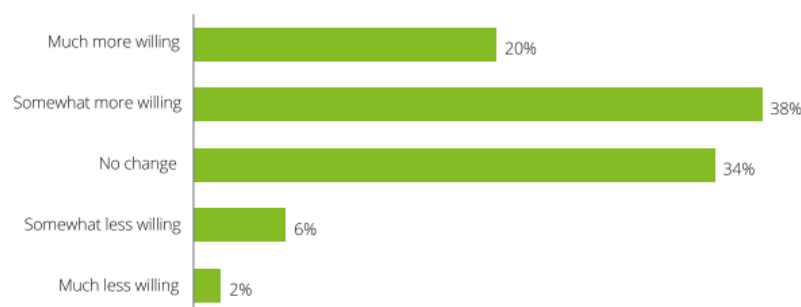


Source: Pindyck S. Robert, Rubinfeld L. Daniel. Microeconomics. 9th edition, USA, 2013

Here, the blue line describes the budget. And three indifference curves (u_1 , u_2 , and u_3) describe a consumer's preferences for food and clothing of B, A, and D baskets, respectively. It is easy to define that point B is not the most preferred choice because a reallocation of income in which more is spent on food and less on clothing can increase the consumer's satisfaction. At point A, its basket located on u_2 that is on the right and above the u_1 , the consumer spends the same amount of money and achieves the increased level of satisfaction associated. In addition, basket D in u_3 achieves a higher level of satisfaction but cannot be purchased because it is out of budget. Therefore, the customer chooses basket A for maximizing satisfaction (Pindyck & Rubinfeld, 2013).

On the other hand, Meng & Oka, (2021) surveyed the impact of the Covid-19 pandemic on Vietnam's consumer behavior. It is evident that with increasing customer preferences for green information technology such as e-commerce or online channels, the results show clearer signs of a shift from traditional commerce to online channels (see Figure 3).

Figure 3 Willingness to make online purchases of necessities and fresh products as a result of COVID-19



Source: Deloitte's Vietnam Consumer Survey (2020)

The survey also showed that there are still many barriers to the adoption of e-commerce and digital payments regarding the green information infrastructure. There is not only the infrastructure including green IT but also the factors related to green transportation in delivery time and cost, and reverse logistics. Another aspect, Vietnamese consumers are generally optimistic about the economy, despite the ongoing Covid-19 pandemic. This optimism can be observed even among low-income consumers. This may be the result of confidence in Vietnam's consistent economic growth in both micro and macro-economies.

2.2 Green Logistics Operations

In today's global economy, manufacturing and logistics are revolutionized by providing the opportunity to utilize advanced technologies. According to Sean Galea-Pace (2020), the supply chain is in a significant transformation with the help of technologies, the three biggest trends in 2020 are AI & Machine Learning, Green Logistics, and Big Data Analytics. Green logistics is a key factor in the global economy's sustainable development in both developed and developing countries. There are many studies on the relationship between G, circular economy, and sustainability (Seroka-Stolka and Ociepa-Kubicka, 2019; Islam et al., 2021; Luu, 2021a).

Recently, Islam et al. (2021) integrated reverse logistics, closed-loop logistics, green logistics, and environmental logistics in a review and presents a generic conceptual model for understanding the implementation process of environmental practices in logistics. Kumar, Singh, and Kumar, (2021) through literature reviews and expert opinion, identified key criteria and barriers that have been solved to meet sustainable goals. Zijm et al. (2015) stated that sustainable logistics and supply chain is growing in terms of system status; cultural change; technological innovation; and new business model development. To sum up, Luu, (2021b) investigated GL operations, in which a typical supply chain consists of suppliers, producers/sellers, distributors, collectors, and customers. After receiving the customer order, sellers will arrange third-party logistics (3PLs) providers to deliver goods to customers. The process includes the eight key green logistics operations such as green information (green IT), green procurement, green manufacturing, green transportation, green packaging, green storage, green consumption, and reverse logistics.

3 Methods

3.1 Research design procedure

The study is designed as a mixed approach consisting of qualitative and quantitative methods. The first phase of the study explores a literacy understanding of the customer preferences and behavior in the microeconomic background, and green logistics operations. In the second phase, a conceptual framework of the impacts of covid-19 on customer behavior along with green logistics operations and its hypotheses are proposed. In the third phase, the research outlines a future agenda to deploy quantitative methods using partial least structural equation modeling through statistical software such as SPSS and SmartPLS-SEM to evaluate and validate the research hypotheses of the proposed framework.

In the future research agenda, a research design procedure will be developed in detail and includes three main steps: focus group, pilot test, and main test. In which the sampling and sample size of the research is defined in the focus group. The questionnaire technique is used to collect sufficient observations. The pilot test assesses a reflective measurement model that involves indicators and constructs' reliability through the outer loading and Cronbach's alpha; convergent validity by the average variance extracted (AVE); and discriminant validity by HTMT (Hair et al., 2017). Finally, the main test analyzes the inner structural model, it test whether the theoretical structural relationships between the constructs are fit and significant. In this step, the coefficients of Pearson's determination (R^2), the cross-validated redundancy (Q^2), the standardized root mean square residual (SRMR), the t -value, and the p -value are used ((Henseler, Ringle, and Sinkovics, 2009).

4 Research Results

4.1 Proposed research framework

As a result of the above discussion, the study focuses on eight green logistics operations related to the microeconomic factor of customer behavior influenced by the covid-19 pandemic. The study uses a simple path model that defines outer and inner models; exogenous and endogenous constructs; and observed variables. In detail, the reflective research model includes 3 constructs of the Covid-19, consumer behavior, and green logistics operations with its 8 independent factors including green information (green IT), green procurement, green manufacturing, green transportation, green packaging, green storage, green consumption, and reverse logistics. The research framework is proposed in Figure 4.

The diagram illustrates the research model with the following components and relationships:

- COVID-19** (Oval) has a direct relationship with **Consumer Behavior** (Oval) labeled *H1*.
- COVID-19** (Oval) has a direct relationship with **Green Logistics Operations** (Oval) labeled *H2*.
- Consumer Behavior** (Oval) has a direct relationship with **Green Logistics Operations** (Oval) labeled *H3*.
- Reverse Logistics** (Rectangle) has relationships with **Green Logistics Operations** (Oval) labeled *H4* and *H5*.
- Green Consumption** (Rectangle) has relationships with **Green Logistics Operations** (Oval) labeled *H11* and *H10*.
- Green IT** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H6*.
- Green procurement** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H7*.
- Green manufacture** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H8*.
- Green transport** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H9*.
- Green packaging** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H10*.
- Green storage** (Rectangle) has a relationship with **Green Logistics Operations** (Oval) labeled *H11*.

4.2 Research hypotheses

- *H1. COVID-19 is harming Vietnam's consumer behavior.*
- *H2. COVID-19 is harming Vietnam's green logistics operations.*
- *H3. Green logistics operations have high effects on Vietnam consumer behavior.*
- *H4. Reverse logistics positively affect Vietnam's green logistics operations.*
- *H5. Green IT positively affects Vietnam's green logistics operations.*
- *H6. Green procurement positively affects Vietnam's green logistics operations.*
- *H7. Green manufacturing positively affects Vietnam's green logistics operations.*
- *H8. Green transportation positively affects Vietnam's green logistics operations.*
- *H9. Green packaging positively affects Vietnam's green logistics operations.*
- *H10. Green storage positively affects Vietnam's green logistics operations.*
- *H11. Green consumption positively affects Vietnam's green logistics operations.*

5 Conclusion

This study focuses on the core of microeconomics - customer behavior, including customer preferences and choices under the impact of covid-19. The finding from the Deloitte survey also illustrates that green logistics services are the top concern for Vietnam consumers, especially in logistics infrastructure including green IT, green transportation, digital payment platform, and reverse logistics.

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of the proposed model to make a better understanding of Vietnam's customer behavior under covid-19 impact along green logistics operations.

Acknowledgment

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References

- Addo, P. C., Jiaming, F., Kulbo, N. B., & Liangqiang, L. (2020). COVID-19: fear appeal favoring purchase behavior towards personal protective equipment. *Service Industries Journal*, 40(7–8), 471–490. DOI: 10.1080/02642069.2020.1751823
- Ahmed, I., Islam, T., Ahmad, S., & Kaleem, A. (2021). A COVID-19 contextual study of customers' mistreatment and counterproductive work behavior at coffee cafés. *British Food Journal*, April. DOI: 10.1108/BFJ-07-2020-0664
- Bae, S. Y., & Chang, P. J. (2021). The effect of coronavirus disease-19 (COVID-19) risk perception on behavioral intention towards 'untact' tourism in South Korea during the first wave of the pandemic (March 2020). *Current Issues in Tourism*, 24(7), 1017–1035. DOI: 10.1080/13683500.2020.1798895
- Baicu, C. G., Gârdan, I. P., Gârdan, D. A., & Epuran, G. (2020). The impact of COVID-19 on consumer behavior in retail banking. Evidence from Romania. *Management and Marketing*, 15(s1), 534–556. DOI: 10.2478/mmcks-2020-0031
- Brandtner, P., Darbanian, F., Falatouri, T., & Udokwu, C. (2021). Impact of COVID-19 on the customer end of retail supply chains: A big data analysis of consumer satisfaction. *Sustainability (Switzerland)*, 13(3), 1–18. DOI: 10.3390/su13031464
- Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management and Data Systems*, 117(3), 442–458. DOI: 10.1108/IMDS-04-2016-0130
- Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing*, 20, 277–319. DOI: 10.1108/S1474-7979(2009)0000020014
- Islam, M. S., Moeinzadeh, S., Tseng, M. L., & Tan, K. (2021). A literature review on environmental concerns in logistics: trends and future challenges. *International Journal of Logistics Research and Applications*, 24(2), 126–151. DOI: 10.1080/13675567.2020.1732313
- Kumar, P., Singh, R. K., & Kumar, V. (2021). Managing supply chains for sustainable operations in the era of industry 4.0 and circular economy: Analysis of barriers. *Resources, Conservation and Recycling*, 164(October 2020), 105215. DOI: 10.1016/j.resconrec.2020.105215
- Luu, V. T. (2021a). Literature Review on Circular Economics Adoption for the Vietnam Economy. In E. Opatrná (Ed.), *15th International Scientific Conference INPROFORUM: New trends and challenges in the management of organizations* (Vol. 1, 8–14). The University of South Bohemia in České Budějovice.
- Luu, V. T. (2021b). Research on Green Logistics and Business Process Management in The Circular Economy Context. In H. C. Hana Stojanová (Ed.), *10th International Conference: Zero Waste Management and Circular Economy* (Vol. 1, 433–444). Mendel University in Brno. DOI: 10.11118/978-80-7509-820-7-433
- Meng, P. W., & Oka, T. M. (2021). The Vietnam Consumer Survey: Staying resilient amidst headwinds. In Deloitte Southeast Asia (Issue February).
- Pindyck, R., & Rubinfeld, D. (2013). *Microeconomics*, 9 edition. Pearson.
- Prasetyo, Y. T., Tanto, H., Mariyanto, M., Hanjaya, C., Young, M. N., Persada, S. F., Miraja, B. A., & Redi, A. A. N. P. (2021). Factors affecting customer satisfaction and loyalty in online food delivery service during the COVID-19 pandemic: Its relation with open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 1–17. DOI: 10.3390/joitmc7010076
- Seroka-Stolka, O., & Ociepa-Kubicka, A. (2019). Green logistics and circular economy. *Transportation Research Procedia*, 39(2018), 471–479. DOI: 10.1016/j.trpro.2019.06.049
- Zijm, H., Klumpp, M., Clausen, U., & Ten Hompe, M. (2015). Logistics and supply chain innovation: Bridging the gap between theory and practice. *Logistics and Supply Chain Innovation: Bridging the Gap between Theory and Practice*, 1–312. DOI: 10.1007/978-3-319-22288-2
- Varian, R. H. (2014). *Intermediate Microeconomics a Modern Approach*. W. W. Norton & Company; 9th revised edition,

Cryptocurrencies in terms of tax burden for a specific entity

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Abstract: Cryptocurrencies are a modern phenomenon not only in terms of technological advancement, but also as a means of payment or investment. The aim of the paper is to evaluate the impact of dealing with cryptocurrencies in terms of tax burden for a particular entity. To assess the tax burden, personal and corporate income tax and value added tax are selected. The analysis is complemented by recommendations for optimising the tax liability and a list of consequences of not declaring income from cryptocurrencies. The conclusion summarizes the results, including the outstanding legislative issues of further taxation.

Keywords: cryptocurrencies, tax, VAT, comparison of personal and corporate taxation

JEL Classification: H25

1 Introduction

Cryptocurrencies are digital assets created using computer networking software that allows for secure trading and ownership. It is a medium of exchange that is digital, encrypted and decentralised. Unlike the US dollar or the euro, there is no central authority that manages and maintains the value of a cryptocurrency. Administrative tasks are widely distributed among cryptocurrency users via the Internet. The 21st century society, through cryptocurrencies and other innovations from Industry 4.0, demonstrates the abnormal potential that lies in technology and its applications. With cryptocurrencies, it is possible to buy common goods and services, although most people invest in cryptocurrencies just like they invest in other assets, for example stocks or precious metals. While cryptocurrency is a new and exciting asset class, buying it can be risky because an investor must do proper analysis to fully understand how each cryptocurrency works.

Experts' opinions on investing in cryptocurrencies are mixed. Because crypto is a highly speculative investment with the potential for intense price fluctuations, some financial advisors do not recommend investing in them at all. For example, Bitcoin's value nearly quadrupled during 2020, and by the end of the year it was valued at over 28 900 USD. By April 2021, the price of BTC had more than doubled from the beginning of the year, but all of that growth had passed by June of that year. Subsequently, BTC more than doubled again, reaching an intraday high above 68 990 USD on November 10, 2021, before falling again to around 46 000 USD by the end of 2021. It is quite noticeable that cryptocurrencies can be very volatile.

The downside is the frequent energy consumption (energy is mainly obtained by burning fossil fuels) and the subsequent environmental impacts associated with cryptocurrencies. Bitcoin mining generates about 96 million tonnes of carbon dioxide emissions each year, a similar amount produced by a small country. In contrast, Ethereum mining produces more than 47 million tonnes of carbon dioxide emissions annually. However, there are also low-energy cryptocurrencies like XRP or Split.

2 Methods

The literature research is mainly based on professional books and partly on foreign articles. Specialized literature was used to study and understand the issue. The books were borrowed largely from the Academic Library of JU or searched in online catalogues on the Internet.

The second part of this thesis is practical. The introduction of the practical part discusses the details of the future business of the FD entity. In 2022, it plans to be involved in trading, mining cryptocurrencies, creating virtual worlds and collecting the new phenomenon of NFTs. Non-fungible token refers to an unquestionable confirmation of possession of a digital item (song, game item, tweet or image) and quick identification of the owner. In the following practical section, the business plan is analysed in terms of the tax burden on the FD entity.

The analysed plan thus provides an overview of the most common situations related to the handling of cryptocurrencies, which together form a complete treatment for the issue of their taxation. The FD entity assumes two

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strategic plans for its business. The first plan, which is rather critical, assumes revenues of up to CZK 1 800 000, and the second, more ambitious plan calculates revenues of around CZK 3 600 000. The practical part for these purposes analyses the situation of taxation of the FD entity's income as an individual, as a legal entity and the related impact of VAT. Doing business through a legal entity brings a number of advantages and disadvantages, of which the FD entity is aware, when it counts on the so-called cheaper and more expensive plan. The analysis of possible alternatives should reflect the potential paths for the FD entity in its future decision-making.

The practical part is divided into logical sub-sections, with the first one dedicated to the business plan, the second one to personal income tax, the third one to corporate income tax, the fourth one to value added tax and the last one to non-taxation of cryptocurrencies. The calculation of each type of tax is discussed in detail below.

3 Research results

When comparing whether it is more advantageous to tax cryptocurrency profits as an individual or a legal entity, there is no clear answer in general terms, as market developments, investment decisions or the introduction of government regulations play a significant role. Also, from a strategic management perspective, an FD entity may pursue very different objectives than a low tax burden. The conclusions drawn are only used by the FD as supporting material for setting further objectives.

4 Business plan of the FD entity

The Business Plan is considerably abbreviated in its scope due to the trade secrets and specific procedures to which the FD Entity claims the right.

For its technical analysis, the FD Entity uses the TradingView portal and other trading and analytical platforms from brokers such as xStation or MetaTrader. When deciding on a trade, it is further oriented by patterns (candle formations that indicate signals of future market development for opening and closing positions) such as a classic trend line, single (123gap) or triangle. It also uses indicators such as trading volume, moving averages, trend indicators, oscillators and others.

It intends to conduct its trading through Coinbase, Crypto.com, Binance and other verified brokers XTB, eToro and Plus500. In its personal calculations, the FD entity assumes membership and brokerage fees, which by their nature are not specifically quantified in the paper.

It estimates its revenue at between CZK 1 800 000 and CZK 3 600 000 and its actual costs at around CZK 800 000. The FD entity in 2022 will have the following in its economic life:

Software used:

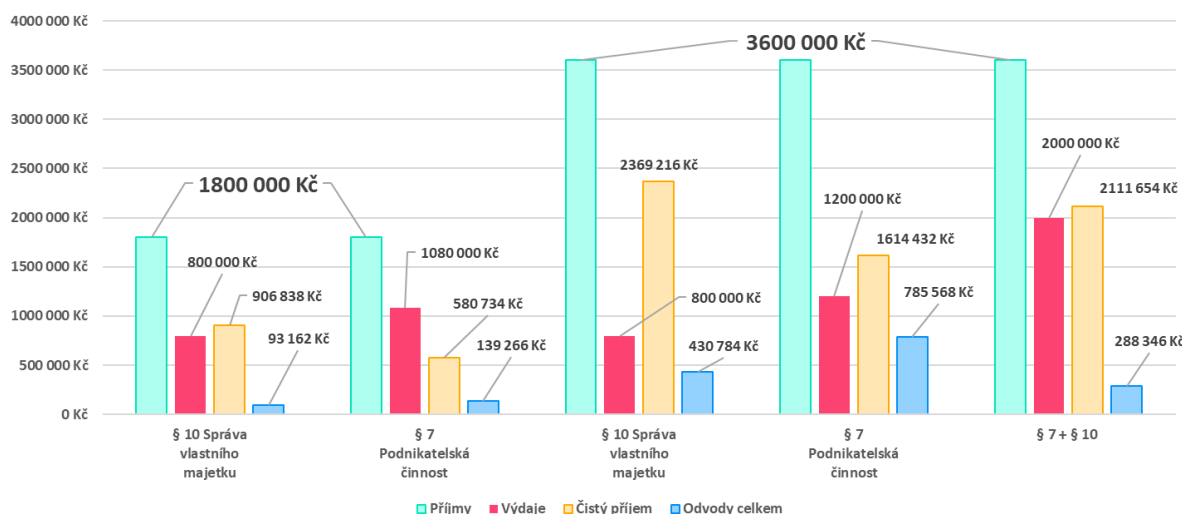
- For cryptocurrency safekeeping: Ledge Vault and Digital assets Fidelity
- For cryptocurrency payments: Coinomi and BitPay

Basic Hardware:

- Dell XPS7390 13" InfinityEdge Touchscreen Laptop = 27,000 Kč
- HP Omen 870-213w Desktop PC = 45 000 Kč
- Gaming Hexblade, gaming keyboard, Cherry MX Silent Red = 2 000 Kč
- Trust Voxx Rechargeable Ergonomic Wireless Mouse = 1 300 Kč
- 2 x 35" LG Ultrawide 35WN75C-B screen = 23 000 Kč

In the case of income of CZK 1 800 000 for an FD as an individual, the difference in levies is not as marked as for income of CZK 3 600 000. The recommendation for the entity in this regard is to use Section 7 and Section 10 at the same time. Tax the income of CZK 2 000 000 according to §7 and use the highest possible flat rate and tax the remaining CZK 1 600 000 according to §10 using the actual expenses incurred. The tax base would be rapidly reduced to CZK 1 600 000, the net income would be CZK 2 111 654 and the total levies would amount to CZK 288 346. In this case, the net income is distorted by the lump-sum expenditure, without the lump-sum being taken into account it amounts to CZK 2 511 654. Another proposal for the FD entity is to increase the existing deductible items or to use other items such as examinations verifying further education, etc.

Diagram 7: Graphical comparison of taxation in §10 and §7



Source: own processing

Without a doubt, it is necessary to mention the advantages of investing in cryptocurrencies as an individual. The first is the entry costs, which can be low, which is not the case for an FD entity. Income is not subject to health and social insurance unless the individual is a business and uses Section 10. As long as the entity's income does not exceed 48 times the average wage, its income is taxed at only 15%, compared to 19%, the corporate rate. If the limit is exceeded, the rate increases to 23%, and there is more talk of a disadvantage. Disadvantages include the inability to offset losses from previous years, the non-application of overhead costs to reduce the tax base, the inability to offset losses of other attributes in one year (Bitcoin and shares) and full liability for its obligations.

5 Capital intensity for legal entity

The share capital of s.r.o. is divided into a part in Czech crowns and cryptocurrencies ETH and BTC (CZK 61 000 and CZK 860 000 as of 26 February 2022). The necessary technical equipment of the company is quantified in Table 7. Again, the company gives two options for initial expenditure, depending on the development of the company's economic situation. The initial expenditure is divided into surplus and expendable expenditure. Hardware for mining is considered expendable, as mining is considered to be only a supporting activity in the company's business strategy. Related to this is the possibility of cloud mining, where no hardware is required and the company would use a cheaper plan at this point in time. Conversely, if the company assessed the situation as promising, according to its internal procedures, it would use the more expensive plan. The positive perception of the future situation is also supported by the fact that in the summer of 2021, the ban on mining in the Sichuan region of China meant the end of 90% of cryptocurrency mining in the country, which meant a general decrease in mining costs. Another imaginary clue for society is "fake news" about bans on the use of cryptocurrencies in various countries, or speculation over central bank negotiations on monetary policy (e.g. the Fed's negotiations, or Turkey's acceptance of cryptocurrencies)

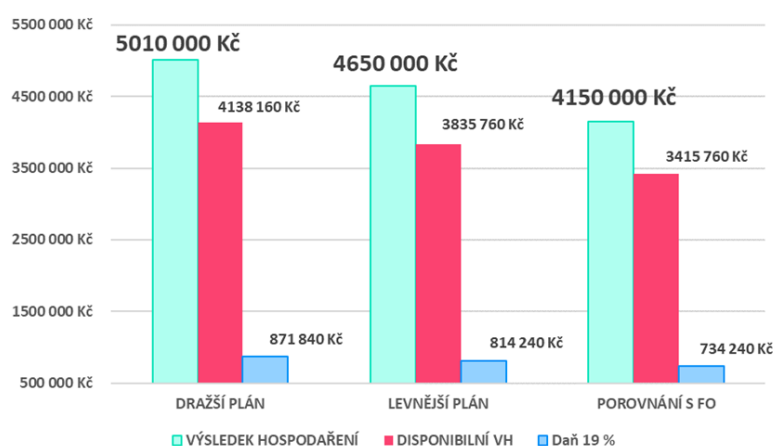
Picture 1 Initial expenses of the company

	DRAŽŠÍ PLÁN		LEVNĚJŠÍ PLÁN	
	bez DPH	DPH	bez DPH	DPH
Založení společnosti	11 000 Kč	13 310 Kč	11 000 Kč	13 310 Kč
pronájem prostorů	120 000 Kč	25 200 Kč	120 000 Kč	25 200 Kč
Stolní počítače	360 000 Kč	75 600 Kč	360 000 Kč	75 600 Kč
Kancelářský nábytek	80 000 Kč	16 800 Kč	80 000 Kč	16 800 Kč
Monitory	184 000 Kč	38 640 Kč	184 000 Kč	38 640 Kč
Příslušenství k počítači	32 000 Kč	6 720 Kč	32 000 Kč	6 720 Kč
Webové stránky	10 000 Kč	2 100 Kč	10 000 Kč	2 100 Kč
Projektor	15 000 Kč	3 150 Kč	15 000 Kč	3 150 Kč
Tiskárna	25 000 Kč	5 250 Kč	25 000 Kč	5 250 Kč
Radeon RX 6900 XT XTREME WATERFORCE WB 16G			470 000 Kč	98 700 Kč
Profi Mining farma – 60x 3060TI NON LHR	5 000 000 Kč	1 050 000 Kč		
CELKEM	5 837 000 Kč	1 236 770 Kč	1 307 000 Kč	285 470 Kč
	7 073 770 Kč		1 592 470 Kč	

Source: own processing

Corporate taxation, on the other hand, allows for netting losses from the previous 5 years, offsetting losses on various attributes, and applying a range of expenses. The disadvantages appear mainly in higher upfront costs, administrative tasks and higher tax rates. Depending on the type of legal entity, the liability is divided among the owners of the company or the liability falls only on the assets of the company.

Diagram 8 Graphical summary of the income tax variants of PO



Source: own processing

The different options represent a situation where the company has opted for more or less expensive capital intensity. The column of the graph on the far right shows a comparison where the company is able to generate the same returns as the FD entity would have been able to generate on its own. Here it can be seen that under the specified internal conditions, the company is able to generate less than a million more free funds. However, it should be noted that the funds remain in the company and, in the event of a profit sharing distribution, the recipient would have to tax this income as an individual. The use of employee benefits seems to be a recommendation not only to optimise the tax liability of the legal entity but also to motivate the employees.

6 Conclusions

Cryptocurrencies are a hot topic in the global financial system, although there is a high volatility of cryptocurrency exchange rates, which is associated with high trading risk. Their growth has managed to gain the attention of many speculators. They are easily transferable but untrustworthy. If cryptocurrencies fail to gain trust, their boom may decline. Even some economies have begun to issue national cryptocurrencies. There is room for less developed countries to use cryptocurrencies for their economic transformation.

The objective of this paper is to evaluate the impact of dealing with cryptocurrencies in terms of tax burden for a particular entity. The introductory theoretical part provided the reader with a space to understand the nature of

cryptocurrencies and then this knowledge was applied in the methodology and practical part. As a result of the practical part, the author concludes the following.

1. The publications and methodologies published so far are insufficient to define and treat cryptocurrencies in a uniform manner. There is no legal anchorage in the Czech Republic that would give an objective view of cryptocurrencies. Taxpayers have a greater tendency not to declare income as they are not aware that it is taxable income and do not know how to practically record cryptocurrency transactions.
2. All known tax jurisdictions point only to the burden of cryptocurrency income, but only marginally address value added tax. Taxpayers are thus faced with a situation where they are unable to clearly identify the expected tax burden as part of their business plans. Again, the tendency to deny income or tax even exempt transactions is increasing.
3. The inability of taxpayers to routinely check whether they have taxed all their cryptocurrency income due to anonymity. Control authorities lack the tools and principles for normal taxpayer supervision and do not pay attention to educating their staff about cryptocurrencies.

The author considers the contribution of the paper to be the demonstration of not only the tax burden and accounting cases related to cryptocurrencies, but also the summary of references to specific cryptocurrency platforms that can inspire similar business ventures. For further information, the author refers to the thesis entitled Tax and Accounting Aspects of Cryptocurrencies by Bc. Ladislav Novotný, a dissertation on a similar topic, Binance academy and mcoin.cz, which focuses on news from the world of cryptocurrencies. The only starting point for orientation for accountants, tax advisors, analysts and auditors is to follow the current events around cryptocurrencies and new innovations coming with them.

References

Mazancová, K. (2022). Kryptoměny z hlediska daňového zatížení pro konkrétní subjekt (Diplomová). České Budějovice.

Financial literacy in Slovakia – comparative study

Marcel Novák¹

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Abstract: With the term financial literacy resp. financial illiteracy, whose low financial literacy of Slovaks we can meet more and more often. The issue of financial literacy also plays an important role in connection with household indebtedness. If households are unable to assess their financial situation or estimate whether it is appropriate for them to seek foreign resources, they can easily become over-indebted without being able to repay debts. The aim of the article is to evaluate the links between the lower level of financial literacy and the growing indebtedness of Slovak households by comparing the results of the personal questionnaire survey and the results of the HFCS household financial behaviour survey. The results suggest the existence of a positive correlation between financial literacy and the level of completed education. Individuals without any form of debt are more financially literate. If individuals are unable to spend their money efficiently and spend it recklessly, it can lead to their debt.

Keywords: Financial literacy, financial illiteracy, survey, indebtedness

JEL Classification: D119, G51, G53

1 Introduction

Whether an individual is a financially literate will be reflected in everyday life situations requiring financial decision-making. However, not all of us can be described as financially literate, which is mainly due to ignorance of finance, the tendency to save less and spend more, which can eventually lead to indebtedness. Financially literate people can independently manage their personal finances and plan their effective use in the future. Financial literacy is one of the indicators that determines how individuals can make decisions in the management of their own resources and whether they are able to predict the phenomena and possible consequences of their decisions. "The more we understand the issue, the more sensible financial decisions we should make." (Prokopec, M., 2019). Undoubtedly, financial planning also belongs to this issue. In publication, Kovalčíková, Z., Smorň, L., Strenk, R., (2011) defined financial planning as "a combination of all income and expenditure so as to optimally meet the needs of the individual / family in the present and in the future." In terms of time, the main indicator is age. Based on this, it can be argued that with increasing age, the needs of individuals change, which affects financial planning. In terms of priorities, financial planning must consider the goal, and thus the needs to be met, whether it is the need to provide income, housing or various goals or dreams.

Indebtedness, as one of the possible consequences of lower financial literacy, is not an unusual phenomenon in society. Banks or non-banking institutions come to the financial market with a relatively wide range of financial products, while declaring advantageous conditions for their provision. However, these may not be suitable for everyone, and it is therefore essential that potential clients be able to identify their financial situation and consider the appropriateness of such conditions. These situations are also one of those where a certain level of financial literacy is required, as its absence could lead to an unfavourable development of the individual's financial situation, such as over-indebtedness.

A study under the auspices of the OECD, known as PISA (Program for International Student Assessment), also looked at research on student literacy. The testing has so far taken place in three cycles (2012, 2015, 2018), with Slovakia voluntarily participating in all three. The study focused on the students' ability to apply their knowledge in practice. Issues in finance concerned money and financial transactions, financial planning and manipulation, the financial environment, and possible risks (NÚCEM, 2020). The result of financial literacy of Slovak pupils in 2018, climbed to the level of 481 points, based on which it was concluded that they have a low level of financial literacy and is directly below average in comparison with other OECD countries (OECD INFE). The average value of the participating countries reached the level of 505 points. During the three phases, we can perceive a fluctuating tendency of the results. Between the phases carried out in 2012 and 2015, not only the level of literacy of Slovak pupils decreased by 25 points, but also the overall average of the participating countries decreased by 11 points. On the contrary, the results for 2018 showed an increase in the average performance of our students by 36 points and at the same time the average performance of all participating

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countries also increased. However, it should be noted that Slovakia is still below the average level of OECD countries. (NÚCEM, 2020). The National bank of Slovakia also assessed the level of financial literacy of households through 4 questions from the financial area, contained in a survey called HFCS (Household's finance and consumption survey). This research was carried out in Slovakia in three waves, namely in 2010, 2014 and 2017. As we have already announced, the results were not satisfactory. Based on the latest survey, it was concluded that the financial literacy of Slovak households is declining. While in 2014 10.6% of households were able to answer all questions correctly, in the last survey only 9.6% knew. The striking fact is that the questions were answered by those who have the best overview of finances within the household. According to NBS analysts, it is likely that other members of the household have even lower financial knowledge (TASR, 2019).

2 Literature review

Around the world, there are many papers in the literature that examine the financial literacy of young people, as well as the impact of financial literacy on the financial markets. Interestingly, we can mention the work of Aren and Aydemir (2014), entitled "A Literature Review on Financial Literacy." According to the authors, objective measures seem to work best in financial literacy among individuals and there is the need for a common and well-structured definition of financial literacy. In research papers in the field of financial literacy there exist some similarities and contrariness in terms of definitive financial literacy issues, probable endogeneity, determinants established by researchers, and other probable estimators. Ansong and Gyensare (2012) explored the determinant of university working-students' financial literacy. The study randomly collected data from 250 undergraduate and postgraduate students of a public university in Ghana and confirmed the relationship between financial literacy and certain demographic characteristics. Age and work experiences were positively related to financial literacy. Existing studies also present a lot of evidence on the impact of many sociodemographic factors on both financial literacy and financial inclusion. Berggren and Gonzalez (2010) found that gender is the most important factor. The studies of Atkinson (2007), Lusardi, Mitchell, and Curto (2009), and Atkinson and Messy (2012) confirmed that the variable "age" is the most important factor for financial literacy. Chen and Volpe (1998) examined 924 college students with regard to their personal financial literacy and the relationship between their literacy level and student characteristics. They conclude that college students are not knowledgeable about personal finance. Lusardi, Mitchell, and Curto (2009), examined financial literacy among the young using data from the 1997 National Longitudinal Survey of Youth. The financial literacy is strongly related to sociodemographic characteristics and family financial sophistication. Atkinson (2007), and Atkinson and Messy (2012), presented the findings from an OECD/INFE pilot study undertaken in fourteen countries. The results highlight a lack of financial knowledge amongst a sizeable proportion of the population in each of the countries. This study enables countries to identify needs and gaps in the financial education provided and develop national policies or strategies. Bayer, Bernheim, and Scholz (1996) examined the effects of education on financial decision-making skills by identifying an interesting source of variation in pertinent training during the 1990s. Results showed that both participation in and contributions to voluntary savings plans are significantly higher when employers offer retirement seminars. The effect is typically much stronger among employees from lower pay grades, than among those from higher pay grades. Cole and Shastri (2012) found that people who achieved higher levels of education also have higher credit scores and are significantly less likely to be delinquent, declare bankruptcy, or experience a foreclosure. Although theoretically, a high level of financial literacy is possible even amongst those who have not completed formal education, financial literacy usually increases with the years of schooling. Atkinson and Messy (2012) found that the main objective of financial education is to increase financial literacy levels by teaching new knowledge, skills, and attitudes that can bring about changes in money management and financial decision-making. Financial education may be also seen as a tool to raise the degree of financial inclusion, enabling people to take greater advantage of the financial services available to them. To be able to make optimal use of financial products and services, individual financial consumers should have the relevant knowledge, optimal behaviour, and right attitude toward financial markets, which are all elements of financial literacy, achieved in the process of financial education. Cole and Shastri (2008, 2012) confirmed that a higher level of financial literacy and more advanced participation in financial markets can also be observed among people with an educational background in economics or finance. Mandell and Klein (2007, 2009) found that there is a differential impact on seventy-nine high school students of a personal financial management course completed one to four years earlier. Students who took the course did not evaluate themselves to be more savings-oriented and did not appear to have better financial behaviour than those who had not taken the course. McDaniel, Martin, and Maines (2002) evaluated financial reporting quality as part of their corporate oversight responsibilities. Financial expertise evaluations are more strongly associated with their assessments of characteristics underlying report quality. Vass (2012) argued that monetary and financial issues could be deemed a way of representing and reflecting both the form and the future orientation of individuals, instead of considering them only being results of whether people are financially knowledgeable. Rob (2011) examined the relationship between financial knowledge and credit card behaviour of college students. They used a sample of 1,354 students from university, and results suggest that financial knowledge is a significant factor in the credit card decisions of college students. Probably the best-known study

on financial literacy and over-indebtedness by Lusardi and Tufano (2015). They found individuals who have less knowledge in the field financial literacy, they label their debts as excessive. In addition, they found that borrowers with higher financial literacy and experience with housing loans, are characterized by much smaller problems with debt repayment. Huston (2012) examined the impact of financial literacy with a focus on cost individual loans. His analyses are realised, through loans to housing and credit cards among individuals in the United States. In this study, he points out that the result of a study that financially literate people are twice as likely to they will have lower costs for financing credit cards and mortgages. Brown et al. (2016) 12 examined the link between financial literacy and debt literacy behaviour in young Americans. They found knowledge of mathematics and financial education improve solvency and discipline. The costs associated with financing needs depend to a large extent on the choice of type credit product, such as housing loans, have significantly lower costs such as credit cards or consumer non-purpose loans. In this regard, Gathergood (2011), confirmed that low financial literacy is associated with a higher risk of possible problem with the repayment of a consumer loan.

3 Research methodology and data

The aim of the article is to evaluate the links between the lower level of financial literacy and the growing indebtedness of Slovak households by comparing the results of the personal questionnaire survey and the results of the HFCS - household financial behaviour survey.

Using the selected methodology, we collected data through an anonymous questionnaire survey, which was the basis of our further analysis. We divided the questions into two basic areas. In the first 8 questions, we found out the basic data about the respondents in connection with what we examined the state of their indebtedness and the way in which they handle their finances. In the last 5 questions, we paid attention to the financial literacy of the respondents, and thus examined their ability to answer questions related to common phenomena in the financial market. These questions were already part of the HFCS survey conducted under the auspices of the NBS. We collected data from 165 respondents. Based on the obtained data, we analysed the current state of indebtedness of households in Slovakia and at the same time we examined their ability to answer basic questions in the field of finance, which would help us to deduce the level of their financial literacy. We used Pearson's chi square test to determine the existence of a link between gender and indebtedness. In a conclusion, it was necessary to determine null and alternative hypothesis - research assumptions. Subsequently, we determined the range of actual data obtained from the questionnaire. Based on them, we calculated the data that we would expect if there were no differences between the variables. Using Excel, we calculated the value of the chi square from the data range. Based on whether its value was higher or lower than the so-called critical point, we rejected or accepted the null hypothesis. Using a comparison, we compared the results regarding financial literacy with data obtained through a survey by the National Bank of Slovakia (HFCS 2014, 2017) and we can assess whether individuals become financially more literate over the years or not (Gertler, P., Jurašková-Kuscárová, J., Strachotová, A., 2019).

4 Results

In connection with the aim of the paper, we tried to find out whether there is a certain relationship between gender and indebtedness. For these purposes, we used Pearson's chi-square, resp. independence test. First, it is necessary to establish a null and then an alternative hypothesis:

- H0 - There is no significant link between gender and indebtedness.
- H1 - There is a characteristic link between gender and indebtedness.

Subsequently, it was necessary to summarize all the obtained real data on the indebtedness of men and women, which we implied in the table (see below). We presented these data individually for both sexes. Of the total number of women, 34 are in debt and of all men live in debt 21. Thus, there are a total of 55 indebted respondents.

Table 1 Real data of indebtedness

Real data	women	men	Together	Proportion to the total number
indebted	34	21	55	0,33333
not indebted	77	33	110	0,66667
Together	111	51	165	

Source: own calculations based on results from survey.

After processing the real data, it was necessary to find out what the expected values would be. In this case, we would assume that there is no difference between the sexes. This means that, based on the data in the table, we would expect 33% of women and 33% of men to be in debt and, conversely, 67% of women as well as men to be in debt. According to the stated percentage, we would therefore expect 37 women and 18 men in debt and 74 women and 36 men in debt.

Table 2 Real data of indebtedness

Expected data	women	men
indebted	37	18
not indebted	74	36

Source: own calculations based on results from survey.

After finding out the actual and expected data, we can proceed to the calculation of the chi-square. We performed the whole procedure using Excel, which allows us to determine the value of the chi-square, which in our case is 0.29, using the "chi-test" function. What is important is the fact whether the value of 0.05 was exceeded, which we call the so-called "Critical point". In general, if the value is higher than the critical point, we do not have sufficient evidence to reject our null hypothesis. Although we perceive some differences between women's and men's responses, there are not enough of them to be able to speak clearly about the interrelationship between the two variables. We can therefore argue that there is no significant link between gender and indebtedness.

Finally, we compared the results regarding financial literacy with data obtained through a survey by the National Bank of Slovakia (HFCS) and we can assess whether individuals become financially more literate over the years or not. Despite the difference in the number of respondents to our questionnaire and the HFCS survey (1089 respondents), which was conducted on a significantly larger sample of the population, we compared the percentage expressions of the results of both surveys.

Table 3 Compared results

Questions	Questionnaire	HFCS survey
In your opinion, which of the following types of mortgages will allow you to determine the amount and number of repayments needed to repay the loan from the beginning?		
Mortgage with a variable interest rate	10,3%	12%
Mortgage with a fixed interest rate	68,5%	49,2%
Do not know	21,2%	38,8%
Imagine that you leave € 1,000 in a current account that has 1% interest and this bank does not charge any fees, also imagine that prices have increased by 2%. Do you think that if you withdraw your money in a year, you will be able to buy the same amount of goods as if you had spent € 1,000 today?		
Yes	3%	3,2%
No, I can buy less	78,8%	67,4%
No, I can buy more	3,6%	5,2%
Do not know	14,5%	24,3%
In your opinion, which of these investment strategies carries a higher risk of losing money?		
Invest all savings in securities issued by one company	69,7%	43,8%
Invest all your savings in securities issued by a wide range of independent companies	20,6%	16,8%
Do not know	9,7%	39,4%
The company can obtain financing either by issuing shares or bonds. Which financial instrument, in your opinion, carries a higher risk of losing money?		
Shares	49,1%	18,0%
Bonds	15,8%	6,2%
It's just as risky	14,5%	26,4%
I don't know the difference between bonds and shares	12,1%	18,4%
Do not know	8,5%	31,0%
What do you mean by "investment risk"?		
Someone will betray my money	0%	18,6%
Due to developments in world markets, I will lose all my investments	15,8%	16,5%
The value of my investment will fall below the amount invested	62,4%	30,1%
I will lose some of my income during the investment	19,4%	17,4%
Do not know	2,4%	17,4%

Source: own calculations based on results from questionnaire and HFCS survey.

In terms of overall success in terms of financial literacy questions, 33 respondents were able to answer all of them correctly, representing 20%. In terms of gender, 22% of all men and 19% of women responded successfully. In the 2014 HFCS survey, only 4.5% of all respondents answered all five questions correctly. As only the first four questions were included in the survey for 2017, it is necessary to compare the success in this range of questions as well. In the mentioned survey, it was 9.6% of respondents who answered all four correctly. Therefore, even in the case of the results of our questionnaire, we will notice certain changes in success. 47 respondents were able to answer these questions, and thus 8% more than was the case with the scope of the five questions.

If we looked at the results from the opposite point of view, (from the point of view of incorrect answers) within the scale of all five questions, only 5 of our respondents answered, which represents 3%. According to the results of the second wave of HFCS in 2014, this is a relatively higher percentage of incorrect answers, namely 12.7%. Between the

first four questions in the field of financial literacy, which were part of the third wave of HFCS, all four 18.5% answered incorrectly. After the deliberate exclusion of the last question in our questionnaire, the number of incorrect answers doubled, and thus 6% of respondents did not mark a single correct answer. If we proceeded to the analysis of the answers in terms of whether more indebted respondents than non-indebted were able to answer correctly, within the range of five questions, most respondents without debt answered correctly. These are specifically 25 respondents, and thus the remaining 8 are in debt. Of the 47 respondents who answered questions 9-12 correctly, 11 are indebted and 36 are non-indebted. Of the total number of respondents living on debt, this represents 20% and 33% of the non-indebted respondents. Based on these results, we could assume that respondents who have been successful in all issues while not having any debts are more than those in debt.

However, the HFCS survey 2017 has shown the opposite (Jurašková-Kucserová, J., Strachotová, A., 2019). According to him, there are a percentage more of those respondents who have a housing loan or other consumer credit or loan and who at the same time answered all the questions correctly than those who are not so indebted. Therefore, if we consider the results of both surveys, we cannot clearly assess how financial literacy affects debt. The differences between the conclusions of the two surveys can be justified on the one hand by the time lag of their implementation, but at the same time by the size and difference of the research sample. It can be assumed that since our questionnaire survey was conducted on a significantly smaller sample than in the case of HFCS, the differences between the results will be significantly larger than the differences between the results of the individual waves of the mentioned national survey.

From the point of view of the highest completed education, 11 respondents with a secondary education and 22 with a university education answered all the questions correctly. If we asked only the first four questions, as was the case in the third wave of HFCS, 17 respondents with completed secondary education answered correctly and all of them were 30. Following the findings, which assumes the level of education as one of the incentives for lower financial literacy, we could argue that to some extent this statement is true. Our questionnaire showed that respondents with a university degree have a higher level of knowledge about functioning in the financial sector than respondents with the highest secondary education. This assumption was also demonstrated in the HFCS survey, which also showed some correlation between the level of education and the correct answers. It has been shown that the higher the education of the respondents, the more correct the answers.

5 Conclusions

Based on the results we obtained through the questionnaire, we can conclude that most respondents can effectively manage their finances. As can be seen from the above graphs, most of them make savings and consider the creation of a reserve in case of unexpected events having an impact on the budget. At the same time, we found that the number of reserves of most respondents reaches the value of at least six-monthly incomes, which is generally considered to be optimal. We can also consider these steps as a procedure of a financially literate individual who is able to think strategically in the future.

The results also point to a relatively low level of indebtedness of respondents, as exactly one third of them are indebted. However, we could justify this by the large representation of the age group 18 - 25, as the highest level of indebtedness was shown in respondents over 25 years. Of these respondents, 47% are in debt. At the same time, it was confirmed that the most common form of debt is a mortgage loan, as we stated in the theoretical part of the work.

Regarding the financial literacy of the respondents, in terms of individual questions, the correct answers were most often marked. However, if we consider the correct answers cumulatively, only one fifth of all respondents were successful. However, compared to the results of the HFCS survey for 2014 and 2017, our respondents are more successful in percentage terms.

As was the case with the HFCS survey, our questionnaire showed a positive relationship between financial literacy and the level of completed education. The highest success was demonstrated by respondents with a university degree.

According to the conclusions of our questionnaire, we could also prove the relationship between indebtedness and the level of financial literacy. The data obtained show that individuals without any form of debt proved to be more financially literate. However, the opposite was the case with the HFCS survey, where indebted respondents were more successful in their correct answers. We justified these differences by the size of the research samples of both surveys and at the same time by the time lag between them.

However, the questions used in the questionnaire are just one of several ways in which financial literacy can be ascertained. How an individual is financially literate results from his daily actions. Whether it's the way money is spent, financial decisions made, consumption and savings, or financial planning, these are all aspects of the ability to manage money efficiently. If individuals are unable to spend their money efficiently and spend it recklessly, it can lead to their indebtedness. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam dui sem, fermentum vitae, sagittis id,

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References

- Aren, S., and Sibel D. A. (2014). A Literature Review on Financial Literacy. *Finansal Araştırmalar ve Çalışmalar Dergisi*. DOI: 10.14784/JFRS.2014117326.
- Ansong, A., and Gyensare, M.. (2012). Determinants of University Working- Students' Financial Literacy at the University of Cape Coast, Ghana. *International Journal of Business and Management* 7(9), 126–133. DOI: 10.5539/ijbm.v7n9p126.
- Atkinson, A. (2007). Financial Capability amongst Adults with Literacy and Numeracy Needs. Bristol: Personal Finance Research Centre, University of Bristol. <http://www.bristol.ac.uk/media-library/sites/geography/migrated/documents/pfrc0701.pdf>.
- Atkinson, A., and Messy, F.A. (2012). Measuring Financial Literacy: Results of the OECD / International Network on Financial Education (INFE) Pilot Study. *OECD Working Papers on Finance, Insurance and Private Pensions*, 15. DOI: 10.1787/5k9csfs90fr4-en.
- Bayer, P.J., Bernheim, D.B., Scholz, J.K. (1996). The Effects of Financial Education in the Workplace: Evidence from a Survey of Employers. *NBER Working Paper*, 5655, 1–29. <https://ideas.repec.org/p/nbr/nberwo/5655.html>.
- Berggren, J. and Gonzalez, R. (2010). *Gender Difference in Financial Decision Making - A Quantitative Study of Risk Aversion and Overconfidence Between the Genders*. Bachelor thesis, Umeå University. <http://www.divaportal.org/smash/get/diva2:324378/FULLTEXT01.pdf>.
- Brown, M. et al. (2016). Financial Education and the Debt Behavior of the Young. *The Review of Financial Studies*, 29 (9), 2490-2522.
- Cole, S., and Shastry, G.K. (2008). If You Are So Smart, Why Aren't You Rich? The Effects of Education, Financial Literacy and Cognitive Ability on Financial Market Participation. *Working Paper*, 09-071. <http://www.afi.es/EO/FinancialLiteracy.pdf>.
- Cole, S., Paulson, A.L., Shastry, G.K. (2012). Smart Money: The Effect of Education on Financial Behavior. *Harvard Business School Finance Working Paper*, 09-071. DOI: 10.2139/ssrn.1317298.
- Gathergood, J. (2012). Self-control, financial literacy and consumer over-indebtedness. *Journal of Economic Psychology*. 33 (3), 590-602.
- Gertler, P., Jurašková-Kuscervá, J., Strachotová, A. (2019). *Analytický komentár: Zisťovanie finančnej situácie a spotreby domácností: hlavné zistenia*. Online: https://www.nbs.sk/_img/Documents/_komentare/AnalytickeKomentare/2019/AK68_Zistovanie_financnej_situacie_a_spotreby_domacnosti_201910HFCS.pdf.
- Huston, S.J. (2012). Financial literacy and the cost of borrowing. *International Journal of Consumer Studies*. 36 (5), 566-572.
- Chen, H., and Volpe, R.P. (1998). An Analysis of Personal Financial Literacy among College Students. *Financial Services Review*, 7(2), 107–128. DOI: 10.1016/S1057-0810(99)80006-7.
- Jurašková-Kucserová, J., Strachotová, A. (2019). *Výsledky tretej vlny zisťovania o financiách a spotrebe domácností (HFCS)*. Bratislava: Národná banka Slovenska,

Online:

- http://www.nbs.sk/_img/Documents/PUBLIK/OP_1_2019_Jurasekova_Strachotova_Vysledky_tretej_vlny_HFCS.pdf.
- Kovalčíková, Z., Smoroň, L., Strenk, R. (2011). *Základy finančnej gramotnosti*. 1. vyd. Bratislava: Metodicko-pedagogické centrum. 68. Online: https://zssnpkrompachy.edupage.org/files/z_klady_finannej_gramotnosti.pdf.
- Kurowski, Ł. (2021). Institute of Finance, Warsaw school of economics Household's Overindebtedness during the COVID-19 Crisis: The Role of Debt and Financial Literacy. *Risks*. 9(4), 62.
- Lusardi, A., Mitchell, O.S. and Curto, V. (2009). Financial Literacy among the Young: Evidence and Implications for Consumer Policy. *National Bureau of Economic Research Working Paper*. 15352. DOI: 10.3386/w15352.
- Lusardi, A., Tufano, P. (2015). Debt literacy, financial experiences, and overindebtedness. *Journal of Pension Economics and Finance*. 14(4), 332-368.
- Mandell, L., and Klein, L.S. (2007). Motivation and Financial Literacy. *Financial Services Review* 16(2), 105–116. <http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=D4B327419572F766138902D74BDDFC0B?doi=10.1.1.392.2771&rep=rep1&type=pdf>.
- Mandell, L., and Klein, L.S. (2009). The Impact of Financial Literacy Education on Subsequent Financial Behaviour. *Journal of Financial Counseling and Planning*, 20(1), 15–24. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2224231.
- McDaniel, L., Martin, R.D., and Maines, L.A. (2002). Evaluating Financial Reporting Quality: The Effects of Financial Expertise vs. Financial Literacy. *Accounting Review* 77 (s-1): 139–167. DOI: 10.2308/accr.2002.77.s-1.139
- Národný ústav certifikovaných meraní vzdelávania. (2020) PISA 2018: Prvé výsledky medzinárodného výskumu 15-ročných žiakov v oblasti finančnej gramotnosti z pohľadu Slovenska. Online: <http://www.nucem.sk/dl/4773/PISA%202018%20financna%20gramotnost.pdf>.
- Národná banka Slovenska. (2021). Aktuálne nastavenie nástrojov v oblasti poskytovania úverov. Online: <https://www.nbs.sk/sk/dohlad-nad-financnym-trhom/politika-obozretnosti-na-makrourovni2/nastavenie-nastrojov/aktualne-nastavenie-nastrojov-v-oblasti-poskytovania-uverov-domacnostiam>.
- OECD INFE. (2020) Measuring Financial literacy: Questionnaire and Guidance Notes for Conducting an Internationally Comparable Survey of Financial Literacy. Online: <https://www.oecd.org/finance/financial-education/49319977.pdf>.
- Prokopec, M. (2019). Finančná gramotnosť je kľúčová. *Hospodárske noviny*. Bratislava: MAFRA, 227, 13.
- Rob, C.A. (2011). Financial Knowledge and Credit Card Behaviour of College Students. *Journal of Family and Economic* 32, 690–698, DOI: 10.1007/s10834-011-9259-y.
- Tlačová agentúra Slovenskej republiky. (2019). Finančná gramotnosť na Slovensku klesá. *Hospodárske noviny*. 21.10.2019. Online: <https://finweb.hnonline.sk/ekonomika/2027864-financna-gramotnost-na-slovensku-klesa>.
- Vass, J. (2012). Beyond Financial Literacy: The Case of Cross-Generational Couples' Problem-Solving the Life Course. *International Journal of Business and Social Science* 3 (14), 166–175. <http://eprints.soton.ac.uk/id/eprint/340693>.

The expenditure side of GDP in the crisis period in the EU

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Abstract: The reduction of economic activity related to crises is natural. The double-dip recessions are emerging in economies. The article deals with two crises, namely global financial crisis (2008-2009) and the coronavirus crisis (2020-2021). The drivers of these crises are different. The EU states used measures to minimize the consequences of the crises, which manifested themselves with varying intensity in their spending. The paper focuses on the comparison of the impact of the two crises on the expenditure side of GDP in the economies of the EU states. The paper analyses the real effects of factors on changes in GDP in individual EU states. The analysis showed a different response of individual expenditures and economic policies to these two crises. In the crisis period of the coronavirus was found a higher degree of synchronization of the impact on changes in spending in EU countries. A different reaction is evident in the area of fiscal policy and its impact on both crises. It can be expected that the subsequent crisis associated with the war in Ukraine and the energy crisis will affect all components of expenditure side GDP.

Keywords: crisis period, expenditure side, GDP, EU

JEL Classification: E23, G01, F41

1 Introduction

The economic performance of the EU economies is not constant and goes through a cyclical process known as the business cycle. One phase of the business cycle is the recession phase, sometimes called the economic crisis, which is characterised by a significant decline in economic performance. An important aspect in assessing crises is to find an answer to the question of what is the main cause (driver) of the crisis. Most often, one can look for causes on the aggregate supply side, aggregate demand side or a combination of both. In addition to the causes, it is also necessary to analyse the impact of the crisis on the economies. Two crises have occurred in EU economies in the last 20 years, namely the financial crisis (2008-2009) and the coronavirus crisis (2020-2021). The aim of the paper is to identify the main differences in the impact of the two crises on the expenditure side of GDP in the EU economies.

A market economy is subject to economic fluctuations, which are distinguished as structural and cyclical. Structural fluctuations occur because of constant changes in consumer preferences as well as the scarcity of economic resources. On the other hand, cyclical fluctuations, where some sectors reduce their production and others expand, are characterised by a general decline and then a general increase in production and employment in virtually all sectors (Holman, 2002) or regions (Redlichova et al., 2019). The economic cycle consists of a more or less regular alternation of two phases, namely a period of expansion followed by a period of recession. In a recession, the productive activity of the economy declines, unemployment rises, investment and innovation activity of firms declines and firms' profits fall. Krugman (2009) also calls this period of economic downturn a macroeconomic crisis. However, periods of expansion and recession do not necessarily alternate regularly. Quite often, the opposite is the case. Recently, the world economy has experienced a double-dip recession (W); sometimes, on the other hand, boom periods last for many years (Čermakova et al. 2022). Fluctuations in the business cycle are either internal or external in nature. In recent decades, the causes are more often external and do because of the global interconnectedness of national economies.

As historical experience shows, the most common causes of downturns in economic activity have been financial crises and price shocks in global commodity markets. Financial crises can be divided into monetary, banking and debt crises. These crises can occur in different interconnections (Czesaný & Johnson, 2012).

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The first crisis analysed after the enlargement of the EU to the new accession countries was the economic crisis in 2008 and 2009. The trigger for the crisis was the housing price collapse in the United States (Blanchard, 2009). When these problems first emerged, it appeared that the impact would be limited mainly to the US financial sector, but the first significant effects on global markets began as early as August 2007. The crisis intensified sharply in September 2008, especially after the collapse of the US investment bank Lehman Brothers (Edey, 2009). The bursting of the housing bubble in the United States had a subsequent impact on financial markets worldwide. This effect subsequently affected European economies and led to recession in most countries in Europe. The countries have reacted differently to the economic crisis in terms of labour market and employment (Pavelka & Löster, 2016). The study of Šetek and Petrách (2017) points to economic and security implications.

The next economic crisis came in 2020 and 2021 and was caused by an external cause, namely the coronavirus epidemic. The coronavirus crisis (Covid crisis) was unique in several respects. This recession did not have an economic origin and has been truly global so far, because, unlike the great financial crisis of 2008-2009, it has affected all countries and regions (Dušek, 2015). The individual policy response was unique in terms of speed, size, and scope and triggered a concerted effort combining monetary, fiscal, and prudential policies (Borio, 2020). On the positive side, the increased use of information technology (Vrchota et al. 2020) can be considered to have outweighed the negatives of this crisis.

2 Methods

The paper focuses on the analysis of the effects of two crises (the Great Depression and the coronavirus recession) on the expenditure side of GDP in EU countries and to compare these effects. In order to compare the real evolution of the observed indicators (physical volume of indicators), the indicators have been adjusted for the price effect. Data were taken from Eurostat, where they are presented in national accounting terms at current and previous year's prices. GDP according to the expenditure method is the sum of final consumption expenditure (households, government and non-profit institutions serving households), gross capital formation (gross fixed capital formation, change in inventories and net acquisition of valuables) and the balance of exports and imports (exports of goods and services minus imports of goods and services). A comparison of the values of the aggregate at previous prices and the value of the aggregate at current prices was used to give a realistic indication of the change in the two crises. The result of this ratio is the Laspeyres volume index.

During the global economic crisis, an index of all components of GDP was found by the expenditure method:

$$I_{q,i,2009/2008} = \frac{\sum p_{i,2008} q_{i,2009}}{\sum p_{i,2008} q_{i,2008}}, \quad (1)$$

in the time period of the Covid crisis then

$$I_{q,i,2019/2018} = \frac{\sum p_{i,2019} q_{i,2020}}{\sum p_{i,2019} q_{i,2019}}. \quad (2)$$

where $I_{q,i,2019/2018}$ resp. $I_{q,i,2009/2008}$ is the Laspeyres volume index, i is Gross domestic product at market prices and its individual components (Final consumption expenditure of general government - FCG, Final consumption expenditure of households - FCH, Final consumption expenditure of nonprofit institutions serving households - NPISH, Gross capital formation - GCF, External balance of goods and services- EB),

$\sum p_{i,2008} q_{i,2009}$, resp. $\sum p_{i,2019} q_{i,2020}$ are individual aggregates in year 2009 resp. 2020 in previous year prices,

$\sum p_{i,2009} q_{i,2009}$, resp. $\sum p_{i,2020} q_{i,2020}$ are individual aggregates in year 2009 resp. 2020 in current prices.

For the analysis of GDP growth, the contribution of each of the domestic demand factors (final consumption, gross capital formation and net exports) to GDP growth was expressed.

For a given interval, the contribution of each of these elements is equal to the product of its growth rate $t/t-1$ and the after-share of that element in the GDP of interval $t-1$.

The GDP growth rate is the sum of the growth rates of each end-use component weighted by the share of each of these components in the GDP of the preceding interval. (Imports are treated as negative uses - the larger the imports, the less they contribute to GDP growth).

$$\left(\frac{FCH_{2009 \text{ in previous year prices}}}{FCH_{2008 \text{ in current prices}}} - 1 \right) \cdot \frac{FCH_{2008 \text{ in current prices}}}{GDP_{2008 \text{ in current prices}}} \text{ resp. } \left(\frac{FCH_{2020 \text{ in previous year prices}}}{FCH_{2019 \text{ in current prices}}} - 1 \right) \cdot \frac{FCH_{2019 \text{ in current prices}}}{GDP_{2019 \text{ in current prices}}} \quad (3)$$

The contribution to final consumption of government and non-profit institutions, the contribution of gross capital formation, the contribution of exports and the (negative) contribution of imports to GDP growth are determined in a similar way. National accounts data in millions of euro are available.

3 Research results

The first part of the analysis focused on the two main components of GDP in terms of expenditure, namely gross fixed capital formation (investment) and household consumption. First, the volume indices of the individual domestic demand factors in the EU countries during the Great Depression (2009/2008) and the coronavirus crisis (2020/2019) were established. The indices always compare the crisis period with the pre-crisis period. Tables 1, 2 and 3 show the different developments of the factors on the expenditure side of GDP across EU countries.

Table 1 Gross capital formation in time periods of crises (year-on-year volume indices)

	2009/2008	2020/2019
>1		Estonia, Greece, Denmark, Romania
1 - 0,9	Belgium, Malta	Finland, Latvia, Sweden, Croatia, Luxembourg, Austria, Malta, Bulgaria, Netherlands, Germany, Portugal, Hungary, Belgium, Slovenia, EU (27 countries), France
0,9 - 0,8	Austria, Netherlands, Portugal, Poland, France, Italy, EU (27 countries), Germany, Czechia, Spain, Sweden, Ireland, Finland	Poland, Czechia, Italy, Cyprus, Spain, Lithuania Slovakia
0,8 - 0,7	Cyprus, Denmark, Croatia, Romania, Hungary, Luxembourg, Bulgaria, Greece	Ireland
0,7 - 0,6	Slovakia, Slovenia	
0,6 - 0,5	Latvia, Estonia	
0,5 - 0,4	Lithuania	

Source: own processing, Eurostat

Table 1 shows the different response of the gross capital formation indicator during the crisis period. While in the period of economic crisis investments decreased, in some countries such as Latvia, Estonia, Lithuania even very significantly by about 50%, in the period of Covid crisis in some EU countries (Estonia, Greece, Denmark, Romania) investments increased or slightly decreased. The average decline in all EU-27 countries was in the range of 0.9-0.8 in the economic crisis, while the average decline in the Covid crisis was lower (in the range of 1-0.9). In the Czech Republic, the decline was about the same in both crises. Rolinek et al. (2015) and Mura et. al. (2021) points out that firms are increasingly focusing on more technology-intensive investments. This effect may somewhat limit the negative impact of the overall decline in investment. Table 2 shows the volume indices of final consumption expenditure of households during the crisis period in the EU countries. Final consumption expenditure did not decrease as significantly as gross capital formation.

Table 2 Final consumption expenditure of households (year-on-year volume indices)

	2009/2008	2020/2019
>1	Poland, Slovenia, Luxembourg, Sweden, Malta, Austria, Belgium, France	
1 - 0,9	Germany, Slovakia, Czechia, EU (27 countries), Italy, Netherlands, Greece, Portugal, Finland, Denmark, Spain, Bulgaria, Ireland, Cyprus, Romania, Hungary, Croatia	Bulgaria, Slovakia, Hungary, Denmark, Lithuania, Estonia, Poland, Sweden, Finland, Cyprus, Romania, Croatia, Germany, Slovenia, Latvia, Netherlands, France, Czechia, Portugal, Luxembourg, EU (27 countries), Greece, Belgium, Austria
0,9 - 0,8	Estonia, Latvia, Lithuania	Italy, Malta, Ireland, Spain

Source: own processing, Eurostat

Table 2 shows that Final consumption expenditure of households increased for some countries during the economic crisis in 2009 (Poland, Slovenia, Luxembourg, Malta, Austria, Belgium, France), but decreased for all EU countries during the Covid crisis.

Table 3 Final consumption expenditure of general government (year-on-year volume indices)

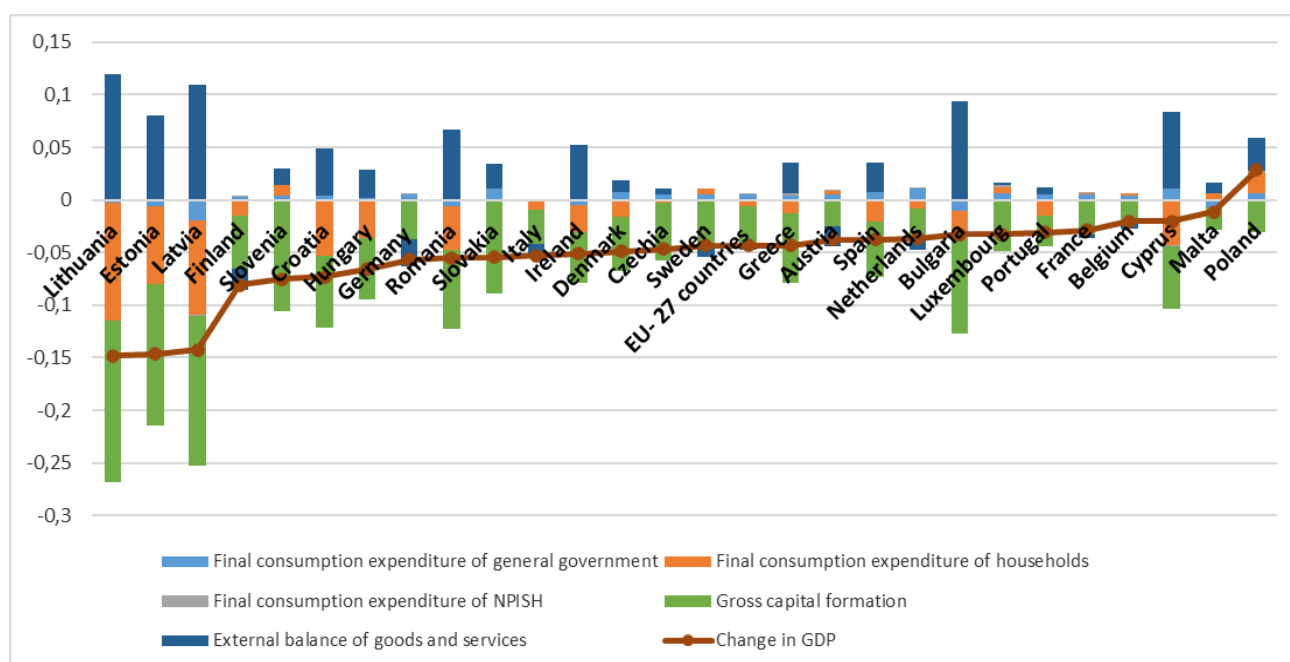
	2009/2008	2020/2019
>1,1		Malta, Cyprus
1,1 -1,0	Cyprus, Slovakia, Netherlands, Luxembourg, Spain, Poland, Germany, Denmark, Czechia, Portugal, Austria, France, EU (27 countries), Sweden, Croatia, Slovenia, Greece, Belgium, Finland, Hungary	Ireland, Bulgaria, Luxembourg, Poland, Slovenia, Croatia, Germany, Czechia, Spain, Estonia, Greece, Latvia, Romania, EU (27 countries), Netherlands, Italy, Finland, Portugal
1 - 0,9	Italy, Lithuania, Ireland, Estonia, Malta, Romania, Bulgaria	Belgium, Lithuania, Austria, Hungary, Denmark, Sweden, France
0,9 - 0,8	Latvia	

Source: own processing, Eurostat

The following part analyses the contribution of the change in the GDP component according to the expenditure method to the change in aggregate GDP in the countries in both crises (Figures 1 and 2).

Figure 1 analyses the above factors during the 2009/2008 economic crisis (comparing the 2009 item in previous period prices and the 2008 item in current period prices). Figure 1 shows that GDP declined in 2009 compared to 2008 in all EU countries except Poland, which recorded a slight increase. The largest falls in GDP can be observed in Lithuania, Estonia and Latvia. In these three countries, the decline was mainly influenced by a fall in investment and consumption expenditure of households, while the positive effect was caused by the External balance of goods and services. In the other EU countries, the decline in GDP was also caused by a fall in investment. Government spending was mostly slightly positive.

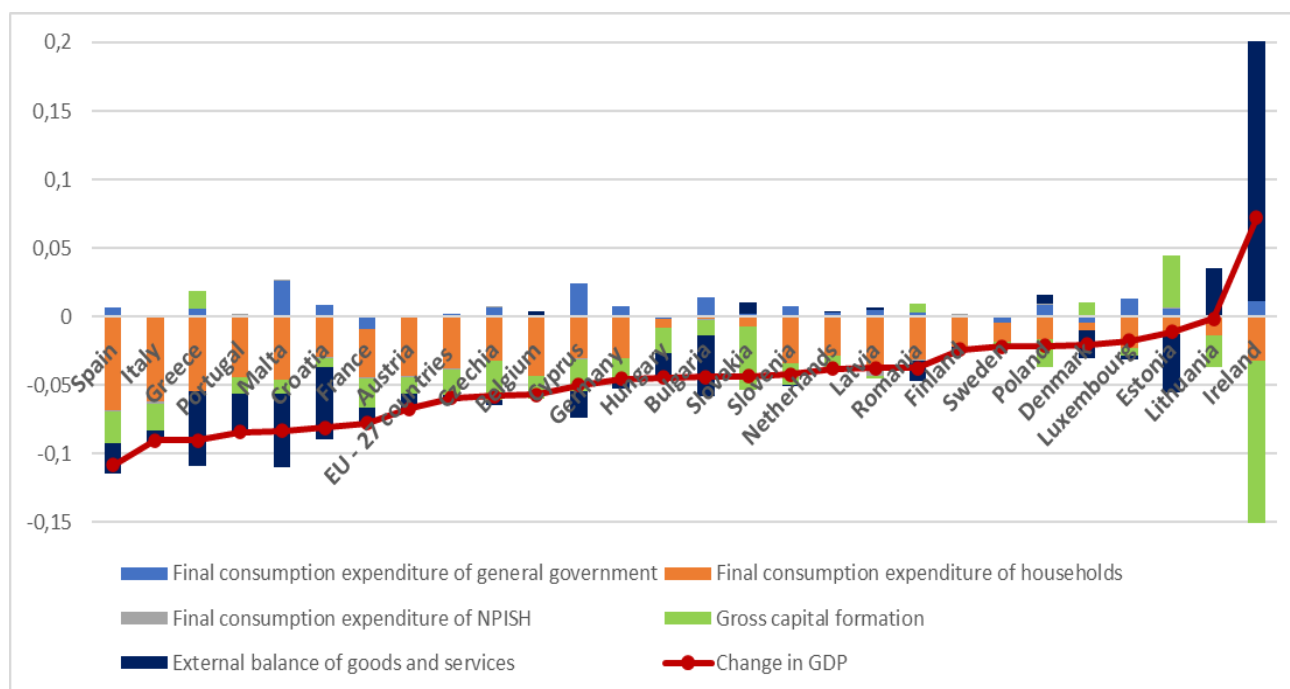
Figure 1 Contribution of individual components from the expenditure side to the change in GDP in 2009/2008



Source: own processing, Eurostat

Figure 2 analyses the same factors in the 2020/2019 Covid crisis period (comparing the 2020 entry in prior period prices and the 2019 entry in current period prices).

Figure 2 Contribution of individual components from the expenditure side to the change in GDP in 2020/2019



Source: own processing, Eurostat

The comparison shows that there is also a decline in GDP that does not exceed 10%. In this period, the decline was mainly driven by household consumption, while the external balance of goods and services was also negatively affected (especially in Croatia, France, Portugal, Bulgaria and Malta). Consumption expenditure of government had a slightly positive effect.

4 Conclusions

This analysis has shown the differences in the impact of the two crises and identified the different responses to these crises from the perspective of the expenditure side of GDP in individual EU countries or the EU as a whole (EU27). The first financial crisis analysed (2009/2008) had an impact on the expenditure side mainly in terms of investment restraint. A study by Kahle and Stulz (2013) adds, in addition to investments, corporate loans and capital expenditures fall sharply at this time. On the other hand, the subsequent economic crisis associated with the Covid epidemic (2020/2019) has had an impact on household consumption. An important aspect here is the different use of different economic policies. In the first crisis, the use of monetary policy was more prevalent and, conversely, during the Covid crisis, the use of fiscal policies by governments to reduce the impact of the crisis was significantly more prevalent. The differences in national responses across EU countries are not significant. A study by Villana and Fana (2021) in their Covid-19 crisis analysis found that a significant risk in the EU is the high degree of integration of European economies. The analysis has shown that each crisis must be assessed individually, both in terms of its causes and its impact.

References

- Borio, C. (2020). The Covid-19 economic crisis: Dangerously unique. *Business Economics*, 55(4), 181-190.
- Blanchard, M. O. J. (2009). *The crisis: basic mechanisms and appropriate policies*. International Monetary Fund.
- Czesaný, S., & Johnson, Z. (2012). *Ekonomický cyklus, hospodářská politika a bohatství zemí*. Oeconomica.
- Čermáková, K., Hromada, E., Henrique Filho, E. A., & Krulický, T. (2022). The Effects of Homeownership on Wealth Distribution. *European Journal of Interdisciplinary Studies*, 14(1), 68-86.
- Dusek, J. (2015). Public Service of Public Transport Connectivity in South Bohemian Regions from the Point of View of Municipalities between the Years 2004-2014. In M. Pech (Ed.), *Proceedings of The 9th International Scientific Conference Inproforum: Common Challenges - Different Solutions - Mutual Dialogue*. 40-46.

- Edey, M. (2009). The global financial crisis and its effects. *Economic Papers: A journal of applied economics and policy*, 28(3), 186-195.
- Holman, R. (2002). *Ekonomie*. Praha: C.H. Beck
- Kahle, K. M., & Stulz, R. M. (2013). Access to capital, investment, and the financial crisis. *Journal of Financial economics*, 110(2), 280-299.
- Krugman, P. (2009). *How did economists get it so wrong?* New York Times, 2(9).
- Mura, L., Zsigmond, T., & Machová, R. (2021). The effects of emotional intelligence and ethics of SME employees on knowledge sharing in Central-European countries. *Oeconomia Copernicana*, 12(4), 907-934.
- Pavelka, T., & Löster, T. (2016). The Development of Unemployment in the European Union's Labour Market Due to the Recent Economic Crisis, Using Cluster Analysis. In *Business Challenges in the Changing Economic Landscape-1*, (323-337). Springer, Cham.
- Redlichova, R., Chmelikova, G., Blazkova, I., & Tamas, V. (2019). Role of Companies' Size in Socio-Economic Development of Regions in The Czech Republic. *Ekonomski Pregled*, 70(6), 833-848. DOI: 10.32910/ep.70.6.2
- Rolinek, L., Plevny, M., Kubecova, J., Kopta, D., Rost, M., Vrchota, J., & Marikova, M. (2015). Level of process management implementation in SMEs and some related implications. *Transactions on Business and Economics*, 14(2A), 360-377.
- Setek, J., & Petrach, F. (2017). National Security in the Context of the Global Economy. In T. Klietk (Ed.), *Globalization And Its Socio-Economic Consequences*, PTS I - VI (s. 2315-2323). Univ Zilina, Fac Operat & Econ & Transport & Commun, Dept Econ.
- Villani, D., & Fana, M. (2021). Productive integration, economic recession and employment in Europe: an assessment based on vertically integrated sectors. *Journal of Industrial and Business Economics*, 48(2), 137-157.
- Vrchota, J., Maříková, M., & Řehoř, P. (2020). Teleworking in SMEs before the onset of coronavirus infection in the Czech Republic. *Management: Journal of Contemporary Management Issues*, 25(2), 151-164.

Multi-year subsidy titles in culture

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Abstract: The aim of the paper is to analyze and evaluate the variability of multi-year subsidy titles in the culture sector in a temporal and cross-sectional comparison, to determine the factors influencing the size and dynamics of subsidies, and then to compare the defined problematic areas with selected cities of the Central Bohemian Region. The analytical part shows the development of subsidies in the context of total income. Furthermore, the share of subsidy providers in the subsidy income of municipalities is examined. Subsequently, a comparison is made of the dynamics of non-investment subsidies, investment subsidies and total expenditures of municipalities. This part also includes the recalculation of subsidies per inhabitant and its evaluation over time. The key part of the paper is to find the factors that affect municipalities' spending on culture. The influence of these factors is investigated through established hypotheses. This paper also focuses on the financing of cultural policy and the formation of the concept of cultural development and gives recommendations that the district cities should adopt in the field of cultural policy.

Keywords: financing of culture, subsidies, comparison of spending on culture, cultural policy

JEL Classification: G32, G33, C35

1 Introduction

The prerequisite of every human activity is the allocation of monetary and other resources needed to meet the specified goals. In this case, it is about preserving and developing the multicultural environment of our entire society. Culture has its own specific criteria, when it is possible in a suitable form, with a purposeful programmatic and especially coordinated focus, to have a retroactive effect on the activation of the economic potential of society. The efficiency of the spent funds, depending on the allocation function of public finances, is usually associated with efficiency, namely societal efficiency, which includes not only general economic attributes, but also, for example, historical, political, social and other attributes. The allocation of program resources intended to support culture has a significant historical undertone, especially in the Czech lands. An integral and important part is, of course, a significant influence on the relevant territory, which specifically includes the cultural environment. The influence of tourism and the local business environment can significantly return the financial costs incurred.

To best illustrate how culture is financed, the study interprets the data within a broad framework of cultural policy, including an analysis of policy priorities, decision-making patterns and administrative organization. The design, focus and implementation of cultural policies manifests itself differently in individual regions. This requires continuous research into cultural policies as well as continuous collection of related data. The study focuses on three main sources of funding for culture: the government, the market and the third sphere (non-profit sector). Each of them has its own justification supported by the given legal competences. The study tries to maintain the distinction between these three main sources of funding by breaking down the data positionally, but at the same time integrating them in a summary way. The diploma thesis deals with the analysis of public direct budgetary financial support (especially subsidies and grants provided by central and lower levels of state administration). The data is very important for the analysis of cultural policy, as it illustrates the differences in the financial demands in individual regions. The adjustments of funds dedicated to the sector, their sources (public or private), their distribution between different levels of government and different artistic sectors - all this is useful to reveal the way in which cultural policies are actually implemented.

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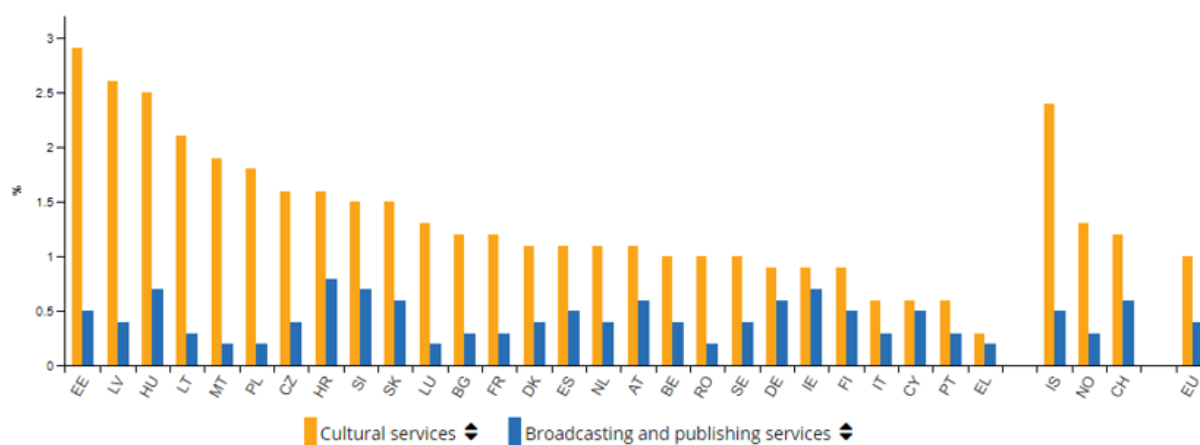
According to common parameters, culture cannot be quantified by a simple economic analysis. It has its own rules and laws. The economic character of public services of local and regional culture is existentially dependent on funds from public budgets. The importance of the national economic point of view cannot be overlooked either, primarily from the point of view of the employment of the population, their income side from which levies are made, from the point of view of the symbiosis of culture and tourism, which brings other important resources to the budgets, and the economic effect of the expenditure of contribution organization of culture necessary for its own activity.

The aim of the work is to analyze and evaluate the variability of multi-year subsidy titles in the culture sector in a temporal and cross-sectional comparison, to determine the factors influencing the size and dynamics of subsidies, and then to compare the defined problem areas with selected cities of the Central Bohemian Region.

The cultural and creative sectors are increasingly seen as drivers of economic growth, especially as a source of job creation. Funding of cultural institutions and events in the Czech Republic and throughout Europe has long been linked primarily to support from public sources. State institutions, as well as self-governing units, have stably introduced items for culture in their budgets and finance the necessary (according to their choice) cultural events and institutions in various ways. (Ledvinová, 2013)

The following graph shows the funding of cultural services, broadcasting and publishing services from public sources (including central and local sources) of European countries in 2019. The share of EU public expenditure on cultural services was on average 1.0%, with the lowest share recorded in Greece (0.3%) and the highest in Estonia (2.9%).

Chart 1: Share of EU countries' government spending on cultural services, broadcasting and publishing services in 2019



Source: Eurostat, 2022

The cultural and creative sector is very susceptible to various fluctuations, be it social, political, cultural-historical and especially economic changes. The economic crisis required and requires more and more interventions from state resources to maintain a functional market. Increasing demands on other parts of the state budget (especially in the social and health areas) caused a certain deviation from culture as a priority of the programs of the ruling parties and resulted in a reduction of the budgets for this chapter.

2 Methods

The work focuses primarily on the analysis of the financing of entities operating at the municipal level, and on the actions implemented or potentially implemented there. The territories of three district towns, Beroun, Příbrami and Rakovník, were deliberately chosen for analysis. These district towns were chosen for the comparison of culture funding because they come from the same region, are neighboring districts and are close to the capital city of Prague. Selected cities are presented in the work and the basic characteristics of the cultural organizations operating in them are given, which are mostly grant-in-aid organizations. The subject of the analysis was the examination and comparison of structured financial costs, in particular the analysis of their budgets and the method of management over a several-year development period. This means comparing the costs of the same organization over a period of several consecutive years, and also in comparison with a similar entity operating in another investigated city.

Every municipality tries its best to develop the cultural subconscious and support the development of culture, when it is possible to do this in different ways, for example by providing financial resources to both individuals and organizations or by founding their own associations. Other options are also used, such as free rental of spaces, equipment, and technologies used to carry out cultural activities. Various forms of cultural support are also shown on the examples of selected municipalities.

In order for the impairment of the above characteristics to be reliable, the following prerequisites must be met:

- clear definition of cultural activities and their bearers
- precise definition of individual factors (dimensions) of the movement of financial flows
- compilation of standard tables enabling the classification of financial flows in the form of expenses and income according to various factors

The economic dimension of culture is much easier to quantify than its social dimension. The first step was a pilot survey, the aim of which was to assess the availability of data in the district towns and the Central Bohemian Region. These data can be used to analyze patterns of public spending, particularly trends in spending on specific functions over time, and to compare across regions.

The sources of information needed to compare culture funding at the district level are diverse, including administrative data as well as data from statistical surveys. The first group primarily includes data on the use of public budgets at various levels of management, as well as information from departments of culture, or city cultural centers. Regular annual reports are also relevant sources of data. Statistical data for individual areas have been compiled in such a way as to provide the most comprehensive view of the diverse cultural sector. The basic indicators are based on Monitor, the information portal of the Ministry of Finance.

Financial management in the field of culture is monitored with the help of a system of tables recording the variously broken down costs and expenses of the relevant activities, the sources of their financing, the need and creation of capital over time. The processing of the above-mentioned data provides important information for economic and political decisions regarding the given area. On a broader scale, it creates a basis for comparisons and analytical evaluations.

Important information for processing the practical part is obtained through structured interviews and consultations with senior employees of individual departments of culture and Municipal Cultural Centers in Příbram, Beroun and Rakovník. In addition, a personal interview with the councilor of the Central Bohemian Region for the area of culture, historic preservation and tourism was included.

The test (t-test) of the significance of the sample correlation coefficient was used to evaluate the established hypotheses that examine the dependence between two variables. Given the assumption that the data follow a normal distribution, this was the Pearson correlation coefficient. In this case, a positive correlation was tested, i.e. a situation where one quantity grows together with the other. All hypotheses were evaluated at the typically chosen significance level of 5%.

3 Research results

The Central Bohemian Region is establishing twenty contributory organizations in the field of cultural services, tourism and historic preservation. These include seventeen contributory organizations focused on the activities of museums, galleries and monuments, the Central Bohemian Science Library and the Institute of Archaeological and Monument Care. Of all the regions, it finances and manages the largest number of its own organizations in the field of culture and thus fundamentally participates in the cultural life of the region by exercising its founding function. With their program, these contribution organizations also participate in the project called the Central Bohemian Cultural Summer, which aims to revive culture after the coronavirus pandemic. In 2021, the contribution organization Středočeská centrálního tourism was incorporated under the Department of Culture and Monument Care, whose main activity is the development and promotion of tourism in the largest region of the Czech Republic.

The amount of spending on culture varies between the selected municipalities. Studies on the expenditure policy of local governments show that the size of the municipal budget is an important determinant of the level of expenditure. Higher local income means more money for all spending categories. Many studies also show that population size is an important factor in the demand for cultural goods. But population size also correlates with the cost of culture. If there are more people who use cultural services, the cultural infrastructure becomes more complex and expensive.

The theory of fiscal federalism posits that local politicians and their preferences and behavior are a very important determinant of local politics. One example of this behavior is the political cycle, where local government officials change spending in the years just before or after an election to increase their chances of winning. It follows that mayors lobby at election time to get more subsidies to cover the expenses associated with their campaign, which will bring them votes. It is therefore possible that council members will want to secure the favor of their constituents in election years and increase subsidies in the areas most preferred by their constituents. Sanjuán et al. (2020) present a case for Spanish medium-sized cities where a clear political cycle can be observed in urban cultural spending. In the Spanish case, the authors argue that politicians can substantially increase their chance of re-election if they increase spending on culture before elections. The

results in this case show that mayors behave opportunistically, increasing spending on culture in the election year and reducing it in the second year after the election.

According to Jílek (2008), the following criteria are most often found in the samples for the distribution of subsidies: the number of inhabitants, the age and social structure of the population, e.g. the number of children, young people or seniors, the unemployed, and structural characteristics of the local government, such as the number of dwellings or the length of the road network. In addition, the socio-economic characteristics of citizens in the form of income, age and education are important factors that clearly influence the expenditure of municipalities on cultural matters.

Another influence on municipal spending on culture can be a large number of separate subsidy programs that depend on the differences in the requirements of individual artistic and cultural fields: If the support is to be targeted effectively to the needs of each field, the specifics of this field need to be defined in detail, which will to a certain extent, always mean the fragmentation of requirements for individual subsidy areas and the difficulty in setting common goals. Based on the results of the reports of the Supreme Audit Office (NAO), the approach and attitude of supporting cultural activities of the Ministry of Culture, which determines the volume and flow of funds not always completely transparently, and is not always able to evaluate the benefit of supported projects, is criticized. The great fragmentation of requirements for individual subsidy areas and the difficulty in setting common goals among applicants sound very negative. Merging these would significantly contribute to the higher usefulness of the organized cultural events. However, development is moving towards limiting these negatives.

The statistical method of verifying the significance of the correlation coefficient, which expresses the degree of linear dependence between two quantities, is used to compare the financing of culture between the selected municipalities. For clarity, graphs are created regarding the comparison of expenses in the field of culture for each municipality separately and expenses summarized for all municipalities together.

Hypothesis No. 1: As the volume of total expenditures of municipal budgets increases, expenditures on the culture of these municipalities increase.

This hypothesis was divided into four sub-hypotheses. The first three hypotheses are focused on each municipality separately, and the last fourth one evaluates the total expenditures of municipal budgets with cultural expenditures for all municipalities together.

Sub-hypothesis No. 1.1: As the total budget expenditure of the city of Beroun increases, the expenditure on the culture of this municipality increases.

Based on the data obtained and the chosen significance level of 5%, it was not possible to reject the null hypothesis in favor of the alternative hypothesis ($0.234 > 0.05$). Thus, a positive correlation between the examined variables was not proven, that with the increasing volume of total expenditures of the budget of the city of Beroun, the expenditures on the culture of this municipality would increase. The established hypothesis was not confirmed.

Sub-hypothesis No. 1.2: As the total budget expenditure of the city of Příbram increases, the expenditure on the culture of this municipality increases.

The null hypothesis was successfully rejected in favor of the alternative hypothesis ($0.004 < 0.05$) at the chosen significance level of 5%. A positive correlation between the analyzed variables was demonstrated. It can therefore be confirmed that spending on culture grew in Příbram depending on the growing total spending of this city. The established hypothesis was thus confirmed.

Sub-hypothesis No. 1.3: As the total budget expenditure of the town of Rakovník increases, expenditure on the culture of this municipality increases.

It was not possible to reject the null hypothesis in favor of the alternative hypothesis ($0.356 > 0.05$) according to the data determined at the chosen significance level of 5%. A positive correlation between the selected variables was not proven, and therefore the culture expenses of the city of Rakovník are not determined by the size of its total expenses.

Sub-hypothesis No. 1.4: As the volume of total budget expenditures of the analyzed cities increases, their expenditures on culture increase.

The null hypothesis was rejected in favor of the alternative hypothesis ($0 < 0.05$) at the chosen significance level of 5%. A positive correlation between the investigated quantities was demonstrated, and thus the established hypothesis was confirmed. The claim that "as the total expenditure of municipal budgets increases, the expenditure on the culture of these municipalities increases" was confirmed due to the significant difference between the expected and observed frequencies.

Hypothesis No. 2: With the economic development of our society, spending on cultural areas increases.

The second hypothesis was also divided into four sub-hypotheses, where the first three hypotheses are based on each municipality separately and the fourth one assesses the dependence of spending on culture in the range of individual years.

Sub-hypothesis No. 2.1: Spending on the culture of the city of Beroun increases with the passing years.

The null hypothesis failed to be rejected in favor of the alternative hypothesis ($0.215 > 0.05$) based on the data obtained and the chosen significance level of 5%. Thus, a positive correlation was not proven and the hypothesis established. It can be confirmed that spending on culture in the city of Beroun has not increased over the years.

Sub-hypothesis No. 2.2: Expenditure on the culture of the city of Příbram grows with the passing years.

At the chosen significance level of 5%, the null hypothesis was rejected in favor of the alternative hypothesis ($0 < 0.05$). A positive correlation between the investigated quantities was demonstrated, and therefore the formulation of the research hypothesis can be confirmed. The result of statistical research is that spending on culture in the city of Příbram gradually increases with the passing years.

Sub-hypothesis No. 2.3: Spending on culture in the city of Rakovník grows with the passing years.

According to the resulting data, it was not possible to reject the null hypothesis in favor of the alternative hypothesis, as the obtained significance level is greater than the chosen significance level ($0.201 > 0.05$). Therefore, the positive correlation and the hypothesis established with it were not proven. The claim that spending on culture in the city of Rakovník has been gradually increasing over the past twelve years is not valid.

Sub-hypothesis No. 2.4: Expenditures of all selected cities increase with increasing years.

In this part, the examined cities were analyzed in summary, thus the hypothesis with No. 2 conclusion could be confirmed or rejected.

The hypothesis summarizing all the municipalities together was confirmed, including the positive correlation between the investigated quantities. The null hypothesis was successfully rejected in favor of the alternative hypothesis ($0.032 < 0.05$) at the 5% significance level. The hypothesis in the wording: "With the economic development of our society, spending on cultural areas grows." was proven.

The understanding of the financing of the cultural area is, with some exceptions, determined from the point of view of classical economic profitability, rather loss-making (if the multiplier effects of the economic impacts of cultural activities are not taken into account). The management of each city strives for the economic sustainability and stabilization of the cultural organizations established and founded by it, for the support and development of multi-source financing with the most optimal involvement of cooperating actors and funds from public sources (European, Norwegian, state, regional and local), as well as obtaining additional resources from private the business sphere, in particular, in an effort to preserve the self-sufficiency of these cultural entities achieved in recent years. It is desirable to prioritize a system of multi-year support for public benefit projects from the city budget with regard to the economic sustainability of planned long-term events. The event organizers anticipate a multi-year stabilization of the economic security of the cultural activities they organize. The resulting situation forced changes in the legal status of individual cultural entities, which were transformed from originally municipal contributory organizations to public benefit societies together with associations, foundations, endowment funds, registered legal entities of churches, religious societies, and to limited liability companies, which resulted in to a fundamental change in the financing and more flexible management of these organizations and greater accessibility to external resources.

The method of financing important cultural and social events and institutions with the help of multi-year grants, which forces individual entities to cooperate better, but at the same time offers them stabilized means for realizing their own plans, appears to be very advantageous in this regard. In addition, several years of gradual development are guaranteed here. Of the cities analyzed, only the city of Beroun offers multi-year financing through its subsidy program. Multi-year grants are not entirely common, although they facilitate better and more forward-looking security, content application and planning for entities. On the contrary, in some cities, so-called micro-grants, which are limited by time and the amount of funds, are more popular, where the one-year cycle is divided into sub-parts, during which the actions are more easily evaluated and adjusted as needed. This situation is advantageous both for the provider and for the activation of young applicants.

When using multi-year grants, greater demands are placed on the directors and employees of contribution organizations and on the management of their administration. It is necessary to reduce the extensive administrative burden by using information and communication technologies and move to the maximum possible digitization.

Multi-source financing contains a lot of advantages, especially in the usability of a higher amount of funds, but at the same time it also brings the uncertainty of long-term cooperation in the association of these entities, their resulting support and the gradual development of the activities of contributory organizations. The main amount and range of funds is determined by the founder's decision. However, the founder's unstable conditions can often lead to an uncertain determination of the amount of financial support. This creates considerable uncertainty. According to Act 218/2000 Coll. the management of the contributory organization is governed by its budget, which must be compiled as balanced after including the founder's contribution or determining the levy. The contributory organization manages funds obtained from the main or other permitted secondary activity and funds provided by the founder. "Furthermore, the contributory organization manages the funds of its funds, funds obtained from other activities, monetary donations from natural and legal persons, and funds provided from the budgets of territorial self-governing units and state funds, including funds provided to the Czech Republic from the budget of the European Union, from financial mechanisms and accepted by contributory organizations from the National Fund. The main activity is the activity defined by the founders of the contribution organization by a special law and carried out by the contribution organization". (Act No. 218/2000 Coll.)

The reserve fund is mainly used, which allows greater flexibility. The scope and individual competences in the relationship between the founder and the provider are determined by the charter. If necessary, this charter can be modified or changed entirely. The approved financial plan of the contributory organization does not allow the transfer of funds from individual approved chapters, with the exception of the possibility of using the approved procedure for activating the reserve fund. The only way to partially defer funds is if the founder allows the establishment of a reserve fund and drawing from it.

4 Conclusions

The aim of this work was to evaluate the situation regarding the financing of the area of culture in the cities of Beroun, Příbram and Rakovník. From this analysis, it follows that the district cities provide funds from their budgets both to contributory organizations of which they are founders, as well as to a number of other organizations and natural or legal persons.

When comparing the selected cities and their spending on culture, it follows that Příbram spends the most resources on culture both in the average percentage share, which is 8.2% in the observed period of twelve years, and in the converted state per inhabitant, which reaches an average amount of CZK 1,785 per citizen of the city. In conclusion, we can say that the city of Příbram is a more cultural city in terms of the number of cultural organizations and activities in this area. It spends a larger amount of money on culture from its budget compared to the other analyzed cities, which was statistically confirmed thanks to the established hypotheses.

In conclusion, it can be said that, according to the obtained analytical data, there is a great interest in culture in these cities, both on the part of the participants and its active operators. So far, the support from the individual components of the Central Bohemian Region is not very significant. The management of the region realistically understands this negative situation, and therefore solves it by developing a more detailed concept of culture, which will be followed by the compilation of strategic goals for the next period. The regional office has so far offered a very conservative view of culture with an emphasis on cultural heritage. The area of live art or creative industries is not sufficiently reflected in cultural policy or subsidy programs. Therefore, the analysis of culture in the Central Bohemia region should be the first step towards systematic and conceptual decision-making at the municipal level. Among the basic prerequisites for the implementation of these activities is that citizens have a need for local culture, which can be confirmed in our selected municipalities.

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References

Act No. 218/2000 Coll.

European Council. (2018). Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing the Creative Europe programme (2021 to 2027) and repealing Regulation (EU) No 1295/2013. Dostupné z: <https://data.consilium.europa.eu/doc/document/ST-9170-2018-INIT/en/pdf>

European Commission. (2022). Creative Europe – about the programme. Dostupné z: https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/creative-europe_en

European Commission. (2017). A new strategy to put culture at the heart of EU international relations. Dostupné z: https://ec.europa.eu/commission/presscorner/detail/de/MEMO_16_2075

European Commission. (2018). Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Dostupné z: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018DC0267&rid=4>

European Commission. (2020). Commission welcomes political agreement on Creative Europe programme. Dostupné z: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2405 Zax, J. S., Forbes, K. F., Zampelli, E. M., & Oates, W. E. (1989). Is There A Leviathan In Your Neighborhood? *The American Economic Review*, 79(3), 560.

Eurostat. (2022). Government expenditure on cultural, broadcasting and publishing services. Dostupné z: https://ec.europa.eu/eurostat/statistics-95explained/index.php?title=Government_expenditure_on_cultural,_broadcasting_and_publishing_services

Jílek, M. (2008). *Fiskální decentralizace, teorie a empirie*. Praha: ASPI–Wolters Kluwer

Ledvinová, J. (2013). *Profesionální fundraising*. Praha: NAMU

Sanjuán a kol. (2020). Mayors, Using Cultural Expenditure in An Opportunistic Way Improves the Chances of Re-Election, but Do Not Do It: Revisiting Political Budget 100 Cycles. Dostupné z: https://www.researchgate.net/publication/345132130_Mayors_Using_Cultural_Expenditure_in_An_Opportunistic_Way_Improves_the_Chances_of_ReElection_but_Do_Not_Do_It_Revisiting_Political_Budget_Cycles

Challenges and opportunities for the economies

Jaroslav Vlach¹

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Abstract: Current economic, social, and political development in the world brings changes in the condition of individual economies as well as their competitiveness, the use of new technologies, and innovations. Thanks to COVID-19 and the Ukrainian conflict, we are even talking about a crisis. The pace of coping with difficulties, i.e., crisis and overcoming obstacles depends above all on the strength of a particular economy, on the innovativeness of its companies and management, i.e., science, research, innovations, and experiences from everyday life. But it also depends on the cyclical phases of the life of the particular society, because the course of history is not just a linear process. The goal of this paper is to search the answers for the following questions with using the secondary data. Can the current emphasis (at least in our conditions) on science, research, innovation be a brake and at the same time a way out of this crisis? Or are they just buzzwords like perestroika and glasnost in the second half of the 1980s? Communists in the former Soviet bloc looked up to them with the hope that they would save that social order. Socialism was supposed to be reformed and consolidated through them. In the end, it ended up in the abyss of history. Is today's overuse of the words – development, research, innovation, science – the realization of our political and economic elites that we are at the end, because nothing grows forever and that we are facing a slow, cascading, or rapid fall, and science, research, innovation, agile management are an attempt to slow down the fall? I believe in a person as a bearer of ideas, not in repeating buzzwords. The EU approved many tools and platforms to support R&D for which it has released large sums of money, but the whole European perspective regarding to its own birth rates isn't good.

Keywords: economy, political, innovation, competitiveness, reformation

Jel Classification: 030, 031, 032

1 Introduction

The scientific conference block of opportunities and challenges evokes in my mind the time not long ago.

They also talked about new opportunities and challenges in connection with perestroika and glasnost, but today the main words in the economic field are competitiveness, innovation, science, and research.

The Green deal also belonged among them half a year ago.

Forty years ago, the Communist regime wanted me to love the Soviet Union. It didn't work. I didn't believe them. Not only because I do not agree with the class struggle, but because of the obvious contradiction between the ideas and the daily practice in which I lived.

At the beginning of this post, I would like to emphasize that I don't want to think of economy as separate, but as one of the very important driving forces. Economy as a tool, not the goal of human endeavor, or even human being. Economy creates sources², i.e. energy penetrating other aspects of the state, society, international organizations, or the entire circle of civilization.

The powerful economy and its healthy development can be considered a weapon that affects other elements of power, political stability, the political system, the functionality of institutions, and their interconnectedness.

Ideology, of course the power of the army, the power of the word in world diplomacy and cultural and social appeal, soft power (Nye, 2004).

The aim of my paper is to look for possible answers to the questions posed in the Abstract.

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² „There are enough sources.“ The statement by the former Prime Minister of the Czech Republic Vladimír Špidla.

2 Methods

I will use publicly available secondary data for my chosen indicators, and I will compare and evaluate them. I am going to follow up the United States Census Bureau, WHO, Eurostat, Visual Capitalist, UN, Pew Research Center, OECD. I will focus on data and strategy documents concerning the support of innovation, competitiveness, the priorities of the EU on this field. I will work with the factors of longevity, age, muslim migration and their share of the total European population and birth rates. I will be interested in the GDP of developed economies, namely the EU, the USA and China. I will also use the basic data from the public sources on migration in the context of the Ukrainian conflict. Using some historical parallels, I will study the present.

On the basis of this comparison, I will summarize the result of my activity at the end of the article. The data will relate to a) the current period and b) forecasts for future years.

3 Research results

The EU has adopted a number of measures and instruments in support of science, research, innovation, and competitiveness.

It started:

2000: Lisbon strategy (2001-2010) EU should have the most competitive knowledge economy

European Research Area (ERA) - ERA: "Science knows no borders", but national systems are limited by borders

2002: Barcelona target – invest to research and science should be 3 % GDP by 2010

the ERA environment must be such that 2 % are invested by the private sector, 1 % by the public sector

2010: Strategy of Europe 2020 (2011-2020)

- Smart growth (support for research, innovation, education, and the digital society)
- Sustainable growth
- Inclusive growth (job creation, skill acquisition, and the fight against poverty)

Strategic agenda of the European Council (2019-2024)

Four priorities:

- Protection of citizens and freedom
- Development of a strong and economic base
- Building a climate-neutral, green, fair, and social Europe
- Promoting European interests and values at global level

Horizon Europe (2021-2027)

The EU has a Green Deal: Europe wants to be a „climate neutral continent” by 2050. It is a very important issue at present due to the war in Ukraine. Is it still actual, or not anymore? Europe will have a problem with sources, in my opinion. But opinions differ.³

The European Innovation Council will have 10 billion EUR available (Vlach, 2022).

I don't want to elaborate more on other supporter tools of R&D or to write about concepts such as Blue Economy, Circular Economy,⁴ and similar courses. I don't want to review a share of the Venture Capital in the field of innovation or GERD⁵ either.

³ We will see what the climate change conference COP27 in November 2022 comes up with.

⁴ My apologies to Professor Kislingerová and other authors from the University of South Bohemia who wrote the book which is called „The Circular economy and economics. “

⁵ GERD (Gross Domestic Expenditure on **R&D**)

Innovations are important, but a person is essential. A man is the main driving force. When I omit Divine force (for the purposes of this article), it does not matter if it is an individual or several individuals in a community, which we call a state or an international organization. Man thinks, creates, begets, feels, but also hates, and loves.

Almost 8 billion people live in the world today. Almost 11 million in the Czech Republic and almost 450 million in the EU. There is none of the EU countries among the ten countries with the largest population.⁶

By simple calculation, we find that the EU accounts for less than 6 % of the world's population.

According to Eurostat:⁷ In 2017, the GDP of the EU-27 represented 16.0 % of the world's GDP, expressed in PPS. China and the United States were the world's two largest economies, with shares of 16.4 % and 16.3 % respectively. India was the fourth largest economy, with 6.7 % of global GDP, followed by Japan with 4.3 %. Germany was the largest EU economy, with a 3.7 % share of world GDP.

The GDP of the EU creates is comparable with the People's Republic of China, which has a population of more than 1,4 billion. It is approximately 18 % of the world population. In the first view, it seems good news. But,

if we look at the European Union in more detail, its aging is a big handicap. As we can see in Table 1. Among the ten countries that have the most people over 65 years of age are nine EU members and at the very top there is Japan with almost 30 % share. Unfortunately, it is not just about aging.

Table 1 Share of the Population older than 65 (% of total, 2019)

 Japan	28.0%
 Italy	23.0%
 Portugal	22.4%
 Finland	22.1%
 Greece	21.9%
 Germany	21.5%
 Bulgaria	21.2%
 Croatia	20.8%
 Malta	20.8%
 France	20.3%

Source: Visual Capitalist⁸

The following table ranks countries by their rate of population decline, based on projected rate of change between 2020 and 2050 and using data from the United Nations.

⁶ Based on: <https://www.census.gov/popclock/>

⁷ Based on: https://european-union.europa.eu/principles-countries-history/key-facts-and-figures/life-eu_cs

⁸ Based on: <https://www.visualcapitalist.com/worlds-youngest-and-oldest-countries/>

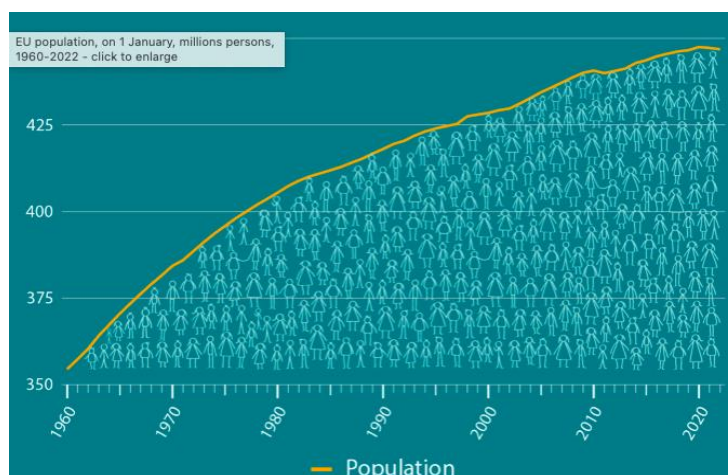
Table 2: Countries by their rate of population decline

1	 Bulgaria	22.5%
2	 Lithuania	22.1%
3	 Latvia	21.6%
4	 Ukraine	19.5%
5	 Serbia	18.9%
6	 Bosnia and Herzegovina	18.2%
7	 Croatia	18.0%
8	 Moldova	16.7%
9	 Japan	16.3%
10	 Albania	15.8%

Source: Visual Capitalist⁹

Even in the table above, we can see the slow extinction of Europe, because in the first ten countries, apart from Japan, there are only European countries. The Figure 1 indicates it at present in EU (see below). I realize that it can be only a minor migrant wave during the Covid-19 pandemic.

Figure 1 The EU population continues to decline for the second year



Source: Eurostat¹⁰

4 Discussion concerning the theme

We talk about a crisis, but what kind of a crisis? Is it the hegemonic crisis (Wallerstein, 2005) or the capitalist crisis (Thompson, 2009) or the civilization crisis (Toynbee, 1948)? In this case I mean our Euro-Atlantic civilization, because as I stated above, each community or state is at a different stage of development.

Lu Suet said:¹¹ „We cannot tell people who hardly earn for living to reduce their emissions “(Lomborg, 2008, p. 38). In our civilization, which grew on Christian and Jewish foundation, our European bureaucrats with a monthly income of 20 thousand Euros or more have different concerns. „EU accused of trying to cancel Christmas!¹² Advice on inclusive language dropped after criticism “(Politico, 2021).¹³

⁹ Based on: <https://www.visualcapitalist.com/ranked-the-20-countries-with-the-fastest-declining-populations/>

¹⁰ Based on: <https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20220711-1>

¹¹ Lu Suet, the former representative of China's Bureau of Global and Economic Affairs.

¹² „It died not by murder, but by suicide “(Toynbee, 1948).

¹³ Based on: <https://www.politico.eu/article/european-commission-cancel-christmas-inclusive-language-lgbtq/>

China began to collapse thanks to the senseless rejection of foreign trade. „Your beggar’s trade “(Smith, 2001, p. 605). By doing so, it deprived itself of benefits of the international division of labor, and on top of it „conflict and series of epidemics reduced the population of China by 35-40 % in the years 1580-1650“(Ferguson, 2014, p. 60).

Significant population decline and introversion cost China a position to which it has been returning to for several decades (Xiaoping, 2017). It is supposed to overtake the USA around 2030.¹⁴ As the current Chinese president Xi Jinping said: „China’s greatest dream is the great revival of the Chinese nation “(Allison, 2018, p. 203). I chose the analogy with China on purpose. I know that every comparison falters. Many European countries, such as the Czech Republic, are pro-export economies.¹⁵

If our input energy sources are high, our products will be unsalable on global markets. They will be uncompetitive, no matter how innovative they are. Restrictions on international trade will affect the quality of European and thus national life. The gas, oil and electricity price jumps extremely fast.

Europe is growing old, and it is also dying out just like China at the turn of the 16th and 17th centuries. It is a fact confirmed by the data.

Some European states have previously solved their demographic crisis by opening the gates of migration from other civilizations. „By 2050, the share of the continent’s population that is Muslim could more than double, rising to 11.2% or more, depending on how much migration is allowed into Europe.“¹⁶ The emergence of no-go zones was an unpleasant accompanying phenomenon. Leicester, Bradford, Birmingham. A parallel court system, the Muslim Arbitration Tribunals was even created, which meant the creation of parallel society as well. The waves of migrants from different parts of world are one of the reasons for the creation of politically correct language. That undermines the very foundation of this civilization, which is freedom of speech.

The war in Ukraine brought a wave of refugees that Europe, especially central Europe, had not experienced. The number of refugees fluctuates about 420 thousand in the Czech Republic. More than two thirds are women, children, adolescents, and seniors. Looking at the situation without emotion, compassion, regret for wasted lives, from the point of view of the Grand Chessboard (Brzezinski, 1995) it is a great opportunity for the EU, the USA, and the Czech Republic without exception. This war gives us much-needed dynamics in life, activity, and awareness of values. This conflict shatters the dangerous vision of the world planned by engineers and bureaucrats (Calhoun, 1973).

The war in Ukraine, a sense of threat, is the best breeding ground for innovation, research, and development in the civilian and military sectors.

The armed clash outside our territory is an opportunity and a challenge for us. The post-war state makes it possible to lend a helping hand in the reconstruction of a war-torn country and to place our products, technologies there. To provide loans like the Americans did after World War II.¹⁷

Let's invest as much as possible in those coming from Ukraine if we are not able to finish the war. Let's make this horror of war an investment in a mutual relationship. The successful business plan.

Until the war in Ukraine, we considered Ukrainians only wage workers. Today, great professionals are already coming. The longer the war lasts, the bigger group will stay here. We will invest money and lose some of it. Unfortunately, people affected by the war count the dead and they lost everything they had been building all their lives. It is unimaginable, incomparable, but it is the reality. On one hand, Ukraine is being destroyed by war, and on the other hand, by demographic, if the refugees find a new permanent home here or somewhere abroad.

Let’s return to Africa. Not like the colonizers but as reparation payers. Reparations for colonization, especially countries with a colonial history. Let’s choose countries in Africa and establish European partner-countries for them. For example: France-Algeria, Italy-Libya, Germany etc. In the first phase, let’s build not one but hundreds basic and apprentice schools there according to the disposition of the particular African country. As the second step, universities and factories where the graduates find work opportunities. It could be a chance for the EU and Africa. We will help to educate their skilled workforce and their elite there, and if these people still want to go to Europe, they will have the appropriate work and cultural habits. From my perspective, it will be cheaper than today’s migratory system without the control and moreover, we would pay old injustice of former colonizers and it could be effective for both sides.

¹⁴ Based on: <https://cebr.com/service/macroeconomic-forecasting>

¹⁵ The Czech Republic is the most industrialized economy in the EU.

¹⁶ Based on: <https://www.pewresearch.org/fact-tank/2017/11/29/5-facts-about-the-muslim-population-in-europe/>

¹⁷ Based on: <https://www.bloomberg.com/opinion/articles/2022-06-10/ukraine-war-rebuilding-can-t-wait-for-peace-nor-putin-time-for-a-marshall-plan>

The innovation new products are brought by human. A talented person. Unfortunately, today there are voices, that resonate, especially in EU, that the cure for all the world's problems is voluntary childlessness.

Childlessness brings us no ideas, no innovations, no products, no competitiveness, no life.

Are we the culture of death? „Contraception, sterilization and abortion are certainly one of the reasons why there is such a large drop in the birth rate“ (John Paul II, 1995, Article 16).

5 Conclusion

Based on the survey, it is evident that the birth rate is decreasing in the European Union but also that our population is growing old. Therefore, it is necessary to educate and bring quality human resources from abroad. Ukrainian refugees and a large number of young African can be our shared opportunity.

We need an innovation of thinking not only innovation of products or commodity. It is not sufficient. We need new ideas, not only the administrators of an established political system. We need politicians who understand political geography, international trade, and relationship. We need politicians who understand humans and the world. Politicians, academics, and businessman (society elite) who do not solve consequences but causes. Otherwise, we do not have elite leadership but a system administrator or maintenance worker, and then it does not matter who stays in the leading position. We need courage to discover our own common sense, otherwise words like science, research, innovation can be just buzzwords that cost European taxpayers a lot of money.

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References

- Alison, G. (2018). *Osudová past Spojené státy versus Čína a Thukýdídovo poučení z dějin*. Prostor
- Brzezinski, Z. (1999). *Velká šachovnice*. Mladá fronta.
- Calhoun, J. B. (1973). *Death squared: the explosive growth and demise of a mouse population*. DOI: 10.1177/00359157730661P202
- Gibbon, E. (1983). *Úpadek a pád římské říše*. Odeon.
- Jan Pavel II. (1995). *Evangelium Vitae*. Zvon.
- Johnson, P. (2008). *Dějiny 20. století*. Leda.
- Lomborg, B. (2008). *Zchlad'te hlavy*. Dokořán.
- Nye, J. (2004). *Soft Power: The means to success in world politics*. Public affairs.
- Thompson, W. R. (2009). The Kondratieff waves as global social processes. *World System History*, 174-195.
- Toynbee, A. (1948). *Christianity and Civilization*. Pendle Hill. <https://www.calculemus.org/lect/07pol-gosp/arch/dekalog-dawne/rozdz-2004/notatki-etc/huntington/toynbee-cywil.html>
- Wallerstein, I. (2005). *Úpadek americké moci v chaotickém světě*. Sociologické nakladatelství.
- Vlach, J. (2022). The innovation and development potential selected economies In M. Jílek & E. Opatrná (Eds.), *Studentská vědecká odborná činnost 2022 (s.267-271)* Jihočeská univerzita,
- Xiaoping, W. (2017). *Ekonomická a politická transformace Číny: nové rozbor*y. FILOSOFIA, nakladatelství Filozofického ústavu AV ČR.

Management of Small and Medium- Sized Enterprises at the Time of Digitalization

Cloud computing as digital technology – definition, models and use in enterprises

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Abstract: Cloud computing (CC) is a digital technology of Industry 4.0 and, together with digitalization, they digitally transform business entities. CC consists of many physical computers connected via the Internet, or is a distributed computing technology over a network, and enables the provision of information technology resources such as servers, databases, storage, applications, and others. The technological model of CC includes models of providing services over the Internet (Software as a Service, Infrastructure as a Service, and Platform as a Service) and models of various deployment methods (public cloud, private cloud, hybrid cloud, community cloud, distributed cloud, and multicloud). The scientific article contains: a theoretical definition of CC technology and a comparison of its use and adoption in enterprises, pointing out expenses, providers, and advantages of CC.

Keywords: cloud computing, digitalization, digital technologies, enterprises

JEL Classification: M15, O00

1 Introduction

Due to the influence of new and developing information and communication technologies (ICT), innovations come that digitally transform the economy and society through digital technologies. Digital technologies together with digitalization represent the main elements and driving forces of The Fourth Industrial Revolution – Industry 4.0, in which companies are intensively involved. Digitalization is the process of using digitization and integration of digital technologies in companies, which result in their digital transformation and thus change business activities, models, processes, products and services, and ultimately the company becomes digital. Digital technologies represent: a combination of information, computing, communication, and connective technologies enabling access to cyberspace and among the most famous are: Artificial Intelligence (AI), Big Data Analytics (BDA), Blockchain, Cloud Computing (CC), Internet of Things (IoT), Radio Frequency Identification (RFID), 3D printing, and others.

A growing trend in the field of information and communication technologies is Cloud Computing (Akhgar, Tafaghodi & Domdouzis (2015). The development of CC has made great progress in recent years, and the reason for its rapid deployment was digital transformation and Industry 4.0 (Loreth & Pickl, 2021). For Industry 4.0 is CC key and the basic platform behind many digital disruptions (Elahi & Tokaldany, 2021).

Cloud Computing is the most famous technology in the world (Tariq et al., 2020), which emerged as a paradigm for hosting and providing services over the Internet (Mahmoud & Xia, 2019). CC is a revolutionary development of running computer applications and saving data through the Internet platform, and it combines distributed computing and grid computing (Li, 2013). Cloud computing is defined by Kumar and Siddappa (2016) as the process of providing IT related computing capabilities on demand based on Pay as you use system. Alptekin and Alptekin (2018) define CC as an on-demand large-scale distributed network to provide and realize computational resources. CC is defined as a technology that consists of a large number of physical computers connected by using the Internet or it is a distributed computing technology over the network, and an essential part of this digital technology is: a large resources, database, applications, services and software (Kanakaner, Saudi & Azman, 2017). CC is a technological model enabling the provision of IT resources (servers, storage, applications, etc.) on demand (Elahi & Tokaldany, 2021). CC providing a number of services to its users, and the key functions of CC include cloud storage (Tariq et al., 2020), and it is a key enabler of the distributed IT environment (Sturm, Pollard & Craig, 2017). The cloud has essential characteristics such as on-demand self-service, resource pooling, and rapid elasticity, which enables organizations to purchase IT services in a utility-based model, paying only for the services consumed (Elahi & Tokaldany, 2021).

Cloud computing environments have been constructed differently according to the services that the given environment offers (Hamed, Dara & Kremer, 2017). According to Laszewski & Nauduri (2012), Cloud computing service models indicate the type of service offered, which is a hardware/software infrastructure or a platform for developing, testing, and

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deploying applications, or enterprise software is ready-to-use on a subscription basis. Laszewski & Nauduri (2012), Sitaram & Manjunath (2012), Hamed, Dara & Kremer (2017), Teikerdogan & Oral (2017), Elahi & Tokaldany (2021) defined as follows:

1. Software as a Service (SaaS) is the earliest CC model that represents a software service containing a business model. A Cloud Service Provider (CSP) provides software to an end user/consumer/client over the Internet that is run and deployed in a cloud infrastructure. In this case, the user is not responsible for the management or maintenance of the cloud infrastructure, including the network, servers, OS or any other issues related to the application. In the SaaS layer, users use the software as an on-demand service and are not allowed to modify the lower levels (hardware resources and application platform).
2. Infrastructure as a Service (IaaS) as a model shares hardware resources between users/consumers and involves management of physical cloud infrastructure by providers. The CSP provides the consumer with processing, server, storage, network hardware, related software, and other basic computing resources that enable the consumer to run its software (OS and applications). Cloud providers typically charge for IaaS services based on users' use of hardware resources.
3. Platform as a Service (PaaS) is the basis for a computing platform based on hardware resources and represents a platform delivered as a service for the development and deployment of applications. It is usually an application engine similar to an operating system or a database engine that combines hardware resources (the IaaS layer) with software (the SaaS layer). The CSP provides a platform for the consumer to deploy consumer-created applications written in any programming language supported by the CSP. The consumer is not responsible for managing or maintaining the underlying infrastructure (network, application servers, databases, OS, or storage), but controls the deployed applications and host environment configurations.

Cloud technology provides a centralized location of data that can be accessed from anywhere, enabling better connectivity and collaboration across multiple data sources (Elahi & Tokaldany, 2021). According to the method of deployment, cloud computing is classified by the authors Sitaram & Manjunath (2012), Tian & Zhao (2015), Akhgar, Tafaghodi & Domdouzis (2015), Goralski (2017) as follows:

1. Public cloud - Services offered over a public network are provided by independent third-party cloud providers over a public network to anyone (the cloud environment is shared by some companies and users) who can pay the costs (e.g., usage fees, floating subscriptions, etc.). The cloud provider also serves to other users; these users share resources owned by the cloud provider. The basic architecture of virtualized data centers and the network connections between them within the cloud is still the same. However, public clouds require much more stringent security requirements, from secure data segregation to unauthorized access and more, so the ease of access to a public network only heightens these concerns.
2. Private cloud – In a private cloud scenario, the entire cloud infrastructure is owned and operated by a business or organization. The cloud environment is created and used by the enterprise/company independently, and users outside the enterprise or organization cannot access the services provided by the CC environment. A private cloud is considered private if it is: single-use, managed by a third party, or hosted on-premises or remotely. Users in a private cloud pay only for what they use (during downtimes in the current emergency these resources can be used by other users), and this disadvantage can be somewhat mitigated by compensation system between departments or divisions or business units of a large organization, but it is often more attractive to deploy cloud computing in some form of public cloud.
3. Hybrid cloud - It is composed of two or more clouds - usually public and private, but in some cases also including community clouds - which remain distinct but can be treated as one in most applications. It is also possible to connect a traditional, non-virtualized service to the public cloud. Hybrid clouds are very popular and have a way of minimizing ongoing costs while still allowing for scaling during peak business periods. The customer can choose to store sensitive client data in their private cloud and connect to the marketing application in the public cloud when needed. IT organizations can temporarily expand their internal capacity using the public cloud when needed - referred to as “Cloud bursting”. Cloud bursting allows a relatively compact IT business to support more users than pure physical resources would suggest.
4. Community cloud - The cloud shares its infrastructure among many organizations, but organizations from a specific community of interest (e.g., hospitals). These communities have common concerns (e.g., monitoring patients, purchasing medicines and others) that are not necessarily shared with other types of organizations. The cloud can be managed locally or by a third party and hosted on-premise or somewhere in the middle of the group. Typically, the cost is spread over fewer users than a public cloud, but more than a private cloud.

5. Distributed cloud - Collects resources in different places, but they are connected by a common network and sets aside some of their capabilities for a common purpose. This is where the distributed computing aspects of the cloud come to the fore and outweigh the vast amounts of data that are buried in huge data centers.

Cloud computing is defined as a model to access shared computing resources through network in a manner which is ubiquitous, on demand, requires less time for provision and release of resources and requires minimum intervention of management authorities (Jaiswal & Bhaise, 2018).

2 Methods

The main goal of the scientific article is to examine the use of digital technology Cloud computing and is based on the following partial goals: analyzing, synthesizing and comparing theoretical sources from foreign literature in order to identify the current state of knowledge in the field of Cloud Computing; identifying cloud computing service and deployment models; analyzing the use of Cloud computing in enterprises through the conducted studies; pointing out the providers, expenses and benefits of Cloud Computing and finally synthesizing a view of the digital technology of Cloud Computing.

The starting point for the development of a scientific article was the study of domestic and foreign literature, its analysis, systematization, synthesis, and comparison in the field of information technology and business entities in the form of professional articles from scientific databases, primarily from Web of Science and Scopus, books, studies, press releases of technology companies etc. The search for literary sources was carried out using key words a key phrases such as: "digital technology", "cloud computing", „CC“, "cloud computing models" and "cloud computing in enterprises", in scientific databases in the range of years from 2012 to 2022, and on professional portals in the range of years from 2020 to 2022. Given that the scientific databases contained several tens of thousands of sources for key words, we sorted the sources according to the most frequently cited and most up-to-date, and then examined them by evaluating abstracts. Another search was carried out through professional portals, where more than a thousand sources were identified, so we focused on the most current data, primarily from 2021 and 2022. When examining the use of digital cloud computing technology in business entities, we focused on information from surveys from companies: Gartner (2021), Synergy Research Group (2022), Cybersecurity Ventures (2020) and the Organization for Economic Cooperation and Development (2021) on specific business areas where CC is applied, used, and what the adoption of the technology is, and further attention was focused on evaluating the benefits that businesses have identified by integrating CC. The selected companies, from which the data came, did not indicate the number of investigated enterprises. We translated and converted data from the OECD into graphical and tabular formats through our own processing, and calculated average values based on descriptive statistics.

3 Research results

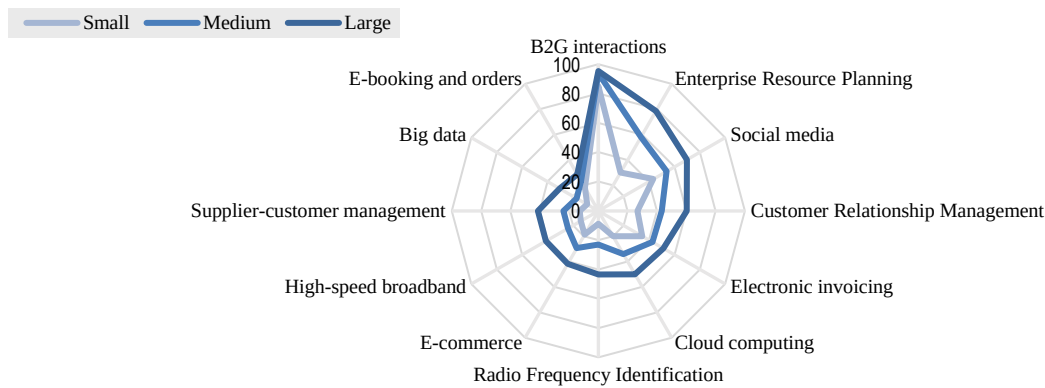
Gooasduff (2021) reports that Gartner's survey of 268 technology leaders found that Cloud Computing was the top investment in technology innovation. Gartner (2021) reports that expected spending on public cloud services should exceed 480 billion USD in 2022, an increase of 21.7 percentage points over 2021. New distributed cloud models are also expected due to the growth of hybrid, multicloud and edge environments. According to Gartner, worldwide public cloud services have an expected increase in usage with a total market of 482,155 million USD in 2022, and of this the main areas of expenditure are: SaaS (171,915 million USD), IaaS (121,620 million USD) and PaaS (100,636 million USD).

Synergy Research Group (2022) reports that enterprise spending in the third quarter on cloud infrastructure services exceeded USD 57 billion, with Amazon AWS (34%), Microsoft Azure (21%), Google Cloud (11%), the largest share Alibaba Cloud (5%), IBM Cloud (3%), and other companies.

Cybersecurity Ventures (2020) predicts that the total amount of data stored in the cloud – in public clouds (operated by vendors and social media companies such as Apple, Facebook, Google, Microsoft, Twitter, etc.), in government-owned clouds (accessible to citizens and businesses) and private clouds (owned by medium to large corporations and cloud storage providers) will reach 100 zettabytes by 2025 - 50% of the world's data at that time. It is also predicted that the total global data storage will exceed 200 zettabytes by 2025 (this includes data stored in private and public IT infrastructures, in public service infrastructures, in private and public cloud data centers, on personal computing devices — PCs, laptops, tablets and smartphones — and on IoT devices).

The Organization for Economic Cooperation and Development (OECD) in its study from the year 2021, examined the digital transformation of small, medium and large enterprises within OECD countries: According to the OECD (2021), digital technologies, including Cloud Computing, are spreading quickly but differently among companies, by countries and industries (Table 1). As we can see on Figure 1, according to the OECD, large enterprises (LE) use digital technologies the most - they have a more proactive approach, and small and medium enterprises (SME) use them less.

Figure 1 Average use of digital technologies by size category of enterprises during the years 2015 to 2018



Source: own processing according to OECD (2021)

Cloud Computing was used by half of the investigated large enterprises, 34.11% of the investigated medium enterprises and in small enterprises, it was used by 20.03% of the investigated companies. Big Data was the least used digital technology, on average it was used by 18.76% of the surveyed enterprises (30.48% large, 17% medium, and 8.8% small enterprises). The following Table 1 shows the percentage of use of Industry 4.0 digital technologies (Cloud computing, Big data, Radio Frequency Identification) broken down by sector: Accommodation and food services (ACC); Administrative and support services (ADM); Construction (CON); Information and communication services (INF); Manufacturing (MAN); Professional, scientific and technical services (PRO); Retail trade services (RET); Transport and storage services (TRA); Wholesale trade (WHO). According to the OECD (2021), the Information and communication services sector has the highest rate of use of digital technologies (avg. 46.40%), followed by Wholesale (avg. 35.62%) and Professional, scientific, and technical services (avg. 30.95%). Conversely, the lowest rate of use of digital technologies was recorded in the following sectors: Construction (avg. 22.37%), Transport and storage services (avg. 25.28%) and Manufacturing (avg. 27.23%).

Table 1 Average use of digital technologies by individual sectors during the years 2015 to 2018 (values are in percent)

Digital technologies	Sectors								
	ACC	ADM	CON	INF	MAN	PRO	RET	TRA	WHO
Cloud computing	14.15	22.10	16.98	56.82	20.62	32.95	20.44	19.95	25.77
Radio Frequency Identification	6.07	11.44	5.72	24.31	13.82	12.92	10.07	13.26	11.97
Big data	8.40	10.84	8.10	25.32	8.33	13.53	10.95	13.60	11.55

Source: own processing according to OECD

According to the OECD (2021), cloud computing is used by 50% of large enterprises among the total number of large companies surveyed and 54.13% of SMEs among the surveyed small and medium-sized companies. The specific use of Cloud Computing digital technology can be seen in the following Table 2, where it is also quite visible that large enterprises progress faster in adoption in specific areas compared to SMEs. E-mail services are the most common way of using Cloud Computing in all investigated size categories of enterprises with an overall average of 22.82% namely: 32.12% in large enterprises, 13.98% in medium enterprises, and 14.12% in small enterprises. Storage of files is the second most used with 20.95% overall average use and the least used is Computing power with 8.75% average use in all enterprise types.

Table 2 Median areas of use of Cloud Computing (CC) in selected small, medium, and large companies of the world during the years 2015 to 2018 (values are in percent)

Types of Cloud Computing adoption	Enterprise type		
	Large	Medium	Small
CC - Finance or accounting software	10.95	9.64	7.08
CC - Computing power	13.61	7.90	4.75
CC - CRM	13.75	8.23	4.52
CC - Hosting of databases	19.91	13.78	8.04
CC - Office Software	24.19	15.51	8.93
CC - Storage of files	30.75	20.57	11.52
CC - Email	32.12	22.23	14.12

Source: own processing according to OECD (2021)

Chatterjee (2022) states that: more than 30 cloud services are part of the average employee's daily routines; 80% of surveyed companies saw operational improvements after adoption; 83% of the workloads of companies surveyed will be in cloud storage, and by 2025, 30% of enterprise workloads will be in the private cloud.

Howard (2022) states that: 76% of organizations worldwide use a multi-cloud operating model (at least one shared and one private cloud) and of these: 90% of large enterprises, 60% of small enterprises, and 76% of medium-sized organizations had a multi-cloud infrastructure; 42% use multicloud cost management tools, 38% use multicloud security tools, and 33% use multicloud management tools; 82% of enterprises use a hybrid cloud model; enterprises use an average of 2.6 public and 2.7 private clouds; 53% of IT decision makers say multicloud helps them achieve their business goals; less than half of traditional small businesses use cloud infrastructure or hosting services; 44% of traditional small businesses use cloud infrastructure or hosting, compared to 66% of technology-based small businesses and 74% of enterprise companies; 31% of enterprises spend more than 12 million USD annually on public cloud; The limiting factors preventing companies from adopting a multi-cloud infrastructure according to IT decision makers are: cost (51%), security (47%), lack of skills (41%), complexity (35%), and compliance (33%).

The advantages of CC according to Chaulya & Prasad (2016) are primarily: cost savings and their minimization, resource maximization, better collaboration in companies, mobile access to CC, independence from location, and equipment, highly automated technology and providing greater flexibility. Sales Force (2022) lists the advantages of CC as: cost savings, security, flexibility, mobility, insight, increased collaboration, quality control, disaster recovery, loss prevention, automatic software updates, competitive edge, and sustainability.

4 Conclusions

Innovations in the context of Industry 4.0 encouraged business entities to integrate and use digital technologies, including the most famous Cloud Computing technology. Cloud computing is an Industry 4.0 digital technology consisting of many physical computers connected via the Internet or distributed computing technology via a network and enables the provision of information technology resources such as servers, databases, storage, applications, and others. The technological model of CC includes the provision of services over the Internet (Software as a Service, Infrastructure as a Service, and Platform as a Service) and various deployment methods (public cloud, private cloud, hybrid cloud, community cloud, distributed, and multicloud).

Cloud computing has been the highest investment in technology investments and cloud services have increased, as evidenced by various statistics. It is mainly used in large companies, in the Information and communication services, and Professional, scientific and technical services sectors, and the most common way of use is e-mail services. Within the models, the most used is SaaS, and from the point of view of deployment it is hybrid cloud, multicloud, and public cloud. Although there are factors that prevent companies from adopting cloud infrastructure (cost, lack of skills, complexity, etc.), the benefits of adoption are noted, namely: cost minimization, resource maximization, security, flexibility, data loss prevention, sustainability, and others.

The adoption of CC in companies leads to digitalization and digital transformation, through which: processes are innovated, and made more efficient, businesses become more competitive, profitability is maximized, return on investment, and others. Cloud Computing has the potential for greater use in the future due to increasing digitization and Industry 5.0, which is a new model extending Industry 4.0 with more efficient and meaningful interaction between systems, people, and machines within their digital ecosystem.

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References

- Akhgar, B., Tafaghodi, A., & Domdouzis, K. (2015). Chapter 15 - Cloud Computing, Sustainability, and Risk: Case Study: A Quantitative Fuzzy Optimization Model for Determining Cloud Inexperienced Risks' Appetite. *Green Information Technology*, 295–311. DOI: 10.1016/b978-0-12-801379-3.00015-2
- Alptekin, S. E., & Alptekin, G. I. (2018). A fuzzy quality function deployment approach for differentiating cloud products. *International Journal of Computational Intelligence Systems*, 11(1), 1041–1055. DOI: 10.2991/ijcis.11.1.79
- Chatterjee, S. (2022, October 12). *Top 50 cloud computing statistics and trends for 2022*. EPC Group. Retrieved November 1, 2022, from <https://www.epcgroup.net/top-50-cloud-computing-statistics-and-trends-for-2022/>
- Chaulya, S. K., & Prasad, G. M. (2016). Chapter 7 - Application of Cloud Computing Technology in Mining Industry. *Sensing and Monitoring Technologies for Mines and Hazardous Areas*, 351–396. DOI: 10.1016/b978-0-12-803194-0.00007-6
- Elahi, B., & Tokaldany, S. A. (2021). Chapter 15 - Application of Internet of Things-aided simulation and digital twin technology in smart manufacturing. *Advances in Mathematics for Industry 4.0*, 335–359. DOI: 10.1016/b978-0-12-818906-1.00015-2
- Gartner. (2021, August 2). *Gartner says four trends are shaping the future of public cloud*. Gartner. Retrieved November 1, 2022, from <https://www.gartner.com/en/newsroom/press-releases/2021-08-02-gartner-says-four-trends-are-shaping-the-future-of-public-cloud>
- Goasduff, L. (2021, November 1). *Cloud, AI and Software Are Top Investment Areas for Data & Analytics*. Gartner. Retrieved November 1, 2022, from <https://www.gartner.com/en/articles/cloud-ai-and-software-are-top-investment-areas-for-data-analytics>
- Goralski, W. (2017). Chapter 29 - Cloud, SDN, and NFV. *The Illustrated Network*, 731–757. DOI: 10.1016/b978-0-12-811027-0.00029-1
- Hamed, T., Dara, R., & Kremer, S. C. (2017). Intrusion detection in contemporary environments. *Computer and Information Security Handbook*, 109–130. DOI: 10.1016/b978-0-12-803843-7.00006-5
- Howarth, J. (2022, August 29). *30 amazing cloud computing stats (2022)*. Exploding Topics. Retrieved November 1, 2022, from <https://explodingtopics.com/blog/cloud-computing-stats>
- Jaiswal, R., & Bhalse, N. (2018). A result evaluation based on privacy preserving using unified security methods (PPUSM). *2018 3rd International Conference on Communication and Electronics Systems (ICCES)*, 733–738. DOI: 10.1109/cesys.2018.8724099
- Kanaker, H., Saudi, M. M., & Azman, N. (2017). Evaluation of EWCDMCC cloud worm detection classification based on statistical analysis. *Advanced Science Letters*, 23(6), 5365–5369. DOI: 10.1166/asl.2017.7377
- Kumar, N. L., & Siddappa, M. (2016). Ensuring security for virtualization in Cloud Services. *2016 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECOT)*, 248–251. DOI: 10.1109/iceecot.2016.7955224
- Laszewski, T., & Nauduri, P. (2012). Chapter 1 - Migrating to the Cloud: Client/Server Migrations to the Oracle Cloud. *Migrating to the Cloud*, 1–19. DOI: 10.1016/b978-1-59749-647-6.00001-6
- Li, L. (2013). 16 - The future of academic libraries in the digital age. *Trends, Discovery, and People in the Digital Age*, 253–268. DOI: 10.1016/b978-1-84334-723-1.50016-4
- Loreth, T., & Pickl, S. (2021). Chapter 5 - Digitalization and security: a new challenge for Mathematics 4.0. *Advances in Mathematics for Industry 4.0*, 115–130. DOI: 10.1016/b978-0-12-818906-1.00005-x
- Mahmoud, M. S., & Xia, Y. (2019). Chapter 3 - Cloud Computing. *Networked Control Systems*, 91–125. DOI: 10.1016/b978-0-12-816119-7.00011-3
- Morgan, S. (2020, June 8). *The World Will Store 200 zettabytes of data by 2025*. Cybercrime Magazine. Retrieved November 1, 2022, from <https://cybersecurityventures.com/the-world-will-store-200-zettabytes-of-data-by-2025/>
- OECD. (2021). The Digital Transformation of SMEs. *OECD Studies on SMEs and Entrepreneurship*, 275. DOI: 10.1787/bdb9256a-en
- Richter, F. (2022, November 15). *CLOUD INFRASTRUCTURE MARKET Amazon, Microsoft & Google Dominate Cloud Market*. Statista Infographics. Retrieved November 1, 2022, from <https://www.statista.com/chart/18819/worldwide-market-share-of-leading-cloud-infrastructure-service-providers/#:~:text=According%20to%20estimates%20from%20Synergy.Microsoft%20Azure%20and%20Google%20Cloud>

- Salesforce. (2022). *12 benefits of cloud computing and its advantages*. Salesforce. Retrieved November 1, 2022, from <https://www.salesforce.com/products/platform/best-practices/benefits-of-cloud-computing/>
- Sitaram. D., & Manjunath. G. (2012). Chapter 1 - Introduction. *Moving To The Cloud*. 1–21. DOI: 10.1016/b978-1-59749-725-1.00001-9
- Sturm. R., Pollard. C., & Craig. J. (2017). Chapter 1 - Overview. *Application Performance Management (APM) in the Digital Enterprise*. 1–9. DOI: 10.1016/b978-0-12-804018-8.00001-2
- Synergy Research Group. (2022, October 27). *Q3 cloud spending up over \$11 billion from 2021 despite major headwinds; Google increases its market share: Synergy Research Group*. Synergy Research. Retrieved November 1, 2022, from <https://www.srgresearch.com/articles/q3-cloud-spending-up-over-11-billion-from-2021-despite-major-headwinds-google-increases-its-market-share>
- Tariq. M. I., Tayyaba. S., Ashraf. M. W., & Balas. V. E. (2020). Deep learning techniques for Optimizing Medical Big Data. *Deep Learning Techniques for Biomedical and Health Informatics*. 187–211. DOI: 10.1016/b978-0-12-819061-6.00008-2
- Tekinerdogan. B., & Oral. A. (2017). Chapter 8 - Performance Isolation in Cloud-Based Big Data Architectures. *Software Architecture for Big Data and the Cloud*. 127–145. DOI: 10.1016/b978-0-12-805467-3.00008-9
- Tian. W., & Zhao. Y. (2015). 1 - An Introduction to Cloud Computing. *Optimized Cloud Resource Management and Scheduling*. 1–15. DOI: 10.1016/b978-0-12-801476-9.00001-x
- Tokaldany. S. A. (2021). Chapter 15 - Application of Internet of Things-aided simulation and digital twin technology in smart manufacturing. *Advances in Mathematics for Industry 4.0*. 335–359. DOI: 10.1016/b978-0-12-818906-1.00015-2

From living room to boardroom of a multinational company (A note on internationalization of small and medium-sized companies from Central and Eastern Europe)

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Abstract: Our paper focuses on one way of internationalization of small and medium-sized companies (SMEs) from Central and Eastern Europe (CEE) – their acquisitions by multinational companies. We address the question if the development of the companies established in CEE as start-ups (many of them first as micro-companies created literally in the living rooms) has been developed enough to become attractive acquisition target for multinational companies (MNCs) as open innovation resources. The basis for our work is the literature review of the available research. Unfortunately, conclusive, or large-scale studies about CEE SMEs and startups as open innovation sources are currently not existing. Therefore we have first focused on the single-country studies or research on open innovation from CEE: we use secondary data to draw a theoretical picture, explain the background and relations between the innovations, acquisitions and SMEs' activity based on the experience and studies from CEE.

Keywords: SME acquisition, internationalization, open innovation, Central and Eastern Europe

JEL Classification codes: F23, M13, O36

1 Introduction

The history of entrepreneurship in Central and Eastern Europe (CEE) has not been long: if we assume that it has started in the 90's after the anti-communist revolutions in the region, it may be theoretically 30 years old. However, the transition following the revolution phase was long and painful: the first decade of the system transformation towards market economies in the region was followed by deep economic and social crisis. The most important part of the transition was privatization conducted in different forms: restitutions, sales to foreign investors or domestic entrepreneurs, voucher privatization, management-employees buy-outs or spontaneous privatization (Gros, Steinherr 2004; Kalotay, Hunya 2000).

The entrepreneurship in the first decade of newly-born market economies was mostly understood as the attempt to participate in the privatization of formerly state-owned assets or as the creation of trading companies importing goods from foreign markets to unsaturated local markets or selling raw materials or semi-finished local products abroad. During that time period the educational institutions have gone through transformation too, and have started adjust slowly and in many cases also dramatically to the Western norms and content in the education, especially in the areas of management and marketing.

At the beginning of the new century the conditions for entrepreneurship have been better: the murky privatization in CEE was to significant extent over, economic conditions and business environment in the region have improved, young people were able to get decent education abroad, and the local universities have improved as well. Therefore more and more young entrepreneurs have started to look at the opportunities on the markets, create and develop ambitious international projects and their own start-ups. The first and especially second decade of the 21st century means a real beginning of the history of start-ups in CEE. (Mets et al., 2018).

Given the fact of the infant stage of the entrepreneurship in CEE compared to classical market economies of Western Europe, USA, etc., the basic goal of our paper is to find the answer to the question if the emancipation of the companies born in Central and Eastern Europe (further CEE) has been developed enough to become attractive acquisition target for multinational companies (further MNC). First, we start with theoretical background. In a later stage, we plan to study selected cases and formulate the answers drawn upon our results.

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Our work is based on the idea that acquisition of start-ups is ideal open innovation source for big multinational companies in the digital era that allow them to stay competitive and address new market segments. However, the research studying the acquisitions of CEE start-ups is missing and therefore we would like to fill this gap. There is no similar study about the open innovation - acquisition cases from Central and Eastern Europe to MNCs in Western Europe or USA. Therefore the ambition of the authors is to contribute to the international business literature on this topic, first by identifying the right theoretical literature and later, by the case study research from this region.

2 Literature review

The concept of Open Innovation did not lose any of its relevance since it was first defined by Chesbrough (2003): “valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well”. In the case of open innovation, the feedback on new ideas is given not only from the internal but also external environment of the company, e.g., customers, suppliers, universities, research centers or other companies. The benefits of open innovation are: higher number of innovative ideas, knowledge about market and customers’ needs, new technologies and skills, possibility of financing from public sources, lower risk due to risk-sharing in joint ventures and faster development of ideas. open innovation can decrease costs and accelerate the commercialization of new ideas. Acceleration of the whole innovation process is a fundamental aspect of open innovation – in other words, the costs for moving too late are much greater than they are for moving too soon“. (Chesbrough, 2003)

According to Drucker (2006), there are seven sources of innovation: unexpected occurrences, incongruities, process needs, industry and market changes, demographic changes, changes in perception and new knowledge. Open innovation can be divided into two types. Inside-Out open innovation is internal knowledge which is used by the external partners (e. g., licensing of patents). Outside-In open innovation is enabled by opening of the innovation process for the external stakeholders in order to gain information on market, technologies or to get feedback. Companies need to have a clear innovation strategy and culture supporting the open innovation. It is important to know which company goals can be achieved via open innovation. (Hengsberger, 2018)

Innovative companies are often objects of mergers or acquisitions because of their valuable intellectual property and know-how. However, these types of transactions can also lead to creation of new innovative ideas. Based on the review of 30 articles published from 1985 to 2018, Christofi et al. (2019) have prepared framework of value-creating and value-capturing factors of technological innovation in mergers and acquisitions. The framework consists of eight factors: social and organizational culture; technological overlap/similarity of the companies involved; human resources management and social capital; social community and integration; transfer of knowledge, skills and technology; structure, processes and size; strategy; top management and leadership.

Open innovation is also linked with startups which tend to be based on innovative idea, product or business model. Greul et al. (2017) have investigated open innovation on the sample of 28 start-ups and/or small companies producing 3D printers from USA, Europe and China. Based on their research it can be assumed that the degree of openness depends on the initial capabilities of the firms and also on their founding intentions. There was a trade-off between faster market entry with the use of external technology and limited options for further innovation of the technology sourced outside the company.

Innovation is often connected with increased productivity and skilled labour. Eliasson et al. (2020) have investigated the impact of foreign acquisitions on the productivity of acquired companies in Sweden. Moreover, they have focused also on employment, share of skilled labour and changes in export and import of the acquired companies. The positive effects in the aforementioned areas are most visible in the small companies in the service sector. Positive impact on productivity can be seen also in large manufacturing companies. The employment tends to increase in small companies. Acquisition therefore seems to be a viable option for small firms with a potential for future growth but also facing the barriers for growth such as access to finance, subcontractors or customers in other countries. The positive impact of acquisitions on productivity is linked with investment in human capital which leads to increase in share of skilled labour. Another factor with positive effect is the access to a greater range of inputs after the acquisition.

In the case of the CEE countries which are the main focus of our research, the scale of the available research results varies greatly among the countries. Poland is probably the country which was the focus of the largest number of authors. It is a country with comparably high M&A activity and apparent attractiveness of Polish companies for foreign investors. Scope of the studies varies from impacts of M&As on the performance of companies to various factors affecting innovation activities. Dziurski and Sopińska (2020) have used the sample of 122 innovative companies from Poland to assess the drivers and barriers for open innovation. Their analysis confirms that open innovation approach is present in high-tech but also non-high-tech industries as well. The drivers and barriers of open innovation do not seem to be different in high-tech but and non-high-tech industries. The results of the research suggest that the most important drivers are market-driven whereas the barriers are legal and financial issues. Mazur and Zaborek (2016) have investigated the

relationship between organizational culture and open innovation performance in Polish SMEs. The authors tried to prove the hypothesis that innovative culture fostering learning, creativity and cooperation among employees have positive effect on the open innovation and performance of the company. Their research sample consisted of 473 companies in manufacturing and service sectors in Poland. Results of their study were mixed. Even though the innovative culture had positive effect on the scope of open innovation sources, the relation between innovative culture and percentage of sales from new and modified products as a metric of innovativeness was not proven. However, innovative culture did have a positive impact on ROI and operational performance, which suggests that the open innovation might influence efficiency due to process and marketing innovations rather than product innovations.

As for the Czech Republic, cooperation increases the innovation activity of SMEs. They are also more active in terms of R&D expenditures per one employee (Kmecová and Vokoun, 2020). Collaboration is crucial for the innovation process and public financing supporting this cooperation is significant in the Czech manufacturing. Cooperation among companies has led to technical innovation activity and increase in revenues (Prokop - Stejskal - Kuba, 2019).

Another study focused solely on Slovakia was realised by Knošková (2015) who has conducted a two-stage research of Slovak companies in 2009 (102 companies) and 2014 (287 companies) with focus on the relationship between radical product innovations and company behaviour. The results show that radical innovators are open to explore new ideas in the external environment and these companies build external and internal networks and link their innovation projects to company strategy. Their entrepreneurial culture is focused on the flexibility, experimenting and creating space for radical innovations.

Leitão et al. (2020) have focused their research on impact of open innovation on the eco-innovative performance of companies. They have used a sample of moderately innovative countries - Slovakia, Spain, Hungary, Italy, Portugal and the Czech Republic. Positive effect of inbound open innovation practices on eco-innovative performance was confirmed in all countries in the research sample. In the case of Slovakia, external sources of information (competitors or other firms) in the same sector of activity on the sourcing side, and acquisition of other external knowledge on the acquiring side are significant for process or product innovation. In the Czech Republic, sources of information in scientific journals and technical or professional publications on the sourcing side and the acquisition of machinery, equipment and software on the acquiring side are important for process or product innovation. Another research hypothesis was that there is positive relation between outbound open innovation practices and eco-innovative performance. Slovakia, Spain and Portugal have showed no significant evidence in favour of revealing ideas to their competitors. Results for Hungary and the Czech Republic show a positive relation.

3 Methodology

The aim of our paper is to find the answer to the question if the emancipation of the companies born in CEE has been developed enough to become attractive acquisition target for multinational companies (MNCs). The basis for our work is the literature review of the available research. Unfortunately, conclusive or large-scale studies about CEE startups as open innovation sources are not currently available. We have therefore focused on the single-country studies or research on open innovation from the larger point of view.

We use secondary data: secondary data is used mostly in the theoretical part to draw a picture, explain the background and connection between the innovations, acquisitions and startup activity. Almost all information comes from foreign studies; the cases and research pieces from Slovakia and Central Europe are not yet available. The majority of information was found via internet in academic databases.

In the practical part, we plan to use a qualitative research method - case study approach - based on primary data, collected via interviews. They will be, of course, enriched by information from secondary resources, such as articles, videos, and all relevant data about the cases from printed, online or social media. We plan to create a sample of 5 – 10 cases. As an illustration, we include the first case that we studied – the company Websupport. As seen from this case, each company will be shortly described and then the most relevant information for our study will be pictured in a table what allows us at the end to compare all the cases studied and to draw conclusions based upon studying and comparing them.

4 Results and discussion

Why multinational, large and established companies buy startups (in CEE conditions practically all of them are SMEs, therefore we use these two terms as synonyma)? One of the most significant resources of the open innovations are acquisitions. There are different reasons why established, large or multinational companies acquire the other companies – among those related to the innovations the following are the most important:

complementing the weaknesses in the value chain in order to obtain complementary competences in R&D (basic research and/or application and product development), manufacturing and services (scale/scope economies, new processes, costs reduction)

inability to adapt organically to changes in competitive conditions, increase in competition and need to react
proactive action and developing new businesses in order to keep pace with new markets, technologies and customer segments, or to foresee them,

obtaining resources both tangible and intangible and to get access to talent and knowledge.

Multinational companies use open innovation very frequently and their acquisition target vary in terms of size, age, origin, industries etc. Many large established businesses undertake collaborations with startups as an important tool for exploring emerging markets and advancing the digital transformation of their core business (Chang, 2004; Naryanan et al., 2009; Gutmann 2018).

The concept of a start-up, even though we meet it today on a daily basis, does not yet have an unambiguous definition. The expression “a startup” has come into business language thanks to successful technology companies such as Dell, Amazon, Facebook, Apple or Microsoft. The public associates this concept with the IT companies, which were created in the garage by a group of university students. In Slovakia resonates the case of the most successful Slovak start-up and later SME - ESET that was created in the living room.

However, startups could be understood as temporary units or organizations founded to find a repeatable and scalable business models – and the main product of startup is creation of a company (Blank, 2010). Unlike a classic company, which is a permanent organization designed to implement a business model that is repeatable and scalable while focusing on its successful execution, the startup is looking for the attractive business model. Therefore, the drivers, the nature and needs of both of these organizations are also different. The intention of the founder or the CEO of a start-up is to disrupt the market with a scalable and efficient business plan, while the intention of the owner of the classic business is to be a boss and secure a place on the market.

The other authors understand startup as a unit bringing new service or product in the extremely unstable environment, in an uncertainty, and the innovations and extreme uncertainty are major factors distinguishing startups from classical companies because classical companies tend to protect their business instead of taking risks and open new horizons in their fields. A start-up is an exceptional type of business as the risk is unknown and cannot be modeled. (Areitio, 2018, Ries 2011). An interesting view is being presented by Grant - he defines the startup as a company in the first phase of operation. According to him, the start-up is founded by one or more entrepreneurs whose goal is to develop a single product or service for which there is demand and want to market it. According to the author, these start-ups do not have a fully developed business model and lack sufficient capital to move to the next phase of the business, while the initial phase of the business is mainly financed by the founders. (Grant, 2020).

Within the characteristics of start-ups, it is also necessary to define the types or categories of start-ups. Since a start-up enterprise does not have a uniform definition, the categories of start-ups are different too. However, the criteria according to which we can categorize start-ups easily could be just two: the sector (industry) and the internal structure. Industry-based start-ups deal with marketing, software, artificial intelligence, robotization, manufacturing, services such as health, education, financial technologies and so on. According to internal structure we distinguish six categories of start-ups (Blank, 2010):

Startup as a small business – these are startups that run their own business with a small number of employees, usually family members. They are not created for huge profits or growth, their main goal is usually to provide means of living to their own family. These include beauty salons, groceries, electricians, gardeners and restaurant owners.

Lifestyle start-up – this type of start-up is typical for people for whom their work is a hobby, these people work for themselves, do not have employees and their own savings are their only source of funding such as teachers, artists, website graphic designers, programmers who work on trade licenses etc.

Silicon Valley-type startups or scalable start-ups - the founders of these kinds of startups believe from the beginning that their vision that has the potential to change the world. The main objective and direction of such start-ups is, above all, the creation of an international or global billion-dollar company that will become publicly traded. Typical examples of such startups are global giants such as Google, Facebook, Tesla or Xiaomi. Scalable start-ups usually need venture capital to find the right business model, to fund research that can attract more investors and generate higher profits. Another typical feature is the hiring the best talents in the field, and this scalability distinguishes this type of startup from others.

Startup designed to be sold quickly or “a buyable startup” – this kind of startup has similar features to the previous one. However, they differ in the objectives set and strategies chosen. (For example, this type of startups is typical of web and mobile app designers, as it is quite easy to finance and to create). These start-ups are set up for later

sale to larger companies. Their goal is to sell the startup to some large business for a large amount, which can be several millions. However, it is essential for investors to see huge potential and customer interest in the product created by the start-up.

The startup of a large company - new competition, changes in customer preferences, change of legislation, new technologies constantly put pressure on the introduction of new innovations. In this way, companies are forced to create new products that will be sold in new markets and to new customers. Established companies therefore have two options. The first option is to develop their own innovative technology in their startups or the second option is to buy another company, for example, the aforementioned buyable startups that own this technology. The second option is usually more successful. A typical example is the acquisition and purchase of Instagram by giant Facebook for \$1 billion. (Oreskovic, Shih 2012).

Social startup - the main motivation of social entrepreneurs is to make the world a better place. These forms of startups are often financed by various subsidies or grants as they are mostly non-profit organizations.

What do the startups offer to potential buyers - there are several reasons why the goal of large enterprises is to find and buy start-ups (Borch 2021). In particular, the reasons include:

Getting advanced technology – failure to innovate or offer exceptional products often leads to a loss of market position of established companies. Therefore large and successful companies look for potential in new startups creating and using cutting-edge or advanced technology. In this way, they can almost immediately increase their market share, profits and competitiveness.

Diversification – due to changes in the global environment, some businesses are becoming unstable – therefore the aim of many enterprises is to overcome these risks and volatility associated with their own sector and acquire startups through which they diversify the risk of their business.

Obtaining complementary products – improving the product line in large companies can take place in two ways: the first way is a product innovation within the company, and the second one is the acquisition of a startup that offers similar, attractive and complementary products or services – in that way the large company can save the cost on research and development, product development, market tests, commercialization etc.

Acquisition of highly competent, creative, experienced and talented experts – to acquire start-ups that have professional human resources and to keep them is one of the major motivation of the acquisition process in highly specialized companies

Gaining a good market position and keeping the pace with the latest trends – large companies often purchase of start-ups which have an exceptional position on the market and keep up with the current and estimated future trends.

Achieving synergies of two enterprises in the same market, with the aim of streamlining operations, saving costs and ensuring higher profitability.

Ensuring vertical integration – the purpose of the acquisition in this case is to gain control over a particular supply chain.

From the point of view of a startup when considering its own sale, its founder should first set clear sales goals and evaluate three basic issues: is the startup ready for sale, is it a good time to sell a startup, what will be the consequences? The entrepreneur and founder of the largest hosting company in Slovakia, Websupport, Michal Truban, presents in his book the standard process of an acquisition of a startup. According to the author, selling a business is a complicated process and it is necessary to involve financial advisors, lawyers, accountants or tax advisors in particular to succeed. The most important partner in the whole process are financial advisors, whose job is to ensure that the founder of the startup obtains the highest possible amount. At the same time, advisors serve to communicate between buyer and seller, thus better identifying the expectations of both parties. (Truban, 2016).

There are two main categories of potential investors or buyers: strategic and financial investor. The **aim of a strategic investor** is to buy the entire startup and connect it to its business. These are usually competitors or other market participants for whom the technologies or start-up team will be very beneficial. The acquisition of a startup gives a strategic advantage to this investor who usually buys a 100% stake. A strategic investor usually offers a better position, a larger market share and opens up new markets. The advantage is that it will ensure quality know-how and a strong network, great potential synergy between existing products and sufficient existing resources. Our study is focused on strategic investors, however some cases studied may have also financial investors.

In the case of a financial **investor**, it may be a venture capital enterprise or a private equity enterprise. These are profit-focused investors and bring potential for synergies due to the different businesses in their portfolio. Financial investors are buying startups because they see weaknesses in management, for example, but they see potential for their growth. In some cases, they buy several similar businesses at once, combine them, change management and organization, and then sell them further with higher profits. The founder of the startup in this case will often have a certain share, and

later he can raise more money from this share than at the beginning. The advantage of financial investors is experience in corporate transactions and rational decision-making. At the same time, however, the disadvantage is a high yield orientation and a low level of concern about the losses that may have been incurred (Truban, 2016).

Start-ups are very often on the “acquisition radar screen” of multinational corporations due to the fact that they bring cutting edge solutions to some of their problems, are very flexible, and often concentrate the best talents in the given fields. When it comes to startup acquisitions, getting the intangible resource, talent and knowledge and in that way to be ahead of the competition seem to be the main motivation. However, large companies are usually very cautious – they need to assess risk, time and contribution to their growth when considering acquisition - a startup can become relevant to an established company’s revenue within a few years only through the “leverage” effect. Collaboration between the established company and the startup and later acquisition should cause an additional stimulation of revenue in the large partner’s core (Freytag, 2019). It simply needs to be a win-win strategy for both – established company and a startup.

Acquisition is often the last step among partnering strategies of multinationals with startups whose origin is in advanced or emerging markets (Prashantham, 2021). Central and Eastern Europe at the beginning and during the first decade of transformation period was originally considered as emerging. Later some countries of the region entered the European Union and their economic performance increased what brought them among advanced economies – however some CEE countries are still considered to be emerging and those „advanced“ ones share many features distant from the original, mature and advanced market economies.

The challenge of innovation worldwide strongly resonates in Central and Eastern Europe, now populated by post-transition economies whose original factor cost advantages are dissipating. As CEE-based companies exhaust their potential for efficiency-led growth, they face a mounting imperative to strengthen their capabilities in innovation to compete in demanding global markets. (Bartlett, Mroczkowski, 2019) Young entrepreneurs from CEE cannot rely on natural resources or capital accumulated by several generations of their families and often create innovation startups where the major resource is knowledge and talents. These startups may have the potential to become acquisition targets of MNCs. Since they are very new on the global scene plus their innovation environment is very different from that one in classical advanced economies, we would like to focus on the detailed study of the cases of their acquisition.

One of the relevant examples – case studies – is the company Websupport. WebSupport was established on 1 April 2002. It was created by a high school student Michal Turban who was too young to start a business according to the local law and needed to start the business using the business license of his mother. His parents invested about 30,000 Slovak crowns (1,000 EUR) into his idea that was a pioneer one on the local market: to provide unlimited hosting. He was working step by step and later at the university he met a co-founder of Websupport who was also known at the hacker community, Pavol Stano. They created a first, real registered company, each of them owing 50% of it (Truban, 2016).

Step by step Websupport became an inseparable part of the Slovak IT community with an impressive history of high customer satisfaction, great entrepreneurial culture and double-digit growth. It concentrates on IT services, webhosting, domains, servers, and security. It offers domain registration and cloud infrastructure-services to consumers and small & medium sized companies. Currently, WebSupport is the biggest provider of web hosting services and registrar of domains in Slovakia. The company is active in the neighboring countries too. It manages more than 218,000 domains of their 182,000 customers. It also stands behind the successful international startup project Nicereply. (Matusšáková, 2019).

In February 2019 acquisition of Websupport by Loopia Group was announced Loopia is an innovative European web services and hosting business with operations in Sweden, and in the Czech Republic with Active24. Loopia also provides services to customers in Germany, Great Britain, the Netherlands, Norway, Serbia, and Spain. Since June 2018, Loopia Group is owned by Axcel, a Nordic private equity company focusing on mid-market companies. According to press release, WebSupport and Loopia Group are a good match, with the ambition to deliver high-quality products, technological innovations and outstanding local customer support. The customer-base in Slovakia and Hungary complements the Loopia’s Active24 business based in Prague and creates a solid platform for future growth in Central Europe (Axcel 2019). As for the original Websupport founders, they rerouted significant amount of their resources to startup project development.

Websupport: innovations and following acquisition		
	Indicators	Websupport, Ltd. (Slovakia)
Company description	Founding year	2002
	Founders	Michal Truban, Pavol Stano
	Acquirer	Axcel Denmark, Loopia Group (2019)
	Price	“double-digit number” i.e. 10-99 mil. EUR
	Industry	ITC, webhosting
	Trigger for creation	Missing service on the local market: no one provided unlimited hosting
	Main events	2010: Start-up Award 2010, 2011: Foreign expansion to the Czech Republic, Poland, 2011: Number 1 in Slovakia in customers and sales, 2012: Turnover more than 1 mil. EUR, 2013: New investor Monogram Venture, 2015: Acquisition of Hungarian company
	Employees	52 (2019)
	Financial indicators	Turnover growth since the beginning: e.g. 2010 587 ths. 2019 5.4 mil. EUR. Continual profit growth (except for 2014 due to problems with IT architecture) (Finstat, 2019).
	Market indicators	Leader in webhosting in Slovakia. Top 10 in Hungary, leading positions in the Czech Republic and Poland. Many awards.
Innovations and foreign market strategies	Countries of operations	Czech Republic (2011), Poland (2011) Austria (2011), Hungary (2015)
	Innovation triggers	To be market leader, to provide complex services, to set the trend in the industry, drive of the founders
	Creation of follow-up start-ups	Yes (Geeplay – failure, Nicereply – success)
	Motivations for foreign markets entry	Market expansion, strengthening market position in Central Europe, getting new customers
	Foreign expansion	Neighboring markets only. All entries were successful, however the expectations were higher.
	Sources of competitive advantage	Innovations, human capital, company culture
	Methods of foreign markets entry	Acquisitions
	Current organization abroad	Local subsidiaries
Owners after acquisitions	Foreign strategies	Acquisitions of companies from top 10 in foreign country, building strong position via foreign subsidiaries
Conclusions	Success factors	Leading position on local market, strong innovation spirit, setting the trend in market segment, foreign market penetration, know-how transfer, building leading position on foreign market

5 Conclusions and further research

This paper is the first step in our effort to assess whether startups from CEE have achieved a stage in their development when they become attractive as acquisition targets for foreign companies. Given the fact that large number of CEE countries are members of the EU and OECD, it can be assumed that more than 30 years after their transition to market economy have begun, there are companies and startups with high potential as open innovation sources. In our future research, we will examine the process of startups in Central and Eastern Europe based on case study research method as outlined from the first one presented in this article: we will concentrate on their creation, motives and triggers behind it, growth, internationalization, strategies and the progress to the step when they become acquisition targets. So far, we have found sufficient number of relevant companies and cases in the Czech Republic and especially in Slovakia. Slovakian situation is a very good for further research since similar Slovak companies need to be very innovative due to limited material resources and at the same time internationally oriented due to the size of the Slovak market. The detailed study of chosen selected cases will provide us the material for finding the common features of these companies as well as for creation of the recommendations and managerial conclusions for founders of the start-ups who would like to develop their business in this direction.

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References

- Areitio, A. (2018). What Is A Startup And How Is It Different From Other Companies. [online]. <https://medium.com/theventurecity/>
- Axcel (2019) Loopia Group acquires WebSupport at <https://www.axcel.dk/loopia-group-acquires-websupport-the-1-web-hosting-company-in-slovakia/>
- Barlett, D. & Mroczkowski, T. (2019). Emerging market startups engage Silicon Valley: Cases from Central and Eastern Europe. *Journal of Small Business Strategy*, 29(1), 55-70.
- Blank, S. *What Is A Startup?* (2010). <https://steveblank.com/2010/01/25/whats-a-startup-first-principles/>.
- Chang, S.J. (2004). Venture capital financing, strategic alliances and the initial public offerings of Internet startups. *Journal of Business Venturing*, 19(5), 721-741
- Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston, MA: Harvard Business School Press.
- Christofi et al. (2019) Triggering technological innovation through cross-border mergers and acquisitions: A micro-foundational perspective. *Technological Forecasting and Social Change*, 146(C), 148-166. DOI: 10.1016/j.techfore.2019.05.026
- Drucker, P. F. (2006). *Innovation and Entrepreneurship*. New York: HarperCollins.
- Dziurski, P. & Sopińska, A. (2020). Does industry matter? Drivers and barriers for open innovation in high-tech and non-high-tech industries—Evidence from Poland, *International Journal of Management and Economics*, 56(4), 307-323. DOI: 10.2478/ijme-2020-0024
- Eliasson et al. (2020). Foreign acquisitions – A shortcut to higher productivity and expansion in smaller firms. In Working Papers, Örebro University, School of Business.
- Grant, M. *Startup*. (2020). <https://www.investopedia.com/terms/s/startup.asp>.
- Greul et al. (2017) Open at birth? Why new firms do (or don't) use open innovation. *Strategic Entrepreneurship Journal*, 12(3), 392-420. DOI: 10.1002/sej.1282.
- Gros, D. & Steinherr, A. (2004) *Economic Transition in Central and Eastern Europe: Planting the Seeds*. Cambridge University Press.
- Gutmann, T. (2018). Harmonizing corporate venturing modes: an integrative review and research agenda. *Management Review Quarterly*, 69, 121-157. DOI:10.1007/s11301-018-0148-4
- Freytag, R. (2019) On a growth track with startups: how established companies can pursue innovation. *Strategy and Leadership*, 47(4), 26 – 33. DOI: 10.1108/SL-05-2019-0070.
- Hengsberger, A. *Definition Innovation Management*. (2018) <https://www.lead-innovation.com/>
- Kalotay, K. & Hunya, G. (2000). Privatization and FDI in Central and Eastern Europe. *Transnational Corporations*, 9(1), 39-66.

- Kmecová, I. & Vokoun, M. (2019). Innovation activities of Czech businesses differences between urban and rural businesses. In J. Horák, J. Vrbka and Z. Rowland. *SHS Web of Conferences - Volume 73; Innovative Economic Symposium 2019 – Potential of Eurasian Economic Union (IES 2019)*. Les Ulis: EDP Sciences
- Knošková, L. (2015). Innovation Processes and Entrepreneurial Culture for Radical Innovations. *The AMFITEATRU ECONOMIC journal*, 17(38), 342-342.
- Leitão, J., Pereira, D., & Brito, S. de. (2020). Inbound and Outbound Practices of Open Innovation and Eco-Innovation: Contrasting Bioeconomy and Non-Bioeconomy Firms. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 145. DOI: 10.3390/joitmc6040145
- Mazur, J. & Zaborek, P. (2016). Organizational Culture and Open Innovation Performance in Small and Medium-sized Enterprises (SMEs) in Poland. *International Journal of Management and Economics*, 51, 104 – 137. DOI: 10.1515/ijme-2016-0022
- Matuščáková, Z. (2019). Truban predal Websupport Dánom. Ponuku od slovenského finančníka bola o milión vyššia. Online. <https://www.forbes.sk/truban-predal-websupport-danom-ponuka-od-slovenskeho-financnika-bola-o-milion-vyssia/>
- Mets, T. et al. (2018) *Entrepreneurship in Central and Eastern Europe: Development through Internationalization*. London: Routledge.
- Narayanan, V.K. et al. (2009). Corporate venturing and value creation: a review and proposed framework. *Research Policy*, 38(1), 58-76. DOI: 10.1016/j.respol.2008.08.015.
- Oreskovic, A. & Shih, G. *Facebook to buy Instagram for \$1 billion*. (2020). Retrieved 12 January 2022, from <https://www.reuters.com/article/us-idUSBRE8380M820120410>.
- Prashantam, S. (2021). Partnering with Startups Globally: Distinct Strategies for Different Locations. *California Management Review*, 63(4), 123 – 146. DOI: 10.1177/00081256211022743.
- Prokop, V., Stejskal, J. & Kuba, O. (2019). Revealing the importance of cooperative ties and R&D support within Czech manufacturing industry. In *2nd International Conference on Research in Business, Management and Finance*. Paris; Diamond Scientific Publishing. <http://www.dpublication.com/wp-content/uploads/2019/11/BMF236.pdf>
- Ries, E. (2011). *The Lean Startup*. New York: Crown Business.
- Truban, M. (2016). *Support*. Bratislava: PREMEDIA.

The use of smart technologies in enterprises

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Abstract: In the fourth industrial revolution, more and more things and devices are considered smart or intelligent. Smart technologies have applications in homes and cities as well as in businesses. This paper aims to examine the use of smart technologies in enterprises. Through statistical methods, enterprises were compared by size and industry branch. A questionnaire survey of 102 enterprises was conducted in the research. The most used smart technologies in enterprises were quality, machine consumption monitoring and maintenance management. The pressure on the efficiency of intelligent technology use also strains enterprises' long-term and systematic development and management.

Keywords: smart, technologies, Industry 4.0, enterprise size, technology application

JEL Classification: M11, Q55, O33

1 Introduction

In recent years, the word “smart” has become one of the keywords in modern scientific and technological development. The term Industry 4.0 was introduced by the German Industry–Science Research Alliance (Buhr, 2017). It refers to modern and advanced production automation and covers the current progressive technologies in industrial production. The primary vision and critical concept of Industry 4.0 is an intelligent factory that monitors its environment through machines without human force (Osterrieder et al., 2020) and their sensors and makes decentralized but highly informed decisions to optimize production. It is the online interconnection of the manufacturer's internal systems and the entire value chain from suppliers on the one hand to customers on the other. Industry 4.0 is a revolution and an evolution (Asadollahi-Yazdi et al., 2020). It uses existing technologies, which have been on the market for a long time and have matured into an entirely usable and integrative state. Connecting individual devices and sharing data is the essence and driving force behind the fourth industrial revolution.

Modern technologies are increasingly used for comfortable living and home (Darby, 2018). Electronic devices are part of the Internet of Things, enabling remote communication and control, including autonomous functions. Development activities focus on automation of individual household elements, systems for remote management of devices, central control systems, communication tools, data storage and transmission, etc. In household appliances, enterprises developed new functions, smart grids, energy-saving and consumption monitoring, air condition and lighting control, solutions, security and communication systems (Li et al., 2018).

Digital technologies can improve production processes (e.g. reducing resource use) and products (e.g. longer life cycles), thus contributing to reduced industrial waste and a green transition. Green technologies combine emission reduction, energy efficiency and renewable energy technologies to fulfil carbon emission reduction (Hottenrott et al., 2016). Green technologies cover four main sectors: energy power, fuel for transportation, water purification and treatment, and clean materials (Hee-Eun, 2011). These technologies include activities with minimal environmental effects (Mohammed, 2021). Green technologies have applications in the fields of chemicals, construction, transport, energy or waste management. They all are committed to reducing the impacts of climate change, preventing its causes and developing sustainably.

Logistics 4.0 is most often used to refer to logistics innovations and applications added by cyber-physical systems (CPS) and the latest information technologies for optimization of storage capacity and transport routes (Holubčík et al., 2021). The application of automation in logistics has its most incredible application in warehouses and in the dispatch of goods, where machines can take over physically demanding and routine work for humans. Current digitized logistics addresses optimizing the flow of materials, semi-finished and finished products inside and outside plants. Robotic process automation (RPA) is increasingly becoming a standard part of logistics systems, often replacing manual transcription and order processing (Flechsigt et al., 2022). Another building block of Supply Chain Logistics 4.0 is the intelligent warehouse

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management system (WMS), whose task is to provide information on the immediate status of inventory, react flexibly to current orders and communicate with the production planning system (Lototsky et al., 2019).

Similarly, the distribution and dispatch logistics are based on a system that starts with receiving goods into the warehouse and ends with transporting the final product to the end customer. Intelligent transportation systems can plan transport routes with optimum utilization of the vehicle fleet and dynamically designed transport trajectories taking into account consumption or vehicle maintenance prediction systems (Barreto et al., 2017). In Logistics 4.0, these will be fully autonomous (driverless), navigating entirely with the help of computer systems that detect the vehicle's surroundings and determine its route (Sell et al., 2019).

The conditions for maintenance of production equipment will continue to improve in the context of Industry 4.0. Manufacturers will focus more on failure-free, maintainability and other aspects, or the entire maintenance assurance. Operational reliability will need to be more closely monitored during the whole life cycle of the equipment. Predictive maintenance allows machines and robots performing production to communicate continuously and inform each other about non-standard situations. Machines self-report to maintenance personnel (or robots) and precisely define the problem (Pech et al., 2021).

Quality 4.0 can be understood as a combination of new technologies, standard tools, and traditional methods to achieve superior performance, higher operational efficiency and higher quality, excellence and innovation (Antony et al., 2021). A quality management system (QMS) should focus on maintaining a complete and comprehensive product design stored in a single system. Furthermore, small and global enterprises can quickly adapt their design processes for new products, including processes throughout the supply chain network, by digitizing and automating design and manufacturing processes. A supply chain quality system is a set of relationships between customers and suppliers that create quality chains (Amoozad Mahdiraji et al., 2012). Quality is meeting a technical standard and complementing the product with appropriate after-sales services.

2 Methods

The research aimed to assess the use of smart technologies in enterprises. A sub-objective was to analyze through a statistical validation the effect of enterprise size on the application of these technologies. We tried to find out how enterprises differ in their technology use.

The data are drawn from a questionnaire survey carried out on a sample of 164 Czech enterprises in 2018. This sample is part of the third wave of research (Vrchota and Pech, 2019), and 104 enterprises participated. After adjustment, wiping, and data cleaning, 102 questionnaires were used for the analysis. The questionnaires were submitted to executives and managers of enterprises and focused on smart technologies. The questions are focused on quality management and machine maintenance, smart air conditioning and lighting control, the use of green technologies, energy consumption monitoring, smart grids (real-time energy control), and intelligent storage and transport management. The questions in the questionnaire were in the form of a Likert scale (1 - little used technology, 5 - much-used technology). The processing of the answers is based on averages, which determine the weight of each possibility.

The classification of enterprise size is based on the methodology (European Commission, 2003). The analyzed groups consist of: 13 micro enterprises (less than ten employees), 32 small enterprises (10-49 employees), 29 medium-sized enterprises (50-249 employees) and 28 large enterprises (over 250 employees). There were 44 enterprises engaged in engineering production, 19 enterprises involved in non-metallic products, plastics or chemical production, 13 enterprises engaged in electrical manufacturing, 14 enterprises focused on food products, and 12 enterprises manufacturing household goods represented in the industry.

The obtained results were first subjected to statistical analysis by Levene's test for homoscedasticity in STATISTICA software. Homoscedasticity means that the residuals are drawn from a population with constant variance. Otherwise, heteroscedasticity refers to situations where the variance of the residuals is unequal over a range of measured values. If heteroscedasticity was insignificant (H_0 could not be rejected at $p < 0.05$ for agreement of variances), then ANOVA was used to test the means differences. Otherwise, heteroscedasticity was significant, and the Kruskal-Wallis test had to be performed (Meloun & Militký, 2004). The working hypotheses of interest, which form the subject matter of the test of means (or medians) verification, are the following:

- H_0 : There is no difference in using smart technology according to the enterprise size.
- H_A : There is a difference among enterprises in using smart technology according to the enterprise size.

Tests of means indicated whether or not there are any statistically significant differences in means (in case of ANOVA) or medians (in case of Kruskal–Wallis test). We tested these hypotheses for each of the nine observed smart technologies. Then, the differences were verified by multiple comparison tests for each size group of enterprises. This allowed us to

identify which enterprises have statistical differences (for example, small and large enterprises). We set the level of significance alpha to 0.05 (5 %) for all used tests and statistical evaluations. Significant results (including the significance level reached – p-value) are presented in the text.

3 Research results

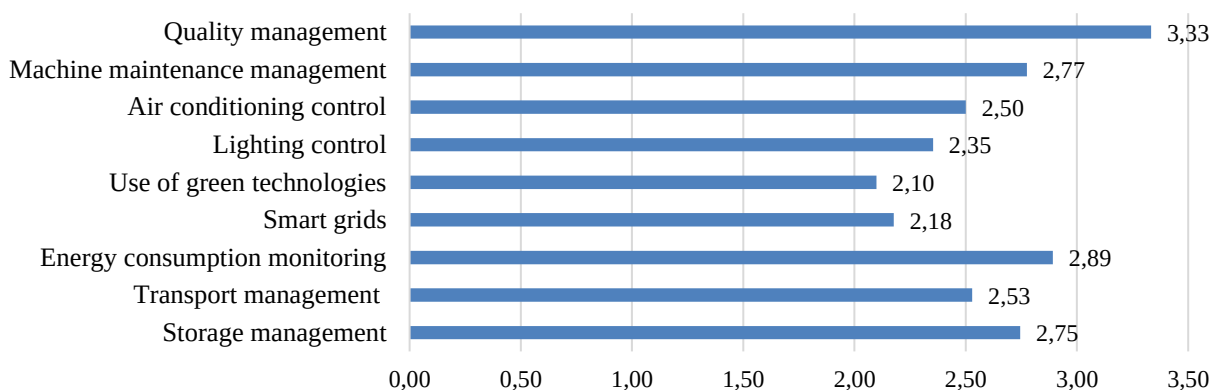
This section outlines the study's main results divided into two sections: widespread application of smart technologies and evaluation of differences between enterprises according to size.

3.1 Application of smart technologies

The widespread application of smart technologies in enterprises is depicted in Figure 1. The summary of main results obtained at various stages of the research shows that Quality management was rated the best with an average rating of 3.33. Quality is always the first thing a customer expects from a manufacturer. Enterprises have been dealing with this for a long time because products would not be competitive in the market area without achieving the necessary quality.

Smart metering is a way to measure the consumption of electricity, water, gas or heat in real-time and remotely. Sensors take regular electricity or gas consumption measurements, and the readings are sent to the Cloud, which can then be displayed in a connected app. Along with this technology is the deployment of smart grids (rating 2.18), which allow real-time regulation of electricity generation and consumption locally and globally. They involve decentralized electricity generation sources (solar and wind power plants, gas-fired microturbines etc.), allowing customers to produce and sell surplus electricity to the grid.

Figure 1 Average rating of smart technologies application



Source: Own processing

Machine maintenance management is a prerequisite for smooth production. Earlier maintenance methods were based on precisely defined maintenance deadlines based on performance (e.g. kilometres travelled) or on time worked (days). Maintenance was carried out either as routine service, intermediate administration or overhauls. It was very uneconomical because the machine's condition depended on how well the operator cared for it. Even if the device was in good condition and could continue to work, it had to undergo scheduled maintenance and be taken out of the production process for a certain period. New technologies make it possible to detect changes in the operation of a machine by comparing the vibration record of a device in good condition with a machine that deviates from this ideal condition. Maintenance is only carried out when it is needed.

The following questions include climate control (rating 2.50) and lighting control (rating 2.35). These physical factors are usually addressed simultaneously by enterprises. Particularly in today's energy crisis, it is essential to focus on this area, as there are significant savings opportunities here. For example, lights can only be switched on when someone enters a designated area. In the case of air conditioning, it is not necessary to heat the production hall in the same way in all places but to create different workplaces with segmented rubber walls and then heat them according to the nature of the work. As our survey was carried out before the energy crisis, it is clear that enterprises had not yet focused on this area or even underestimated it.

In transport management (rating 2.53), new technologies make it possible to track a vehicle's journey on roads anywhere in Europe and send the necessary information directly to digital maps at short intervals of about ten minutes based on satellite observations of cars. However, the situation has also changed in the communication with the driver. Drivers now receive instructions from their dispatcher on the route to make the journey either as short as possible or with the lowest possible diesel consumption. Nevertheless, enterprise dispatchers have a significant role in managing transport.

They have to make decisions based on a great deal of information about almost everything the driver has to do in the vehicle.

Intelligent storage management has a slightly higher rating (2.75), which is probably related to the fact that the enterprises have implemented this operation under supervision. There is a real revolution in warehousing systems today, and it is believed that eventually no workers will be needed in warehouses, and this area can be completely automated and robotized. So far, enterprises are about halfway there. It is a matter of loading and unloading operations and replacing paper-based filing and manual handling with progressively appropriate technical systems.

Enterprises reported using green technologies with the lowest rating, only 2.10. Enterprises do not yet see benefits in this area. Rather only see costs. The energy crisis will probably lead to changes, especially in constructing new buildings, where more electricity from photovoltaic panels or better water management will be needed. Rainwater must be harvested and used wherever it can replace existing drinking water consumption. Buildings will also have to be designed to prevent large heat leaks, and green plants will be more common on roofs, etc.

3.2 Differences between enterprises

Table 1 summarises the differences between enterprises by size, showing the average rating of enterprises. The results show that large enterprises have higher ratings for using smart technologies. On the contrary, managers of micro and small enterprises reported that they do not implement these technologies much. It may be mainly due to higher financial requirements or a lack of information about the possibilities of their use. According to the results, it was also found that large, medium and small enterprises use smart technologies most in quality management. In this case, it may be mistake-proofing devices, Internet of Things, RFID, artificial intelligence and machine learning for big data analytics. Large and medium-sized enterprises also needed energy consumption monitoring and storage management technology. Small enterprises often use machine maintenance management (2.59) and air condition control (2.50). Micro enterprises primarily use quality management (2.00) and energy consumption monitoring (2.08).

Table 1 Evaluation of smart technologies application according to the enterprises' size

Smart technology application	Micro enterprises	Small enterprises	Medium enterprises	Large enterprises
Quality management	2.00	3.28	3.21	4.14
Machine maintenance management	1.69	2.59	2.79	3.46
Air condition control	1.77	2.50	2.24	3.11
Lighting control	1.46	2.03	2.28	3.21
Use of green technologies	1.31	1.81	2.28	2.61
Smart grids (real-time energy control)	1.15	1.84	2.14	3.07
Energy consumption monitoring	2.08	2.28	2.86	4.00
Transport management	1.31	2.38	2.72	3.07
Storage management	1.08	2.31	2.90	3.86

Source: Own processing

We further tested working hypotheses that there is no difference in using smart technology according to the enterprise size. We evaluated the differences for all technologies studied. First, we used Levene's test to investigate whether the residuals are drawn from a population with constant variance. The results of the homoscedasticity tests are shown in Table 2. Only in the case of air condition control (p -value = 0.0942) was it impossible to reject the hypothesis of matching variances - homo. Thus, in this case, analysis of variance (ANOVA) was used to test for the consistency of means. The study of variance shows that there are differences between the enterprises for air conditioning. Otherwise, for other technologies were, heteroscedasticity for smart technology applications conclusive. Thus, it was necessary to use the Kruskal-Wallis ANOVA test. From the results in Table 2, it is clear that for all technologies, differences were found between groups of firms by size. Thus, we can conclude that differences between enterprises were found in all the technologies studied. Furthermore, we performed a multiple pairwise comparison analysis to more accurately identify differences.

Table 2 Differences in the evaluation of smart technologies application according to the enterprises' size

Smart technology application	Levene's test		Variance analysis		Kruskal–Wallis ANOVA	
	F	p-value	F	p-value	H	p-value
Quality management	4.5923	0.0047*	-	-	18.3394	0.0004*
Machine maintenance management	4.7092	0.0041*	-	-	13.4763	0.0037*
Air condition control	2.1886	0.0942	3.6409	0.0154*	-	-
Lighting control	5.4505	0.0017*	-	-	16.1861	0.0010*
Use of green technologies	8.2746	0.0001*	-	-	9.2328	0.0264*
Smart grids (real-time energy control)	8.7066	0.0000*	-	-	20.2019	0.0002*
Energy consumption monitoring	4.1064	0.0086*	-	-	29.0639	0.0000*
Transport management	5.6896	0.0012*	-	-	13.0352	0.0046*
Storage management	11.8088	0.0000*	-	-	32.2990	0.0000*

Source: Own processing

Pairwise comparison results showed the following findings:

- Quality management. Results show differences between micro and large enterprises (p -value = 0.0003). Small enterprises apply costly quality management systems to a lesser extent despite the lack of financial and human resources that are typical for them.
- Machine maintenance management. The pairwise comparison reveals differences between micro and large enterprises (p -value = 0.0031). The biggest challenge for micro-enterprises in implementing smart maintenance is the development of their information systems and platforms for their connection to mobile applications. Although, with the advent of the Cloud, many functions can be implemented through IT services.
- Air condition control. The LSD pairwise comparison test show differences between micro and large enterprises (p -value = 0.0034), medium-sized and large enterprises (p -value = 0.0155). In smaller companies, air conditioning is used more for technological or production reasons. It is not often used for administrative purposes or to improve the working environment.
- Lighting control. Results show differences between micro and large enterprises (p -value = 0.0025), small and large enterprises (p -value = 0.0240). Lighting control is often used to save energy. Large enterprises are more likely to use it due to the larger production scale.
- Green technologies. Pairwise comparisons indicate differences between micro and large enterprises (p -value = 0.0490). Even green technologies are used more by large enterprises with sufficient capacity to implement them.
- Smart grids. Pairwise comparison show differences between micro and large enterprises (p -value = 0.0005), small and large enterprises (p -value = 0.0170). Smart grids tend to be built by large energy utilities due to high acquisition costs. Therefore, differences were also evident between large and medium-sized enterprises.
- Energy consumption monitoring. Pairwise comparison show differences between micro and large enterprises (p -value = 0.0003), small and large enterprises (p -value = 0.0000), medium-sized and large enterprises (p -value = 0.0151). Currently, it transpires that energy monitoring is still the domain of large enterprises that use SCADA systems for central monitoring of industrial processes.
- Transport management. Pairwise comparison show differences between micro and large enterprises (p -value = 0.0044), micro and medium-sized enterprises (p -value = 0.0377). Electromobility, autonomous cars and other technological innovations in the transport sector seem to be more the domain of large companies.
- Storage management. Pairwise comparison show differences between micro and large enterprises (p -value = 0.0000), small and large enterprises (p -value = 0.0017), micro and medium-sized enterprises (p -value = 0.0029). The financial complexity of smart warehouse technologies creates a gap between businesses. Smaller enterprises use manual warehousing, while semi-automatic or fully automatic systems use large enterprises.

Overall, we can conclude that differences between micro, small and large enterprises were mostly found. These findings are based on large enterprises' advantages over small ones. Large enterprises are more successful in digital

transformation. Small and medium-sized enterprises are vital financial support initiatives (Rupeika-Apoga et al., 2022). Small businesses have a disadvantage in terms of staffing for smart projects, high costs and lack of finance, little market knowledge and institutional obstacles that are likely to affect their innovation activities (Arza & López, 2021).

4 Conclusions

New technologies are constantly being mentioned in the professional press, but it is forgotten to emphasize that new technologies are not the target. The target must be the restructuring of the Czech economy and production. It will enable the production of products with higher added value. The new technologies should not merely increase the output of the existing production lines several times over but allows the transition to new energy sources that will produce ever less harmful emissions. Thus, they contribute to the European Union's strategic commitment to becoming the first continent to become carbon neutral by 2050.

Our research confirms that large enterprises play a significant role in applying new technologies. In contrast, small and medium-sized enterprises remain somewhat reticent to adopt these new developments. It is understandable, as new technologies require high investments with long-term returns. Clearly, the entire car industry is switching to electric cars. This fundamental change will affect thousands of smaller subcontractors working with these large multinationals. Similarly, major production-technology revolutions are taking place in the steel, construction and other industries. The EU is also supporting these efforts with large financial loans and grants to ensure that the competitiveness of European enterprises remains high even in these challenging conditions.

For small and medium-sized Czech enterprises, this implies that they cannot continue to wait or make only minor organizational adjustments. They must change their strategies fundamentally if they have not already done so. New technologies also bring the need for new professions; the old ones will quickly disappear. There is still a shortage of workers in the labour market. It will be up to the enterprises to retain the existing workers and retrain them for the necessary future professions.

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References

- Amoozad Mahdiraji, H., Arabzadeh, M., & Ghaffari, R. (2012). Supply chain quality management. *Management Science Letters*, 2(7), 2463–2472. DOI: 10.5267/j.msl.2012.07.020
- Antony, J., McDermott, O., & Sony, M. (2021). Quality 4.0 conceptualization and theoretical understanding: A global exploratory qualitative study. *The TQM Journal*. DOI: 10.1108/TQM-07-2021-0215
- Arza, V., & López, E. (2021). Obstacles affecting innovation in small and medium enterprises: Quantitative analysis of the Argentinean manufacturing sector. *Research Policy*, 50(9), 104324. DOI: 10.1016/j.respol.2021.104324
- Asadollahi-Yazdi, E., Couzon, P., Nguyen, N. Q., Ouazene, Y., & Yalaoui, F. (2020). Industry 4.0: Revolution or Evolution? *American Journal of Operations Research*, 10(06), 241–268. DOI: 10.4236/ajor.2020.106014
- Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: An overview. *Procedia Manufacturing*, 13, 1245–1252. DOI: 10.1016/j.promfg.2017.09.045
- Buhr, D. (2017). *Social Innovation Policy for Industry 4.0*. Friedrich Ebert Stiftung.
- Darby, S. J. (2018). Smart technology in the home: Time for more clarity. *Building Research & Information*, 46(1), 140–147. DOI: 10.1080/09613218.2017.1301707
- European Commission. (2003). *Recommendation of 6 May 2003 Concerning the Definition of Micro, Small and Medium-Sized Enterprises. Text with EEA Relevance, Notified Under Document Number C (2003) 1422*. European Commission.
- Flehsig, C., Anslinger, F., & Lasch, R. (2022). Robotic Process Automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation. *Journal of Purchasing and Supply Management*, 28(1), 100718. DOI: 10.1016/j.pursup.2021.100718
- Hee-Eun, K. (2011). Defining Green Technology. In *The Role of the Patent System in Stimulating Innovation and Technology Transfer for Climate Change* (s. 15–20). Nomos Verlagsgesellschaft mbH. <https://www.jstor.org/stable/j.ctv941r23.5>
- Holubčík, M., Koman, G., & Soviar, J. (2021). Industry 4.0 in Logistics Operations. *Transportation Research Procedia*, 53, 282–288. DOI: 10.1016/j.trpro.2021.02.040
- Hottenrott, H., Rexhäuser, S., & Veugelers, R. (2016). Organizational change and the productivity effects of green technology adoption. *Resource and Energy Economics*, 43, 172–194. DOI: 10.1016/j.reseneeco.2016.01.004
- Li, M., Gu, W., Chen, W., He, Y., Wu, Y., & Zhang, Y. (2018). Smart Home: Architecture, Technologies and Systems. *Procedia Computer Science*, 131, 393–400. DOI: 10.1016/j.procs.2018.04.219

- Lototsky, V., Sabitov, R., Smirnova, G., Sirazetdinov, B., Elizarova, N., & Sabitov, Sh. (2019). Model of the Automated Warehouse Management and Forecasting System in the Conditions of Transition to Industry 4.0. *IFAC-PapersOnLine*, 52(13), 78–82. DOI: 10.1016/j.ifacol.2019.11.137
- Meloun, M., & Militký, J. (2004). *Statistická analýza experimentálních dat* (2.). Academia.
- Mohammed, S. I. (2021). Advantages of Green Technology to Mitigate the Environment Problems. *IOP Conference Series: Earth and Environmental Science*, 779(1), 012133. DOI: 10.1088/1755-1315/779/1/012133
- Osterrieder, P., Budde, L., & Friedli, T. (2020). The smart factory as a key construct of industry 4.0: A systematic literature review. *International Journal of Production Economics*, 221, 107476. DOI: 10.1016/j.ijpe.2019.08.011
- Pech, M., Vrchota, J., & Bednář, J. (2021). Predictive Maintenance and Intelligent Sensors in Smart Factory: Review. *Sensors*, 21(4), 1470. DOI: 10.3390/s21041470
- Rupeika-Apoga, R., Bule, L., & Petrovska, K. (2022). Digital Transformation of Small and Medium Enterprises: Aspects of Public Support. *Journal of Risk and Financial Management*, 15(2), 45. DOI: 10.3390/jrfm15020045
- Sell, R., Rassõlkin, A., Wang, R., & Otto, T. (2019). Integration of autonomous vehicles and Industry 4.0. *Proceedings of the Estonian Academy of Sciences*, 68(4), 389. DOI: 10.3176/proc.2019.4.07

Economic of Agriculture:
Current Trends in Agribusiness

The sustainability of the activities of food banks in the Czech Republic with regard to the planned strategic changes of the EU agri-food sector

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Abstract: The review type article aims to identify key aspects for sustainability of activities of food banks in the Czech Republic, in connection with currently given objectives of the EU's Common Agricultural Policy for the agri-food complex in the programming period starting from 2023. In this context, there are taken into account identifiable impacts on current best practice of food banks.

Keywords: food banks, food supply chain, Common Agricultural Policy

JEL Classification: Q18, D21

1 Introduction

Food banks can be considered as independent institutions of public interest due to the possibility of reducing food waste and also through corporate social responsibility in relation to address poverty and related nutritional needs of the affected population (eg. Caraher and Furey, 2018). Beck and Gwilym (2022) add that food banks have become a type of a safety net for people who have failed the social security system in times of the Covid-19 pandemic and current austerity.

The problem framework of activities of food banks in the European area can be identified mainly in the diverse range of areas for managerial solutions, which include, on the one hand, financing of this type of activity with regard to the necessity to fully follow hygiene standards when donating food and, on the other hand, the lack of interest to participate in the food donation system by certain types of business entities (eg. Gracjasz and Grasseni, 2020; Nikolov, 2021).

The EU strategy for the period 2021+ targets the need to transform the agri-food complex with an emphasis on fair market conditions, quality, safety and environmental friendliness of production systems. In the mentioned context, an effort to "redesign" food supply chains, which currently represent about a third of global greenhouse gas emissions, is declared. It is also associated with an inefficient consumption of natural resources, resulting in loss of biodiversity and negative health impacts. Furthermore, aspects, which take into account the sustainable economic profitability and viability of participating economic entities, especially primary producers, are emphasized (©European Commission, 2021).

2 Methods

The review type article is based on the research of the current state of knowledge in the field of effective provision of food banks' services. Methods of analysis and synthesis of both foreign and domestic information sources are used.

Secondary data was also used as part of the European Commission's monitoring of the price situation and market outlook for agricultural commodities and food, which are available at the Agriculture and rural development portal (European Commission, ©2022a).

3 Research results

European Food Bank Federation represents institution that aims to reduce food insecurity in Europe by preventing food waste and promoting the need for solidarity, support and development of food banks in countries where their services are needed. It emphasizes in its latest report (European Food Bank Federation, ©2022) the negative effects of the war conflict in Ukraine on ensuring the security perspectives of supplying vulnerable groups of people with food and the necessity of direct measures by the EU to respond to the given crisis situation. The Czech Federation of Food Banks is a member of the European Federation of Food Banks in the Czech Republic. The Czech Federation of Food Banks currently supports activities of 15 regional food banks in the Czech Republic, incl. common central distribution warehouse in Prague.

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3.1 Provision of services of food banks in the Czech Republic

Provision of food banks' services in the Czech Republic towards the distribution of food aid according to the Act No. 110/1997 Coll. on food and tobacco products, as amended, has been supported since 2016 by the national budget of the Ministry of Agriculture of the Czech Republic. In response to the Russian invasion of Ukraine and the deterioration of the financial situation of socially weaker groups of the population, the Ministry of Agriculture of the Czech Republic has increased the financial framework of the long-term support provided to food banks (Ministry of Agriculture of the Czech Republic, ©2022). These facts were positively reflected in the volume of aid distributed by domestic food banks to people in material need (see Table 1).

Table 1 Volume of operational and investment subsidies provided by Ministry of Agriculture of the Czech Republic, volume of distributed food help by food banks in the Czech Republic

Item / Year	2016	2017	2018	2019	2020 - 2021	Total
Volume o subsidies (Mill. CZK)	22.5	29.6	40.8	117.0	177.2	387.1
Volume of food help (tons)	1300	2300	4200	4700	7000*	19500

Source: Own processing using data of the Ministry of Agriculture of the Czech Republic (©2021) and the Czech Federation of Food Banks (©2021)

*Note: Volume of food help for year 2021 not currently available

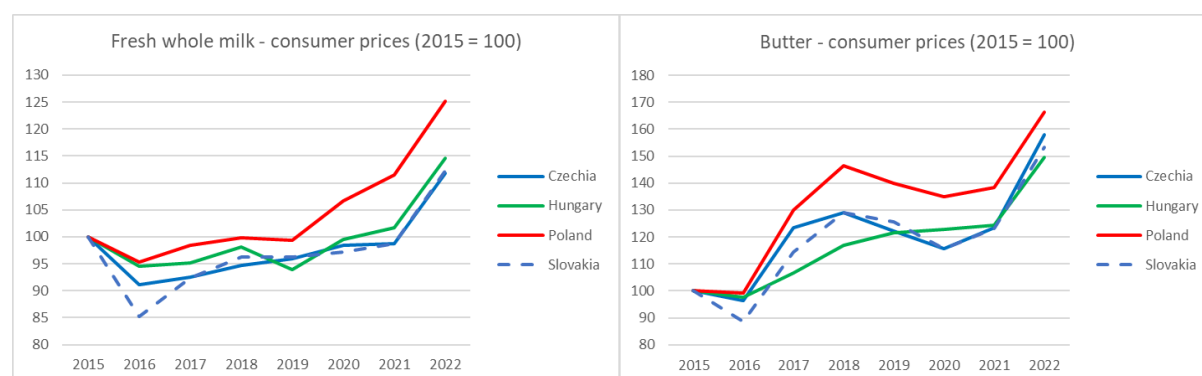
Beside the financial support of the Ministry of Agriculture, there is also a financial support by the Ministry of Labor and Social Affairs and the Ministry of the Environment, which in the year 2022 will be provided to food banks in the Czech Republic 200 million CZK for investments from EU budget (Ministry of the Environment of the Czech Republic, ©2022; Ministry of Labour and Social Affairs ©2021).

3.2 A Context of the Common Agriculture Policy and sustainable food production behind year 2022

Addressing food waste is one of the essential areas for achieving sustainable development within the agri-food complex. A 2016 study (European Commission ©2022b) concluded that 20 % of food in the EU is wasted. This waste represents approximately 6% of greenhouse gas emissions in the EU and also represents an excess burden on soil, water use and other scarce natural resources. By mid-2023, the European Commission will propose relevant binding targets that will enable the reduction of food waste throughout the EU.

Raise of food prices that is caused by negative development of cost of inputs within the whole foodchain itself could be directly controlled by the EU Common Agriculture Policy. Fig. 1 declares development of consumer prices of selected products in Visegrad 4 member countries. Rapid increase of producer prices of basic food is correlated with the raising proportion of people who need food help provided by food banks.

Fig 1 Development of consumer prices for fresh whole milk and butter



Source: Own processing using data of European Commission (©2022a)

Note: Data for year 2022 represents available values for the first half year

Meuwissen and Feindt et al. (2021) point out at the importance of the resilience attributes of food production systems, it shows that it depends significantly on the design of the system itself. Assessing the systematic resilience of agricultural production systems can help highlight its vulnerability. Many farming systems in Europe are facing a looming resilience crisis.

Sustainable food production is essential for its availability. It is necessary to continue the long-term construction of sustainable, productive and resilient agriculture, as envisaged in the Farm to Fork and Biodiversity strategies. The current crisis highlights aspects of the dependence of the EU food production system on imported inputs such as fossil fuels, fertilizers and feed. These facts emphasize the need for a fundamental reorientation of EU agriculture and its EU food systems towards sustainability in line with the Green Deal and the reformed Common Agricultural Policy. (European Commission ©2022c).

4 Conclusions

The recent crisis caused by the spread of the disease COVID 19 and the current war crisis affect food security not only in the EU Member States, but throughout the world. Food banks in the role of charitable type of non-profit organizations can be a certain safety net for people in material need.

The activity of food banks in Europe is professionally supported by the European Federation of Food Banks (FEBA). These federation have got currently 24 full and 6 associated members. FEBA declares that European food banks are dependant on donations and sharing of food. FEBA recognizes the following major activities of food banks: supply, distribution and operations. All these activities are mostly depend on volunteer work. This fact raises the question of how to sustainably adopt the activities of this type of non-profit organizations also in the context of planned changes of the EU's Common Agricultural Policy.

This review type of article provides a partial output of on-going research project on key attributes for sustainable provision of food banks in the Czech Republic regard to a best practice in this area. This research project will, in its various phases, focus on taking into account the context of identifiable impacts on the current best practice of food banks in EU member states. Achieving the objectives of the on-going project is assumed mainly through the use of relevant publicly available secondary information and data. It is also intended to conduct a questionnaire research among representatives of food bank full/associated members.

The concept of food banks in the area of supporting socially disadvantaged population groups is not new and has a tradition both in the EU core countries and in newer member states. However, they are facing new challenges, starting with the pandemic of a new type of corona-virus and the current war conflict. It is therefore very important to continuously revise the frontiers of the possibilities of providing a given type of social services of a charitable nature. All the aforementioned aspects in the context of the necessary reforms of the EU's Common Agricultural Policy, respecting the key areas of the so-called Green Deal.

It is also necessary to reflect within the current ongoing research that the activities of food banks also compensates existing inefficiencies of the food production system, which can basically be viewed through the amount of food waste. However, binding surplus food and reducing its waste only through food banks cannot be sustainable in the long run. In this context, it is thus possible to discuss the usability of food waste also, for example, for energy use within the framework of carbon-neutral concepts. However, it is essential to state that food within the defined key areas will not be produced intentionally for energy use only. This fact may paradoxically mean that streamlining and further optimizing the system of sustainable food production will lead to their unavailability for socially vulnerable groups of the population. So, further government intervention in the area of food availability, or food self-sufficiency appears to be inevitable in the near future.

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References

- Beck, D., & Gwilym, H. (2022). The Food Bank: A Safety-Net in Place of Welfare Security in Times of Austerity and the Covid-19 Crisis. *Social Policy and Society*, 1-17. DOI:10.1017/S1474746421000907
- Czech Federation of Food Banks (©2021). Výroční zpráva za rok 2020. [On-line]. Cited 09-01-2022. Available from <https://www.potravinovebanky.cz/nase-cinnost#gallery-pdf-3>
- Caraher M., & Furey S. (2018). Title Growth of Food Banks in the UK (and Europe): Leftover Food for Leftover People. *The Economics of Emergency Food Aid Provision*. Cham: Palgrave Pivot.
- European Commission, ©2021. Farm to Fork strategy. [On-line]. Cited 09-01-2022. Available from https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en
- European Commission, ©2022a. Monitoring the price situation and the market outlook for agricultural commodities and food. [On-line]. Cited 08-22-2022. Available from https://agriculture.ec.europa.eu/data-and-analysis/markets_en
- European Commission, ©2022b. EU Platform on Food Losses and Food Waste. [On-line]. Cited 09-01-2022. Available from https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/eu-platform-food-losses-and-food-waste_en
- European Commission, ©2022c. Security, stability and sustainability: Tackling global food security and affordability challenges. [On-line]. Cited 06-24-2022. Available from https://agriculture.ec.europa.eu/system/files/2022-05/factsheet-tackling-food-security-affordability-challenges_en_0.pdf
- European Food Bank Federation, ©2022. FEBA EU Monitoring: February-April 2022. [On-line]. Cited 08-22-2022. Available from https://www.eurofoodbank.org/wp-content/uploads/2022/05/FEBA_EU_Monitoring_FebApril_2022_final.pdf
- Gracjasz, A., & Grasseni, C. (2020). Food-gifting in Gdańsk: between food not bombs and the food bank. *Ethnologia Polona*, 41, 33–50. DOI: 10.23858/EthP41.2020.2018
- Meuwissen, M.P.M., Feindt, P.H., et al. (2021). Impact of Covid-19 on farming systems in Europe through the lens of resilience thinking. *Agricultural Systems*, 191, 103152, DOI: 10.1016/j.agsy.2021.103152.
- Ministry of Agriculture of the Czech Republic (©2022). Miliony navíc pro potravinové banky: Ministerstvo přidalo na jejich provoz dalších 20 milionů. [On-line]. Cited 08-22-2022. Available from https://eagri.cz/public/web/mze/tiskovy-servis/tiskove-zpravy/x2022_miliony-navic-pro-potravinove-banky.html
- Ministry of Agriculture of the Czech Republic (©2021). Zásady, kterými se stanovují podmínky pro poskytování dotací na udržování a využívání genetických zdrojů pro výživu a zemědělství pro rok 2021. [On-line]. Cited 08-22-2022. Available from <https://eagri.cz/public/web/mze/zemedelstvi/geneticke-zdroje/dotace/zasady-pro-rok-2021/>
- Ministry of the Environment of the Czech Republic (©2022). Operational Program Environment 2021–2027. [On-line]. Cited 08-22-2022. Available from <https://opzp.cz/dokumenty/programovy-dokument/>
- Ministry of Labour and Social Affairs of the Czech Republic (©2021). (FEAD) - Operational program of food and material aid for the program period 2014-2020. [On-line]. Cited 09-01-2022. Available from <https://www.mpsv.cz/dokumenty-a-informace-o-programu>
- Nikolov, R. (2021). Waste Management Projections in Bulgaria, *Proceedings of Agribusiness and Rural Areas - Economy, Innovation And Growth 2021*, Yogyakarta, August 25-26th 2021. DOI: 10.36997/ara2021.325

Financial ratios and profitability prediction

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Abstract: The presented article deals with the possibility of using financial ratio indicators to predict the profitability of agricultural enterprises. The Albertina database was used as a data source. A total of 701 agricultural enterprises were selected, with sales of more than one million crowns. Companies from the manufacturing industry were used for comparison. The correlation between the value of the financial ratio and the company's profitability in the following years was calculated. Spearman's correlation coefficient was used. Research shows that the success rate of agricultural enterprises is relatively stable. The correlation between ROA value and subsequent profitability is 0.41 to 0.48 (for year $t+1$). In the following years, the correlation decreases. These values are approximately 5 – 10 percentage points below the importance of the manufacturing industry. However, correlations can be increased by dividing businesses into categories of similar size or according to similar altitudes. The usability of other financial ratios is lower. The correlation between indebtedness and future profitability is approximately -0.25, and the correlation between liquidity and future profitability fluctuates around the value of 0.20. These values correspond to values from other industries as well. A significant difference is the usability of activity indicators. For manufacturing, correlation values range from 0.21 to 0.24, but for agricultural enterprises, the correlation is considerably lower. The reason is the high dependence of the indicator on the altitude and the production orientation of the agricultural enterprise.

Keywords: Agriculture, profitability, profitability prediction, corporate rating

JEL Classification: G32, G33

1 Introduction

Accurate profitability forecasts are essential for operational management and investment decisions and provide valuable information for investors, managers, and other corporate stakeholder groups. Since accurate profitability estimates increase the company's valuation, they are also of interest to stock market traders. (Mundt, 2020)

Stigler (Stigler, 1963) already dealt with the question of profitability predictability. In more recent research, studies by Mundt (Mundt, 2020), Nissim (Nissim, 2001), can be cited. All these studies confirm the possibility of successful prediction.

There are different ways of predicting profitability. Van Lear (Van Lear 1999) describes the relationship between profitability, investment, and the economic phase of the business cycle. Xu Xu et al. (XU 2021) create profitable models for predicting the performance of airlines in the short term. They recommend applying the LASSO estimation method to calculate and determine the relevant factors.

However, most analyses are based on data from financial statements. (Ohlson, 1980). Extensive review studies on this topic have been published, for example, by Balcean (Balcean, 2006) and de Andres (de Andres, 2005). The quality of predictions is highly dependent on the explanatory power of financial statements. (Allen, 2005), (Beaver, 2012), (Islam, 2020).

The basis is the so-called credit models. In the conditions of the Czech Republic, IN99 models are used the most. (Neumaierová, Neumaier 2002) Economic profit was calculated for a sample of 1,698 companies. The companies were divided into two groups (companies with a positive EVA value and companies with a negative EVA value). The model was created using discriminant analysis. The authors report a classification success rate of 85%. For agricultural enterprises (this thesis also focuses on agricultural enterprises), the Gurčík index is essential. Gurčík (2002) divides the set of agricultural enterprises into prosperous and non-prosperous enterprises. He considers a prosperous company to be

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one that made a profit between 1998 and 2000, and in the last year, the return on equity was higher than 8%. Selects five indicators: retained earnings/total liabilities, earnings before taxes/total liabilities, earnings before taxes/revenues, cash flow/total liabilities, inventories/revenues.

The objective of this article is to:

- Verify whether the stability of the profitability of agricultural enterprises is sufficient for the creation of a prediction model
- Find indicators of financial analysis that are correlated to the size of future profits (respectively, to future profitability).

The study can thus be understood as a first step before creating a more complex prediction model. The applied procedures are based on the principles of the one-dimensional prediction model. These models determine the dependence between the resulting property and the financial variable. Classification analysis is also performed for each variable. The advantage of this procedure is its simplicity.

Beaver (Beaver 1966) used this method as one of the first. Beaver called his method Profile Analysis. He compared 79 unsuccessful businesses with the same number of “good” businesses. A unsuccessful company went bankrupt, defaulted on bond obligations, exceeded its overdraft limit, or failed to pay a dividend on preferred stock. Beaver determined the prognostic reliability of the ratios: Cash flow/Total debt, Net income/Total assets, Total debt/Total assets, Working capital/Total assets, and Current assets/Current liabilities. The method was chosen for its simplicity even though Majdánková's study (Majdánková, 2020) draws attention to worse results in agriculture (in forestry)

2 Methods

Financial data for the article was obtained from the Albertina database. The condition for inclusion in the database was sales of more than one million crowns and complete data for five years of monitoring (years 2015 to 2020.). A total of 701 agricultural and 7,828 non-agricultural enterprises were evaluated (from the sector: manufacturing industry). Agricultural enterprises were further divided by size (into four groups according to the corresponding quartiles).

Another classification of agricultural holdings was according to the share of areas with natural or other limitations (ANC). The categorization corresponded (given the year 2015 as the start of the monitored period) to the original LFA. Two hundred thirty-two enterprises were classified in NON-LFA areas, 80 enterprises were classified in mountain areas, 201 enterprises were from the mixed areas, and 81 enterprises were classified among areas with notable disadvantages.

The research calculated correlations between the value of the financial indicator in year zero (marked as t) and the profitability of the company's assets in the following years (market as $t+1$, $t+2$, etc.). The initial year 2016 thus allowed the correlation calculation for the years 2017($t+1$), 2018($t+2$), 2019($t+3$), and 2020($t+4$). The initial year 2017, allowed the analysis of the correlations for 2018($t+1$), 2019($t+2$), 2020($t+3$), etc. This method made it possible to observe whether the correlation changes over time. That is, whether the correlation in year $t+1$ is different when the year zero (t) is different. If the correlation changes over time, it indicates the influence of external factors. The value of the financial indicator suitable for the original situation would become disadvantageous in case of varied economic conditions. The optimal value of the financial indicator would not exist and creating a prediction model would become more difficult.

ROA, asset turnover, indebtedness, current liquidity were selected as analysed financial indicators. The indicators of sales per hectare, profit per hectare and labour productivity were also selected for agricultural enterprises. Partial results indicated that operational indicators achieve better prediction results than financial ratios (the correlation between the value of the indicator in year zero and profitability in the following years is higher).

The success of enterprises is determined as relative (given by the ranking in the database), not as an absolute value of profitability. Spearman's correlation coefficient was used. The reason for this calculation was a large number of extreme values and the expected effect of external conditions (typical for agriculture and manifested in other sectors due to the covid-19 epidemic).

3 Research results

Table 1 Profitability and risk (from 2016 to 2020)

Sectors	Years	2016	2017	2018	2019	2020
Agriculture	Mean	4,15%	4,13%	3,17%	2,91%	2,69%
	Standard deviation	4,58%	3,92%	3,63%	4,12%	3,51%
Manufacturing industry	Mean	6,15%	5,77%	5,66%	4,85%	3,43%
	Standard deviation	14,12%	13,13%	12,86%	12,73%	14,18%

Source: Database Albertina, Own processing

Table one shows the agriculture and manufacturing sectors' primary yield and risk characteristics. The average profitability of agriculture is smaller. It reaches its maximum in 2016 at 4.15% and gradually decreases in the following years to a value of 3.51% in 2020. Low return is also associated with low risk. The standard deviation (inter-firm volatility) in agriculture ranges from 3.63% in 2018 to 4.58 in 2016. Profitability in the manufacturing industry is about two percentage points above agricultural yields throughout the monitoring period. However, the risk and volatility are also significantly higher.

A drop in profitability can be observed in both areas. Interestingly, although the covid epidemic has already marked the last two years of monitoring, the decline is not very significant. At the same time, there is no increase in inter-firm volatility.

Table 2 Spearman correlation coefficient between ROA ratio and future profitability

Industry	t	2016	2017	2018	2019	2020
Agriculture	2016	1	0,4444	0,3841	0,3340	0,3180
	2017	x	1	0,4176	0,3734	0,3406
	2018	x	x	1	0,4886	0,3348
	2019	x	x	x	1	0,4522
	2020	x	x	x	x	1
Manufacturing industry	2016	1	0,5206	0,4129	0,3463	0,2960
	2017	x	1	0,5180	0,4152	0,3272
	2018	x	x	1	0,5193	0,3952
	2019	x	x	x	1	0,4975
	2020	x	x	x	x	1

Source: Database Albertina, Own processing

Table two shows the correlations between the ROA ratio and the future profitability of businesses. It can be seen from the table that the ranking of the companies does not change much. The correlation between years zero (t) and year t+1 reaches values from 0.4975 (for year t = 2019) to 0.5206 (for year t = 2016) in the manufacturing industry. In agriculture, the correlations are slightly smaller. The values range between 0.4176 (for the year t = 2017) and 0.4886 (for the year t = 2018). The correlation coefficients are surprisingly high (given the low inter-firm volatility). In the case of low volatility, even a small change in the company's profitability can significantly affect its ranking in the database. Nevertheless, the ranking of companies remains stable during the monitored period.

In the following years, the correlation gradually decreases. For the manufacturing sector and for t+2, the values vary between 0.3952 (for t = 2018) and 0.4152 (for t = 2017). Under similar conditions, agriculture achieves a correlation of around 0.38. The exception is the period t = 2018, in year t+2, (i.e., in 2020), the value of the correlation coefficient dropped to 0.3348. For period t+3, the correlations reach (equally for both sectors) values between 0.3272 and 0.3463. Period t+4 can only be calculated for t=2016. The correlation is 0.2960 for the manufacturing industry and 0.3180 for the agriculture sector.

The impact of the covid epidemic did not affect the relative success of businesses. The correlation coefficients for the years 2019 and 2020 (that is, the years marked by the restrictive measure) do not differ from the results of the previous periods. Although the average profitability has decreased, the companies have maintained their ranking in the database.

Relatively high and stable correlation indices support the idea of creating a predictive model. The company's success rate has been relatively stable over time.

Table 3 Spearman correlation coefficient between ROA and future profitability. Breakdown by size of company (for year=2016)

Years	2017	2018	2019	2020
Total	0,4444	0,3841	0,3340	0,3180
The smallest enterprises. (Below the first quartile)	0,4064	0,3979	0,3919	0,3345
Enterprises below average in size (Between the first quartile and the second quartile.)	0,5379	0,4480	0,4436	0,7271
Enterprises average by size. (Between the second quartile and the third quartile)	0,5677	0,5433	0,4853	0,4846
The biggest enterprises. (Above the third quartile)	0,6640	0,5955	0,5931	0,5627

Source: Database Albertina, Own processing

Table three shows the dependence between the ROA indicator in 2016 and the subsequent profitability (from 2017 to 2020). Enterprises are divided according to economic size. The first group includes companies with sales below the value of the first quartile. Into the second group are companies between the first and second quantiles. The third group is between the second and third quantiles. The last category includes businesses above the third quartile.

Table 4 Correlation between ROA and future profitability. Breakdown by land share in ANC (for year=2016)

Years	2017	2018	2019	2020
Total	0,4444	0,3841	0,3340	0,3180
NON ANC	0,5824	0,5123	0,4880	0,3572
ANC O	0,4527	0,4336	0,4229	0,3252
ANC S	0,4502	0,4254	0,3722	0,3528
Mountain areas	0,5720	0,4840	0,4728	0,4326

Source: Database Albertina, Own processing

Table four shows the dependence between the ROA indicator and the subsequent profitability, enterprises are classified according to the share of land in disadvantaged areas (ANC)

Both tables (three and four) show a substantial increase in correlation and dependence. The value of the correlation coefficient rises to 0.6640 (for large enterprises) and 0.5820 (for enterprises from the NON-ANC area). Correlations are increasing in most business categories.

We believe there are different causes behind the increase in addiction in both divisions. If we break down companies by economic size, year-on-year volatility decreases in the three categories with the largest companies. Large enterprises can better diversify their production. Diversification reduces volatility and the possibility of a sudden drop in profitability due to unexpected natural events. The order of the company in the database becomes more stable. A supporting argument for the previous statement is the increase in dependence with the increasing economic size of the enterprise.

In the case of the division according to the share of land in disadvantaged areas, the inter-annual volatility remains high, but the inter-company volatility within individual categories decreases. Thus, companies with a similar production orientation remain in one category. An external factor affecting profitability (such as purchase prices) affects all

businesses similarly. The profitability of most companies in the category moves in the same direction, and the ranking of the companies will remain the same. A supporting argument for the previous statement is the increase in dependence with the increasing economic size of the enterprise.

In the case of the division according to the share of land in disadvantaged areas, the inter-annual volatility remains high, but the inter-company volatility within individual categories decreases. Enterprises with the same share of ANC have a similar production structure. An external factor affecting profitability (e.g., purchase prices of commodities) similarly affects all enterprises in the category. The profitability of most companies in the category is moving in the same direction, and the ranking of the companies will remain the same.

A supporting argument for this fact is that the highest increase in dependency occurred in NON-ANC areas and mountainous areas. Enterprises in each of these areas have a narrowly focused production structure. The effect described above is, therefore, the most pronounced. Enterprises from the remaining regions (ANC-S and ANC-O) form transitions between the two extreme categories, and their product structure is not precisely defined. The increase in correlation is, therefore, less pronounced.

Table 5 Spearman correlation coefficient between Indebtedness ratios and profitability in subsequent years

Industry	t	2016	2017	2018	2019	2020
Agriculture	2016	-0,2591	-0,1730	-0,1558	-0,1498	-0,1258
	2017	x	-0,2671	-0,1938	-0,1831	-0,1478
	2018	x	x	-0,2455	-0,2100	-0,1613
	2019	x	x	x	-0,2685	-0,1736
	2020	x	x	x	x	-0,2433
Manufacturing industry	2016	-0,33026	-0,1763	-0,1671	-0,1418	-0,1435
	2017	x	-0,2984	-0,1977	-0,1606	-0,1533
	2018	x	x	-0,3043	-0,1953	-0,1715
	2019	x	x	x	-0,2956	-0,1941
	2020	x	x	x	x	-0,2873

Source: Database Albertina, Own processing

Table number five contains correlations between the debt ratio and future profitability. In the case of indebtedness (in contrast to the previous ROA indicator), it makes sense to calculate the correlation even for year $t+0$. The correlation for $t+0$ is negative and reaches -0.2433 (for $t=2020$) to -0.2685 (for $t=2019$) for the agriculture sector. In the case of the manufacturing industry, the correlation is only marginally higher (with a maximum of -0.33026 in 2016). The correlation between indebtedness and future profitability (as in the case of ROA) decreases with increasing time lag.

For $t+1$, the correlation value of the values reaches -0.1730 (the deal was calculated for $t=2016$) to -0.2100 (the value was estimated for $t=2018$). There is no difference in the achieved values of the agriculture and processing industries; this contrasts with the ROA indicator, where correlations were higher in the manufacturing sector. For possible prediction, it is crucial that the correlation reaches relatively high values also in period $t+3$ (from -0.1558 to -0.1831).

Table 6 Spearman correlation coefficient between Current liquidity and profitability in subsequent years

Industry	t	2016	2017	2018	2019	2020
Agriculture	2016	0,1932	0,1493	0,1114	0,0091	0,0903
	2017	x	0,2135	0,1620	0,1171	0,1107
	2018	x	x	0,1871	0,1661	0,1398
	2019	x	x	x	0,2044	0,1604
	2020	x	x	x	x	0,1862
Manufacturing industry	2016	0,2810	0,1922	0,1814	0,1668	0,1698
	2017	x	0,2818	0,1940	0,1747	0,1616
	2018	x	x	0,2859	0,2049	0,2026
	2019	x	x	x	0,3055	0,2310
	2020	x	x	x	x	0,3098

Source: Database Albertina, Own processing

Correlations between current liquidity values and future profitability are higher in the manufacturing industry. For period t+0, the correlation reaches values between 0.2810 (for t=2016) and 0.3098 (for t=2020). For period t+1, the correlation coefficient reaches values from 0.1922 to 0.2310. Again, it can be seen that the correlation between 2016 and 2020 increases slightly. In this industry, the correlation reaches high values even for the t+2 and t+3 intervals.

The values obtained for the agricultural sector are considerably lower. Already for the period t+0, the correlation is around ten percentage points below the values usual in the manufacturing industry. Worse, however, is the drop in correlation with the lengthening period. For period t+2, the correlation value does not exceed the limit of 0.12. Such low values make it difficult to use the indicator in potential prediction models.

Table 7 Spearman correlation coefficient between Assets turnover and profitability in subsequent years

Industry	t	2016	2017	2018	2019	2020
Agriculture	2016	0,1652	0,1084	0,0721	0,0710	0,0515
	2017	x	0,1627	0,0955	0,0741	0,0440
	2018	x	x	0,1616	0,1048	0,0507
	2019	x	x	x	0,1577	0,0833
	2020	x	x	x	x	0,1278
Manufacturing industry	2016	0,2409	0,1979	0,1658	0,1489	0,1177
	2017	x	0,2359	0,1973	0,1642	0,1266
	2018	x	x	0,2301	0,1807	0,1527
	2019	x	x	x	0,1980	0,1669
	2020	x	x	x	x	0,2180

Source: Own processing

The asset turnover indicator can be used for predictions only in the case of the manufacturing industry. In the case of agricultural enterprises, the correlation value drops already for period t+1 to values around 0.1. For period t+2 and period t+3, a further decrease in correlation is noticeable. The correlation coefficient drops to almost zero values, for t=2017 and period t+3 (i.e. in 2020), the value is calculated to be 0.0507. The low correlation is the high dependence of the indicator on altitude and the share of land in disadvantaged areas. As altitude increases, asset utilization drops sharply. As a result, the indicator's value does not indicate the company's success but its geographical location. For the dependence between altitude and profitability, for example, Střeleček (Střeleček, 2008), or Lososová (Lososová, 2017)

For the manufacturing sector, using the indicator for prediction is meaningful. Correlation values start around 0.24 for year t+0. Correlation coefficients for period t+3 reach values between 0.1558 and 0.1628

Table 8 Spearman correlation coefficient between Non-financial ratios and profitability in subsequent years (in %)

Industry	t	2016	2017	2018	2019	2020
Labor productivity	2016	0,2155	0,1272	0,0975	0,1263	0,0375
	2017	x	0,2044	0,1244	0,0975	0,0542
	2018	x	x	0,1998	0,1265	0,871
	2019	x	x	x	0,2036	0,1274
	2020	x	x	x	x	0,2055
Revenues per hectare	2016	0,2791	0,1506	0,0826	0,0791	0,0881
	2017	x	0,2451	0,1422	0,0855	0,0824
	2018	x	x	0,2412	0,1433	0,796
	2019	x	x	x	0,2399	0,1468
	2020	x	x	x	x	0,2484
Profit per hectare	2016	0,8875	0,4207	0,3863	0,3707	0,2497
	2017	x	0,8914	0,4284	0,3712	0,3312
	2018	x	x	0,8744	0,4116	0,3788
	2019	x	x	x	0,8625	0,4196
	2020	x	x	x	x	0,8719

Source: Database Albertina, Own processing

Table eight examines operating indicators' usability for the eventual creation of a prediction model. Some partial results indicated that the correlation between operational indicators and future profitability is higher than between future profitability and financial ratios. For example, Novotná (Novotná, 2015) describes the relationships between production factors and profitability in detail.

The usability of labour productivity and indicators of revenue per hectare is questionable. The correlation values obtained are higher than those obtained using the asset turnover ratio. The correlation between revenues per hectare and profitability was between 0.24 to 0.27 for period t+0 (and the field of 0.1433 to 0.1503 for period t+1). However, the reliability dropped sharply for more extended periods (t+2 and beyond). The disadvantage of the indicator is also the difficulty of obtaining relevant data.

The correlation between profit per hectare ratios and future profitability is very significant. For period t+0, the correlation coefficient reaches values over 0.88. For period t+1, it ranges from 0.4116 to 0.4284. These values decrease only slowly as the interval increases. However, these values are comparable to those obtained using the ROA indicator. At the same time, ROA can be obtained more easily. This limits the usefulness of "Profit per hectare" ratios in cases where the value of the ROA indicator is unreliable. For example, in the case of small enterprises with high depreciation of fixed assets.

4 Conclusions

The first goal of this article was to verify whether the stability of profitability in agricultural enterprises is sufficient to create a predictive model. This was verified. However, creating a model can be associated with several problems. The financial result and profitability of agricultural enterprises fluctuate considerably over time. The order of companies in the database fluctuates similarly. The values of the Spearman correlation coefficient do not reach the values usually in the manufacturing industry. A decrease in the correlation coefficient over time is also evident. The difference between the ranking of companies in year zero and the ranking in subsequent years is constantly increasing. In the industrial sector, this difference is lower in order, and the Spearman correlation coefficient is higher.

It is evident that external influences cause the fluctuation of profitability. Large enterprises (upper quantile according to the size of sales), which can diversify production better, have a higher relative success rate (comparable to industrial sectors). The influence of external factors can be observed even better if we follow the ranking of enterprises with the same production focus (or with the same share of ANC). In particular, NON-ANC and mountain areas companies achieve correlation results that exceed industrial sectors.

The second goal of the work was to find financial indicators correlated to future profitability. There is a big difference in the predictive ability of individual financial analysis indicators. In both agriculture and industry, the highest correlation between the value of the financial ratio in year zero and profitability in the following years is the ROA indicator. Asset turnover rate has good predictive power in industrial sectors, but the correlation is practically zero in agriculture, and the indicator is useless. The reason is the high correlation of the ratio indicator with the production focus (given by the altitude and the share of land in the ACN). Indebtedness indicators also have a particular predictive ability. In this case, the correlation between the ratio in year zero and subsequent financial results is negative. In the case of industrial sectors, liquidity indicators can also be used (especially current liquidity). Interestingly, this ratio is more correlated to future profitability than the quick test (which is more commonly used in predictive models).

Correlations of financial indicators (except ROA) and future economic results are stable over time. The correlation between the ratios in year zero and future profitability does not decrease much over time. This fact increases the usefulness of these ratio indicators in creating predictions.

Part of the research was also an attempt to verify whether non-financial ratio indicators can be used for prediction, labour productivity, and ratios: yields per hectare and profits per hectare. The correlation coefficient between the last two indicators (revenues per hectare and profits per hectare) and future profitability is slightly higher than the correlation using financial indicators. But the differences are not very significant. However, the limited availability of data makes the usability of these indicators difficult. Operating indicators are not required to be published (unlike financial results).

References

- Allen, D. E., Salim, H.M. (2005) Forecasting profitability and earnings: a study of the UK market (1982–2000), *Applied Economics*, 37:17, 2009–2018 DOI: 10.1080/00036840500244634
- De Andrés, J., Landajo, M., & Lorca, P. (2005). Forecasting business profitability by using classification techniques: A comparative analysis based on a Spanish case. *European Journal of Operational Research*, 167(2), 518–542.
- Balcaen, S., & Ooghe, H. (2006). 35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems. *The British Accounting Review*, 38(1), 63–93.
- Beaver, W. H., McNichols, M. F., & Rhie, J. W. (2005). Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy. *Review of Accounting studies*, 10(1), 93–122.
- Beaver, W. H., Correia, M., & McNichols, M. F. (2012). Do differences in financial reporting attributes impair the predictive ability of financial ratios for bankruptcy?. *Review of Accounting Studies*, 17(4), 969–1010.
- Beaver, W. H. (1966). Financial ratios as predictors of failure. *Journal of accounting research*, 71–111.
- Gurčík, L. (2002). G-index–metóda predikcie finančného stavu poľnohospodárskych podnikov. *Agricultural economics*, 48(8), 373–378.
- Islam, M. S. (2020). Predictive capability of Financial Ratios for forecasting of Corporate Bankruptcy. Available at SSRN 3637184.
- Van Lear, W. (1999). Profitability in business cycle theory and forecasting. *Review of Radical Political Economics*, 31(2), 46–60.
- Lososová, J., Zdenek, R., & Kopta, D. (2017). Development of the main production and economic indicators of Czech farms. *Custos e Agronegocio*, 13(2), 88–109.
- Majdánková, A., Giertlová, B., & Hajdúchová, I. (2020). Prediction by financial and economic analysis in the conditions of forest enterprises. *Journal of Forest Science*, 66(1), 1–8.
- Mundt, P., Alfarano, S., & Milaković, M. (2020). Exploiting ergodicity in forecasts of corporate profitability. *Journal of Economic Dynamics and Control*, 111, 103820.
- Nissim, D., & Penman, S. H. (2001). Ratio analysis and equity valuation: From research to practice. *Review of accounting studies*, 6(1), 109–154.
- Neumaierová, I., & Neumaier, I. (2002). *Výkonnost a tržní hodnota firmy*. Grada.
- Novotná, M., & Volek, T. (2015). Efficiency of production factors and financial performance of agricultural enterprises. *AGRIS on-line Papers in Economics and Informatics*, 7(665–2016–45076), 91–99.
- Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of accounting research*, 109–131.
- Střeleček, F., Lososová, J., & Zdeněk, R. (2008). Economic results of agricultural holdings in less favoured areas. *Agricultural Economics-Zemědělska ekonomika*, 54(11), 510–520. DOI:10.17221/266-AGRICECON
- Stigler, G. J. (1963). Introduction to "Capital and Rates of Return in Manufacturing Industries". In *Capital and rates of return in manufacturing industries* (3–10). Princeton University Press.
- Xu, X., McGrory, C. A., Wang, Y. G., & Wu, J. (2021). Influential factors on Chinese airlines' profitability and forecasting methods. *Journal of Air Transport Management*, 91, 101969.

Is there any „farms’ productivity rule“?

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Abstract: This article aims to explore the relationship between productivity of farms in different locations, of different size, with different production orientation and their subsidies. The share of agricultural subsidies on the agricultural revenue is 20% using the total sample of farms. When focusing on the size groups, this share is 19% in very large farms, 28% in the middle sized and 30% in small sized. Regarding the production orientation this share is 1.5 times higher in the medium and small farms (compared to the very large ones) in all the production orientations (field, milk, mixed, cattle breeding). Taking the above-mentioned information into account, the paper gives some insights in the subsidies’ development in the relation with the Czech Republic agrarian structure and economic efficiency of farms.

Keywords: agricultural productivity, farms productivity size structure, production orientation, productivity differentiations factors

JEL Classification: O13, Q13, Q18

1 Introduction

The transition to the long-term sustainable EU economy that should use the sources in the environmentally responsible way is changing the Common Agricultural Policy (CAP) as well. The more attention is paid to the benefits of agriculture for the environment, the landscape creation, the generational change of farmers and income parity. However, the assurance of enough food in the good quality and price still remains one of the main CAP’s aims. The EU conception document “The Future of Food and Agricultural” forms the aims for the next years CAP in the above-mentioned sense. The document also gives the EU member states higher responsibilities for the CAP realization.

The development of the size structure of agricultural companies remains one of the open questions of the CAP EU as well as its managing. This topic is of special interest and controversy in the Czech Republic, as it relates to the subsidies’ allocation to the farms of different sizes. The size structure development is the matter of interest of a lot of authors already for a long time. e.g. Boehlje (1992, 1999), Alen a Luech (1998), Ahearn et al.. (2009), Hoggart a Paniagua (2001), Savillse (2001), Cochrane (1958). The farms development in the transition economies is the special issue of Swinnen (2009). The important CAP part are the farms subsidies. Weight, Williams (1998), Tracy (1993), Devadors, Chot (1991), Herringsmayer (1991), Swinnen (1994) or Grega (2005) deal with the reasons of the subsidies. Based on their findings, the main reasons are the economic ones; however, the political, social and environmental points of view are important as well. The subsidies are economically justified in case when the operation of “free market” decreases the society well-being.

The aim of the paper is to express, what kinds of farm’s specifics are the most connected to the productivity differentiation. These „specifics” are the farm’s size, production orientation, location in different agroecological conditions and subsidies. The paper findings extend the previous research of the authors dealing with the efficiency of the farms of different size structure (Svobodová et al., 2022) and follow up the research on impact on companies’ size on the regional development (Redlichová et al., 2019).

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2 Methods

The main data source for this research is the Farms Accountancy data Network of the Czech Republic (FADN CZ), what is the part of FADN EU database created mainly for Common Agriculture Policy purposes. The responsible institution is the Institute of Agricultural Economic and Information in Prague. The methodological principles of survey and data processing are stated by Hanibal et al. (2017) and Macháčková et al. (2020).

The measurement of the farm and the monitoring of the farms' size structure could be based on input-output indicators. Commonly used characteristics are the area under cultivation, number of employees, volumes of capital or the agricultural production (Zdráhal and Bečvářová, 2013). In this research we have used output criterion of farm economic size, called "standard output (SO)", as it is defined by FADN EU methodology. It is the sum of annual standardized production of the farm. Besides this indicator, the acreage and number of employees are also considered. The natural conditions differences are expressed by dividing the farms in groups based on ANC, e.g. mountain ANC (ANC M), others ANC (ANC O) and location out of ANC (non ANC = N ANC).

The sum of consumption, depreciation and cost for external factors (wages + rent + interests), what is used in FADN methodology, is adjusted by the value of unpaid labor. This value is based on the average personal costs for paid worker (AWU) in small, medium and large farms of the research sample, what is 324 K CZK (13 208 EUR). The total value of cost including this unpaid labor is signed as "adjusted costs = AdC".

The research is focused on financial revenues from the agricultural production and the operational subsidies. These are calculated as total operational subsidies minus subsidies for renewable energy sources.

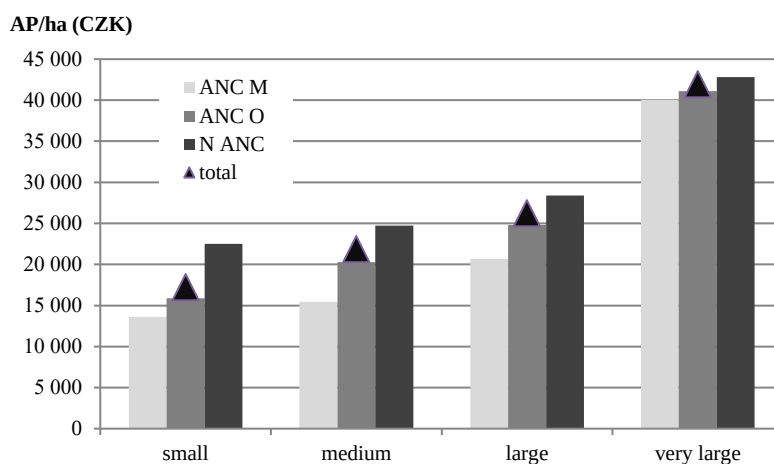
All the outcomes represent the average value of the time series 2015 – 2020.

3 Research results

3.1 Productivity

The results of the differences in the productivities levels among the farms of different sizes confirm the relation with the economic size of the farm and prove the benefits of larger extend of company (economy of scale). The productivity and economic efficiency are inevitable criterions of the farms size development.

Figure 1 The productivity in the farms of different sizes and agricultural conditions (2015 – 2020 average)



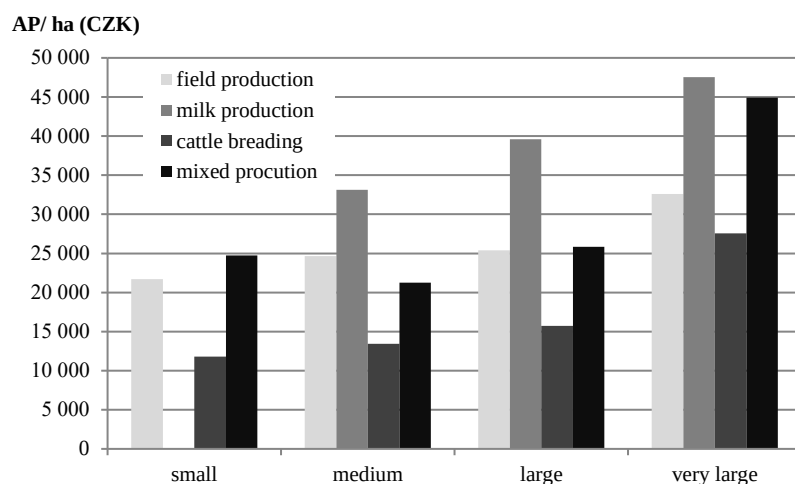
Source: Own processing, 2022 (data: FADN CZ)

Note: AP = agricultural production

The data on land productivity in the regions with different agroecological conditions bring the base information on the land and land conditions usage intensity. The analysis outcome that could be seen on the Figure 1 clearly presents higher production factors productivity of very large companies compared to the small and medium ones. The others size groups are not so substantially differentiated.

The differentiation of the total production factors (labor as well as material) productivity levels in the companies of different production orientation are presented in Figure 2. The data here show the following:

Figure 2 The productivity in the farms of different sizes and production orientations (2015 – 2020 average)

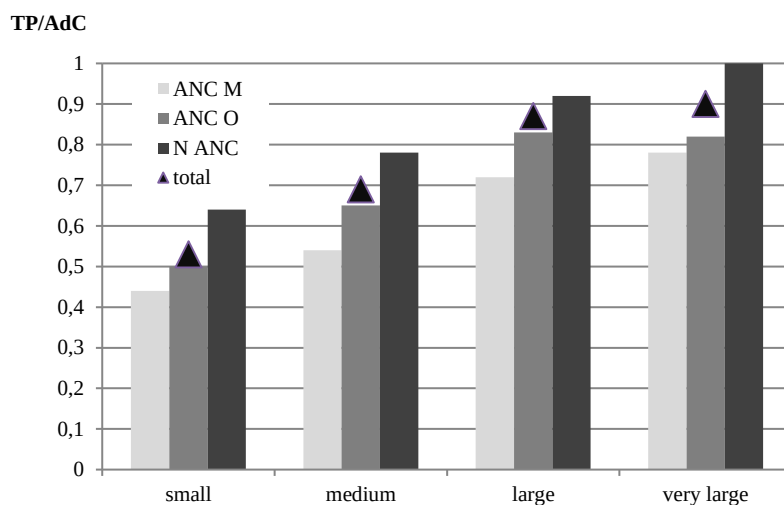


Source: Own processing, 2022 (data: FADN CZ)

Note: AP = agricultural production

- the highest intensity is reached by the milk farms, while the differences among the size groups are smaller compared to the farms oriented on other productions;
- the differences in the intensities are quite low in the field production farms, the highest are in the cattle breeding farms;

Figure 3 Total factor productivity in the farms of different sizes and agricultural conditions (2015 – 2020 average)

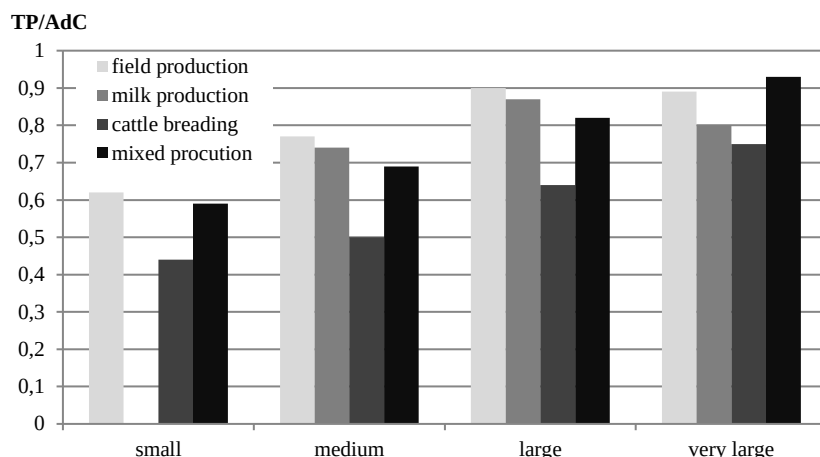


Source: Own processing, 2022 (data: FADN CZ)

Note: TP = total production; AdC = Adjusted Costs

The total factor productivity overview (Figure 3) in different agroecological areas gives the information on the usage of labor and material under specific land and climate. Not surprisingly, the lowest productivity is in the group of mountain ANC and the highest in the areas without natural constraints.

Figure 4 Total factor productivity in the farms of different sizes and production orientations (2015 – 2020 average)



Source: Own processing, 2022 (data: FADN CZ)

Note: TP = total production; AdC = Adjusted Costs

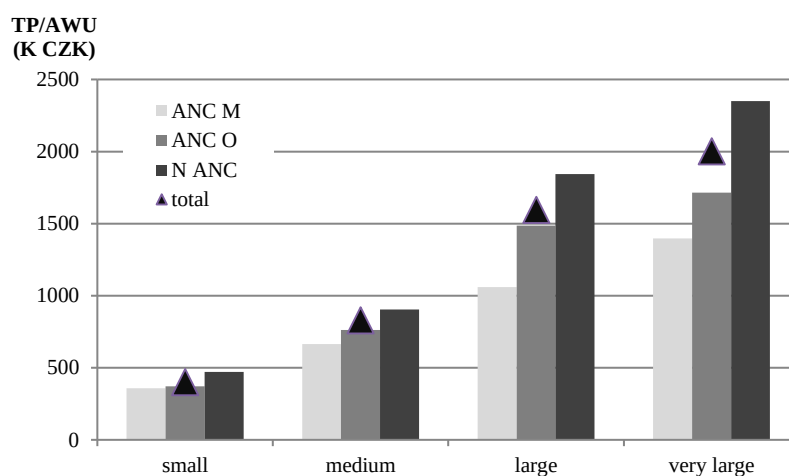
Figure 4 shows the same analysis focusing on the production orientation.

- the levels of total factor productivity among the groups of farms of different production orientation is less balanced in small and medium farms, the large farms have more balanced level;
- the companies oriented on field production reach the highest total productivity, while the differences among the size groups are relatively smaller;
- the lowest total productivity is in the cattle breeding orientation. The differences among the farms of different sizes are also the more evident.

The most significant differences among the size groups of farms have been found in the labor productivity as well (Figures 5 and 6). The small farms are on the 20% level of the labor productivity compared to the very large ones; the medium ones are on the 40% level. These results correspond to the more developed substitution of labor by technique and higher innovation activity of large and very large companies in terms of technique and technology reproduction. The similar results of Novotná et al. (2021) show technological investment having the greatest positive impact on the growth of labor productivity and on a decline in labor intensity in low technology enterprises.

The differences of the labor productivity among the farms located in different agroecological conditions Figure 5) are substantially lower. The levels of ANC M and ANC O are 59%, resp. 73% of the N ANC level.

Figure 5 The labor productivity in the farms of different sizes and agricultural conditions (2015 – 2020 average)

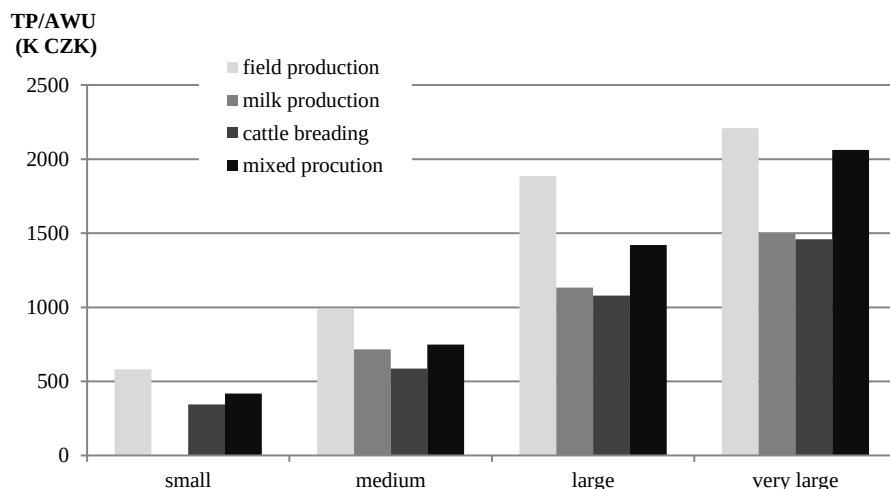


Source: Own processing, 2022 (data: FADN CZ)

Note: TP = total production; AWU = annual working unit (2 000 working hours per a year)

While evaluating the labor productivity differences it is necessary to keep in mind the methodological limitation of the research data about the unpaid labor. The ratio of this kind of labor on total AWU is 87% in small and medium farms, 43% in large farms and 0.5% in vary large farms.

Figure 6 The labor productivity in the farms of different sizes and production orientations (2015 – 2020 average)



Source: Own processing, 2022 (data: FADN CZ)

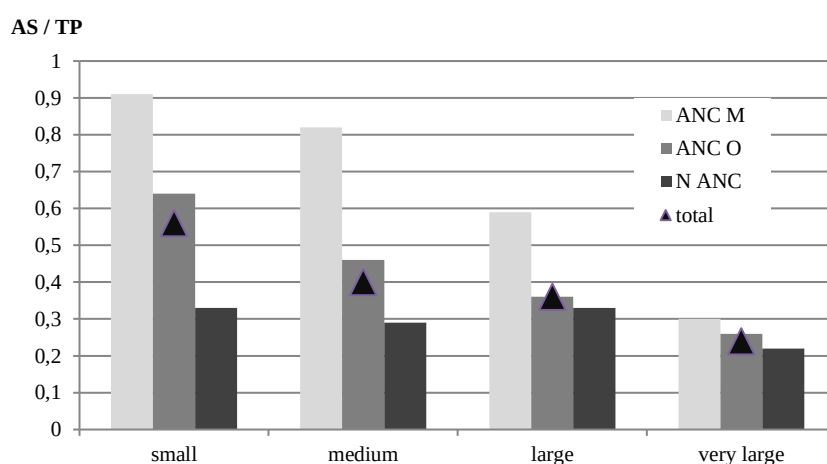
Note: TP = total production; AWU = annual working unit (2 000 working hours per a year)

Figure 6 shows the same comparison of size-based differentiation of labor productivity however, taking the production orientation into account (not agroecological conditions). The smallest differences among the size groups are in field production and milk production, more evident differences are in the rest production orientations, e.g. cattle breeding and mixed production. These differences in the labor productivity in the farms of different sizes and production orientations are connected to the different levels of agricultural intensities as well as different employment, what is the sign of different level of substitution of labor by technique.

3.2 Level of Subsidies

The important criterion when evaluating of the state subsidies in agricultural is the value of subsidies compared to the value of production.

Figure 7 Agricultural Subsidies per one unit of Agricultural Production in the farms of different sizes and agricultural conditions (2015 – 2020 average)



Source: Own processing, 2022 (data: FADN CZ)

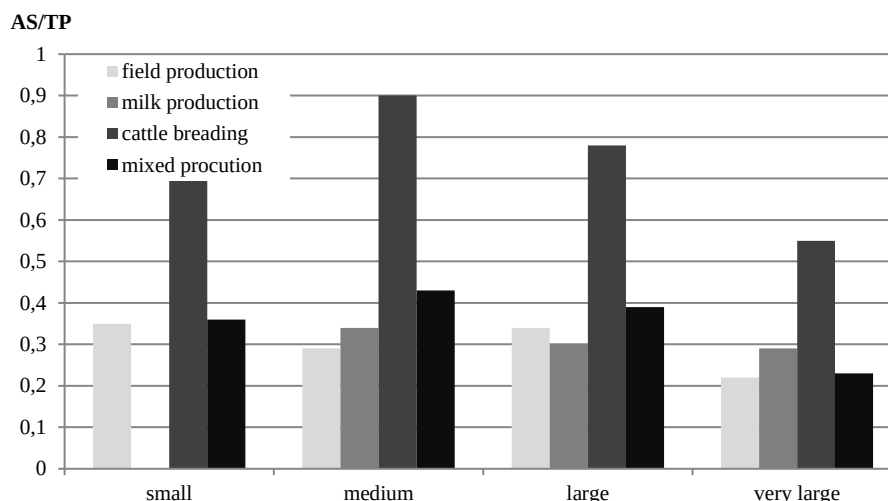
Note: AS = agricultural subsidies; TP = total production

The data in Figure 7 demonstrated significant differences among the farms located in different agroecological conditions. The differences in the levels of subsidies it could be seen in the groups of small and very large companies. The highest share of subsidies is in the case of small companies operating in mountain ANC (47.6 %), the smallest very

large farms out of ANC (17.8%). The average value of this share is 19.8% in total, while the farms in mountain ANC gain 1.5 higher subsidies per production unit compared to farms out of ANC. In the small farms this ratio is 2.3. The highest value of this indicator 0.91 was in the group of the least efficient farms, the smallest value 0.22 the most efficient companies.

The companies oriented on field production, milk and mixed production obtained on one unit of agricultural production the subsidy of 0.26. Concretely the very large farms get 0.25, large and middle 0.35 and small 0.36. The small farms therefore obtained on one unit of agriculture production 1.4 times higher subsidies compared to the very large ones.

Figure 8 Agricultural Subsidies per one unit of Agricultural Production in the farms of different sizes and production orientation (2015 – 2020 average)



Source: Own processing, 2022 (data: FADN CZ)

Note: AS = agricultural subsidies; TP = total production

The highest subsidy support for one production unit among the different production orientation farms is in the cattle breeding. This is given by the prevailing location of this type of farms in the worse agroecological conditions and the applied extensive land management on the permanent grass lands. The most dependency on subsidies in the mountain ANC where observed by Lososová and Kopta already 5 years ago (Lososová and Kopta, 2017). The exogenous solution of these mainly peripheral areas was also proposed by Chmelíková and Redlichová (2020).

4 Conclusions

For the present Czech agriculture the substantial differences in the economic efficiency among the different sized companies are typical. The very large companies reach quite higher productivity level compared to small and medium ones, what is evident in different production orientations as well as different agroecological conditions.

The state subsidies are the essential part of financial sources of agricultural companies. In the research sample the average subsidies share was 20%. In small companies was this share 30%, medium 28%, large 27% and very large 19%. The subsidies on one unit of production are the highest in the small and medium companies. Compared to the very large companies is the subsidy support 1.5 times higher. This is valid for the field production orientation, milk and mixed production. In the cattle breeding is this share 1.6.

The subsidy policy damps the impact of different productivity level of different size and production orientation. This is connected with the subsidies provision rules, what are oriented mainly on the land acreage. The obtained information leads to the conclusion that the operational subsidies in CAP EU substantially contribute to the compensation of the price transmission in the un-perfect competition of food verticals of agribusiness.

The economic efficiency differentiation of the different size groups of agricultural companies is one of the main characteristics of Czech agricultural. In the period under observation the results show the higher productivity of very large companies compared to the small and medium ones. The similar results are reached among the size groups of all the production orientations. The knowledge of the economic efficiency differentiation of Czech farms in the period of 2015 – 2020 support the positive evaluation of the Czech agriculture size structure development. This structure is one if the assumption of the Czech agricultural competitiveness. The necessity of considerable share of subsidies on the total financial sources of farm opens the question on the efficiency of antitrust policy in the agribusiness sector.

The differences in the subsidies to production rations in the different size of companies and production orientation lead to the topic of editing of allocation methods of subsidies, taking the criterions of products structure and performance measurement into account.

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References

- Ahearn, M.C, Korb, P., & Yee, J. (2009) *Producer Dynamics in Agriculture: Empirical Evidence, Producer Dynamics: New Evidence from Micro Data*, Chicago: Universtiy of Chicago Press and National Bureau of Economic Research, chapter 10, 2009.
- Allen, D.V., &Lueck, D. (1998). The Nature of the Farm. *Journal of Law and Econ.* 41, 343-386.
- Boehlje, M. (1992). *Alternative Models of Structural Change in Agriculture and Related Industries*.
- Boehlje, M. (1999). A World Agriculture in the 21 st Century, *Proceedings Exploring Our Global community People, Food, and Agriculture*, Global Summit, St. Paul, MN 1999.
- Cochrane, W.W. (1958) *Farm Prices: Myth and Reality*. Minneapolis: University of Minnesota Press.
- Hanibal, J. et al.. (2017) *Uplatnění „Zemědělské účetní datové sítě“ (FADN) v České republice*.
- Hoggart K., &Paniagua, A. (2001). What rural restructuring. *Journal of Rural Studies* 17, 62, 2001.
- Chmelíková, G., & Redlichová, R. (2020). Is There a Link Between Financial Exclusion and Over-Indebtedness? Evidence from Czech Peripheral Municipalities. *Journal of Rural Studies*. 78(August), 457-466.
- Lososová, J., Zdenek, R., & Kopta, D. (2017). Development of the main production and economic indicators of Czech farms. *Custos e Agronegocio*, 13(2), 88-109.
- Macháčková, J. et al. (2020) *Hospodářské výsledky zemědělských podniků ve FAND CZ za rok 2020*. UZEI.
- Novotná, M., Volek, T., Rost, M., & Vrchota, J. (2021). Impact of technology investment on firm's production efficiency factor in manufacturing. *Journal of Business Economics and Management*, 22(1), 135-155
- Redlichová, R., Chmelíková, G., Blažková, I., & Tamáš, V. (2019). Role of Companies' Size in Socio-Economic Development of Regions in the Czech Republic. *Ekonomski pregled*. 70(6), 833-848.
- Savillse, A. (2001) *Structural change and the implications for the countryside*. Report to the UK Countryside Agencies.
- Svobodová, E., Redlichová, R., Chmelíková, G., & Blažková, I. (2022). Are the Agricultural Subsidies Based on the Farm Size Justified? Empirical Evidence from the Czech Republic. *Agriculture*. 12(10), 1574.
- Swinnen, J.F.M. (2009). Reforms, Globalization, and Endogenous Agricultural Structures. *Agricultural Economics*, 40 (1), 719-732
- Zdráhal, I., & Bečvářová, V. (2013). *Velikostní struktura podniků v zemědělství – faktory, tendence, souvislosti*. Mendelova univerzita.

COVID-19 pandemic and agricultural SMEs of Central Europe: A forecast study to evaluate the performance indicators

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Abstract: COVID-19 is a global pandemic that has tangible effects on the agricultural economy. This study investigated the effects of COVID-19-related events in Central European agriculture, forestry, and fisheries, as well as the future of the economy of agricultural Small and medium-sized enterprises (SMEs). The data for agricultural SMEs in Austria, Czechia, Germany, Hungary, Poland, Slovakia, and Switzerland was obtained from the Eurostat database, and the duration of the data was from 2011 to 2021. The number of employees, labour force input, Gross Domestic Product (GDP), wages and salaries, value-added, and agricultural output was the performance metrics considered in this study. Data from this study revealed that agricultural SMEs in Poland, Switzerland, and Germany produced less employment than in the other Central European countries, although Hungary's labour force input was more affected. During the COVID pandemic, GDP in Hungary and Slovakia dropped significantly. Wages and salaries in Germany and Poland fell, while value-added and agricultural output fell in Germany, Hungary, and Slovakia. Employment in Poland and Germany is expected to fall until 2025, while labour force input in Germany, Poland, and Hungary may drop. Wages and salaries, as well as agricultural output in all of the addressed countries, may rise, while GDP may fall. In conclusion, the COVID-19 pandemic had a detrimental impact on agricultural output, labour force input, employment, GDP, value-added, earnings, and salaries in SMEs of Central European countries. The pandemic regulations and restrictions disrupted the market distribution network, causing a stop in production, transportation, and a scarcity of labour and materials.

Keywords: employment, GDP, labour force, pandemic, value-added

JEL Classification: E23, E25, E27, O47, O52

1 Introduction

Agricultural production generates labour market equilibrium through a unique implementation of non-labour markets, commonly depending on intermediaries, such as contractors to corporate groups of employees and moving them to the farm, and implementing piece-rate salary processes to encourage businesses and labourers to cooperate with the labour supply (Xing & Xiaofeng, 2021). In addition, the possible volumes of gross value added of goods in agriculture, forestry, and fisheries are determined while considering the current level of investment efficiency under credit circumstances and investment potential expansion. The principles of creation and growth of investment potential of the agricultural sector of the economy by extending the credit component are substantiated based on the generalization of ways to determine the investment potential of agricultural businesses (Matsyhora, 2020). COVID-19 not only influenced farming favourably, but many impacts of the pandemic can be observed in all aspects of socio-economic life. For instance, domestic input prices are observed to be increases during the pandemic; import input has been restrained, and, among many other factors, food consumption, agricultural production, and product prices are also increased. Food supply has become a priority, with

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a preference for local production and a reduction in imports. Promotional trends have been changed, web ordering and delivering orders have increased, and advertisements have become increasingly creative. As the processed food demand and domestic manufacturing companies, fresh food consumption increased during the pandemic, the cost of processed foodstuffs has increased, while processing technologies have become more diversified. There are several improvements in agricultural strategies, such as online financial transactions, widespread information transmission, broad sharing of agricultural experiences, an increase in pricing information, and multi-stakeholder sessions are becoming more common (Mariyah et al., 2021).

The pandemic hit small enterprises more than bigger ones. SMEs operations mostly involved lower sales (75%), trouble obtaining inputs (54%), and demand depression, which resulted in reduced sales and business revenue, resulting in the unemployment of many employees in the SMEs. Government initiatives included SMEs growth, online selling, provision of local products, and risk management in terms of employee accessibility (Brown, 2020).

The instability in the economic situation due to the COVID-19 pandemic and the fall in demand has a detrimental impact on the development of SMEs. High investment risks and a lack of confidence limit productive and opportunity-based entrepreneurial growth opportunities. Nevertheless, SME's sectoral structure has expanded, and the percentage of online services has increased. Because of the pandemic's forced digitization, these processes may accelerate, particularly in huge cities and areas (Zemtsov, 2020). During the early stages of the European pandemic, a country's GDP per capita fell (Pardhan & Drydakakis, 2021). The unemployment, business, oil price, and productivity fluctuations began in September 2020. According to the data, the COVID-19 lockdowns generate a 7.2% drop in worldwide GDP and a 9% drop in grain prices. As a result of these changes, the number of persons facing food shortages was expected to climb by 211 million by 2020, a rise of 27.8% (Beckman et al., 2021). The global financial problem (in the short-term) and climate change (in the long-term), along with national calamities (for instance, the COVID-19 pandemic), all contributed to a weakening of the economy, particularly its growth, rising unemployment, and diminished buying power (Elizabeth, 2021). The gap between long-term and current political and economic growth was mainly attributable to the COVID-19 pandemic's impact on the economy and people. A substantial decline in aggregate demand as a result of lower household and corporate expenditure, investments, and exports increased visible high unemployment. The COVID-19 pandemic exacerbated pre-existing basic issues, such as de-industrialization, a wide urban-rural, East-West, and inter-regional virtual divide; high unemployment; poor human wealth improvement; low involvement in worldwide value chains; and poor educational efficiency (Ssenyonga, 2021).

The issues and difficulties SMEs suffer in a pandemic condition propose that the government must have a pivotal role in helping firms resume work and stabilize employment, continue to optimize public services, utilize fiscal and taxation policies intelligently, and guide enterprises to digitalization. Enterprises must prioritize pandemic prevention and usage, make excellent use of preferential policies, strengthen their credit rating, use Internet technologies effectively, and accelerate enterprise transformation and upgrading (Hu et al., 2020).

2 Literature Review

COVID-19 is a highly contagious virus that produces a significant health problem and leads to deaths in humans worldwide (Al-Fadly, 2020). No place on the earth has escaped the pre-emptive construction of a worldwide recession to battle a global infection. In this light, Caiazza et al. (2021) have evinced that Covid-19 has disrupted supply networks, purchasing behaviours, and business strategies in a wide range of sectors, including a sizable proportion of SMEs because SMEs provide for the majority of employment in market-based economies; any examination of the economic impact of COVID-19 would be insufficient without including the SME sector (Caiazza et al., 2021). During the period of the COVID-19 outbreak, a large number of agricultural processing and manufacturing firms experienced severe difficulties in the consumption of agricultural goods, even when they were unable to sell. Businesses have become increasingly challenging; in addition, many businesses are not strong enough to resume production; thus, ways to overcome this difficult moment are required (Nguyen, 2021). The COVID-19 outbreak has impacted agriculture and the economy, forcing states to block borders, whereas there is a constant increase in the sector of agro-industrial output. Such strict limitations have not been imposed on critical food items (Kuandykova, M. B. et al., 2021). The pandemic has had a substantial impact on food systems across the world; specifically, agricultural supply and product markets, food production, and labour throughout food supply chains are all observing an increase in unemployment and nutrition and health insecurity. The pandemic is still dangerous and worsening in some nations, while it is under control in others (Huang, 2020).

Farmers and farmworkers are critical to ensuring a secure food supply, but they are also at high risk of catching COVID-19. The reduction in labour availability caused by COVID-19 is predicted to lower agricultural output (Lusk & Chandra, 2021). Disruptions in agricultural and food systems hugely influence the livelihoods of a significant portion of the world's population (Özkan, 2021). The labour force with a strong representation of revenue profile, with a smaller

proportion of wage resources, is connected to the market's ability to drastically decrease agriculture wages compared to other marketplaces (Valdés, 2020). According to the employment structure, levels of weighted pay share were the lowest in agriculture and the greatest in the service sector before Covid-19 (Mihnenoka & Senfelde, 2015). The drop mainly influenced the change in the aggregate wage share in the primary and secondary sectors, mainly based on a decrease in employed individuals. The overall labour investment of farmer households has decreased slightly as labour costs have risen; there are considerable variations in the distribution of labour investment across farmers due to changes in labour needs resulting from different trading variables in consequences of the COVID-19 pandemic (Yuan & Chen, 2019). All kinds of labour, cropped area, revenue, and input costs play vital roles in enhancing the value of output and productivity. However, the situation is the exact reverse: it is witnessing a fall in the labour force leading to outmigration and a decrease in the number of farmers (Nakasone et al., 2021).

COVID-19 has negatively influenced the country's macroeconomics, reducing national GDP, decreasing tax collection, delaying economic growth rate, falling wage rate, price inflation, and generating job losses. Every area of socioeconomics has weakened, harming the country's economy. Remittances, labour and employment, tourism, education, and agriculture (Dairy, vegetables, and Poultry) have all been mentioned to impact (Khanal, 2020). The COVID-19 outbreak delayed the gross domestic product (GDP). The anticipated short- and long-term scenarios indicated that in contrast to farming, the services and manufacturing companies will be more affected in all countries (Islam et al., 2020). Inflation has a negative and significant long-run relationship with agricultural sector progress, implying that inflation is more destructive than beneficial to agricultural industry growth (Zhang & Diao, 2020). Agriculture industry development is directly tied to its lag value, investment, workforce, factors output, inflation, and currency exchange in the short-run (Mekonen, 2020). Fiscal and investment determinants have a direct influence on economic development. Spending on education, health, wages and salaries, agriculture, and interest payments has a bigger impact on long-term economic development than the remaining expenditure composition (Chen et al., 2020). As per the long-run model, employed people with higher education considerably affect gross agricultural value-added (Buchta, 2018). The coefficient in front of employed people with higher education is positive, indicating that as the number of employed persons with higher education grows, so does the gross value-added, and vice versa. The human component appears to be quite crucial for gross agricultural value-added (Metodieva & Bartos, 2021).

The role of agriculture as an economic activity in the construction of gross added value of nations based on sectoral structure, as well as to identify and define areas of economic development based on comparison and experience of different countries. Compared to the Russian Federation, most European nations have a small degree of variances in the sectoral structure of gross added value. Relatively modest levels of sectoral structure disparities and different growth rates of the significant macroeconomic indicator are feasible (Salimova et al., 2020). The spread of COVID-19 has led to a fall in commercial and economic activity and an output recession - practically all international economies have experienced a considerable drop in GDP. The agricultural industry encountered significant logistical challenges as a result of the decline in production, the closing of markets and borders, and the cancellation of orders. Furthermore, the economic crisis hampered farmers' access to financial resources (Kaminskyi et al., 2021). Optimizing farm workforce levels aid in the growth of the industry's financial and socially sustainable development. Transfers of excess supply created in secondary and tertiary industries must, at the very minimum, decrease, if not remove, the economic consequences of these discrepancies might be at a technologically, financially, environmentally, and socially acceptable level of labour in farming (Kołodziejczak, 2020). The rural workforce level, agricultural labour, and net economic benefit must be considered the most when assessing direct payments. Agricultural business revenue is primarily influenced by total factor productivity while farming R&D investments are influenced by gross value-added, direct payments, and gross value added in the agriculture industry (Cristea et al., 2021).

The present economic crisis is unusual, including many businesses and industries encountering completely unseen problems and risks. Grondys et al. (2021) revealed that in the current financial situation, the workforce component was thought to be a determinant of the perception and assessment of the degree of selected risks arising from economic activities in the marketplace. The effects of private sector, financial, fiscal, and logistical threats on the performance of micro, small, and medium-sized enterprises (MSMEs) are regularly threatened by the strong industrial rivalry, rising energy prices, and inadequate profit (Grondys et al., 2021). Organizations must monitor and assess all events related to the transmission of the emerging virus and establish and implement emergency plans in the event of a COVID-19 pandemic. According to him, the role of SMEs in economic development and Vision 2030 is critical. Countries should continue to examine COVID-19's impact on SMEs and provide help based on the evaluation report (Nurunnabi, 2020).

3 Materials and Methods

The current study aimed to create a detailed schematic of the COVID-19 crisis's effects on agricultural SMEs in Central European countries, including Austria, Czechia, Germany, Hungary, Poland, Slovakia, and Switzerland. To conduct the

study, an empirical analysis was used as an effective way to collect information for prediction research to examine the outcome measures. The keywords for this objective, such as COVID-19, international lockdowns, business disturbance, agriculture, food distribution network, food shortages, economic recession, climate modification, and natural hazards, were examined using research engines, for instance, Google Scholar, Scopus, as well as other global and domestic data sources. Eurostat and other European databases were utilized to assess the outbreak's impact on agricultural circumstances in European countries using indicators such as the number of employees, labour force input, Gross Domestic Product (GDP), wages and salaries, value-added, and agricultural output and the duration of the data was from 2011 to 2021. This study mainly focused on the literature evaluation divided into COVID-19 and Agricultural disasters, COVID-19 economic crises, and agricultural forecasts for European nations and prediction of the study will be till 2025. The collected evidence was linked to the Eurostat database. After obtaining all relevant information, the study's findings were presented by graphs in a categorized way.

4 Results and Discussions

This study analyzed the COVID-19 outbreak's influence on the output of agricultural, labour force input, the number of employees, GDP, value-add, wages, and salaries in agricultural, forestry, and fishing SMEs in Central European countries. The following results of indicators of the study were as below:

4.1 Wages and Salaries

The agricultural sector employed a disproportionate proportion of its workforce in low-wage jobs, and for many vocations, the sector had lower earnings, whereas other industries had higher average rates and salaries.

Fig. 1. Impact of the pandemic on wages and salaries of agricultural, forestry, and fishing SMEs in Central European countries

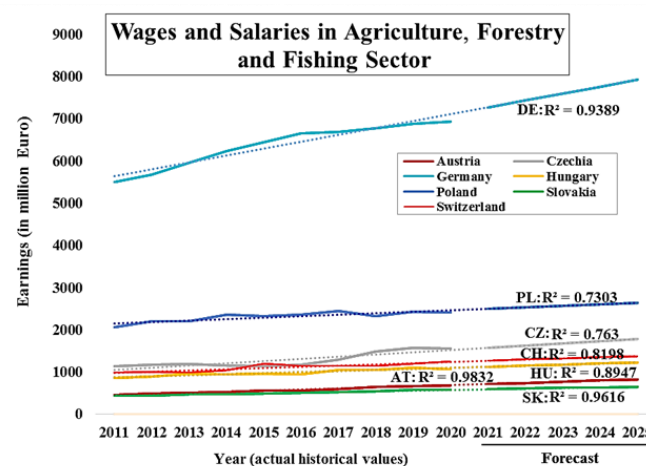
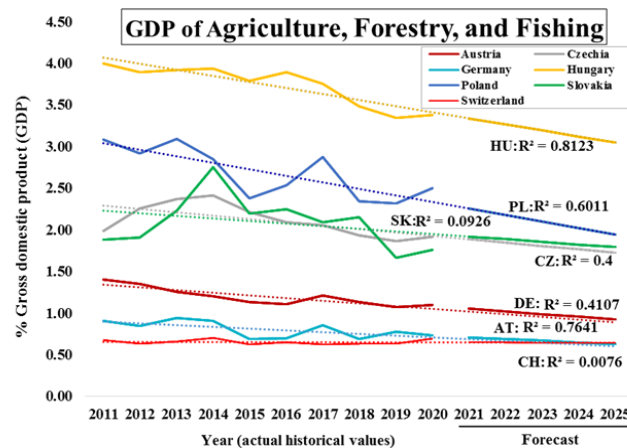


Figure 1 represents earnings and salaries in Central European agricultural SMEs' agricultural, forestry, and fishing sectors before and during COVID-19 from 2011 to 2021, with projections through 2025. In Germany and Poland, wages and salaries in agriculture were approximately 5,499 and 2,061 million euros in 2011, respectively, which were higher than those in the Czech Republic, Austria, Hungary, and Switzerland. While wages and salaries in Germany and Poland declined in 2021 as compared to the pre-COVID. The forecast revealed that in 2025 Germany would increase the wages and salaries of agriculture SMEs. A ten-year data set revealed that agricultural earnings and salaries in the remaining European nations were slightly improved. Salaries were also impacted by the agricultural occupational structure of the industry, with a significant number of employees in low-wage occupations. Additionally, the occupational employment statistics for the highest-paying occupations were low. Farmworkers and labourers (crops, nurseries, and greenhouse; farm workers, farm, and aquacultural animals), directly connected to the sector's principal economic activity, dominated employment in the agricultural sector, impacting salaries.

4.2 Gross Domestic Product (GDP)

Fig. 2. Impact of the pandemic on GDP on agricultural, forestry, and fishing SMEs in Central European countries

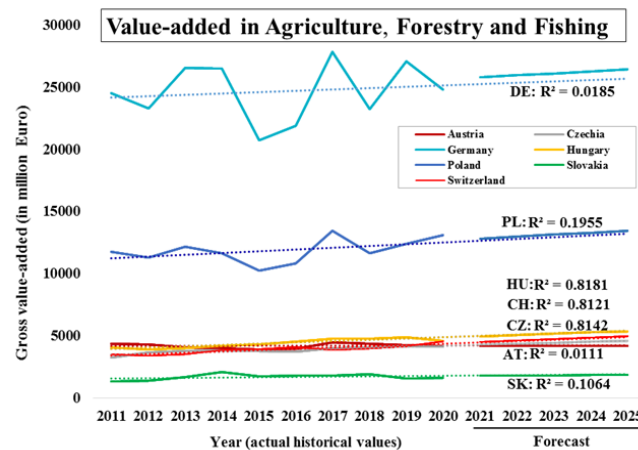


Agricultural, forestry, and fishing SMEs contribute significantly to GDP and economic growth through essential linkages between production and consumption, supplying raw materials for production and commodities to the non-agricultural sector (industry and commerce). Agriculture also consumes energy, minerals, and chemicals, among other things. Figure 2 depicts the GDP of agricultural, forestry, and fishing in Central Europe before and during COVID-19. In 2011, Hungary and Poland had higher GDP rates of approximately 3.99 and 3.09 %, respectively, compared to other European countries before the pandemic. The GDP rate of Austria, Czechia, Germany, Hungary, Poland, Slovakia, and Switzerland was inconsistent from 2011 to 2018, continuously declining and rising, but GDP in Hungary and Slovakia dropped significantly. However, It was noticed that during COVID-19 in 2020, there was a higher impact on the Central European economy and GDP because of agricultural market shocks, including the inclusion of demand, supply, and fiscal reactions in agricultural production/trade markets.

4.3 Value-Added

Value-added agriculture refers to a collection of agricultural strategies that enable farmers to fulfil customer needs for agricultural or food items with a unique form, space, time, identity, and quality characteristics unavailable in conventionally produced raw agricultural goods. Agriculture with added value is a crucial strategy for agricultural SMEs as well as rural development. Figure 3 depicts the value-add in agriculture, forestry, and fisheries in Central European agricultural SMEs from 2011 to 2021, before and during the COVID-19 crisis. The value-added (figure 3) in agriculture, forestry, and fisheries in Central European SMEs was compared in the pre-pandemic era (2011-2019) and during the COVID-19 crisis (after 2019). During the pre-pandemic period, Germany's collection of value-added tax fluctuated; statistics revealed that Germany collected more than 24,512 million euros/year of value-added tax in 2011, 2013, 2014, 2017, and 2019, but it declined in 2012, 2015, 2016, and 2018. In the agriculture sector in Germany, value-added is expected to reach about 26420 million euros by 2025 in the agriculture, forestry, and fisheries sectors. In 2011, Poland's value-added tax collection was 11,718.9 million euros, which grew with volatility from 2012 to 2014, as well as in 2017, 2019, and 2020. In contrast, there was a decline in value-added in 2015, 2016, and 2018. Surprisingly, in 2020, amid the COVID crisis, Poland's value-added (13,103.1 million euros) was quite strong in comparison to the pre-pandemic era. However, by 2025, the value-added in Poland's agriculture sector is anticipated to rise by approximately 13444 million euros in the agriculture, forestry, and fisheries sectors. Austria's value-added climbed consistently from 4,347.7 million euros in 2011 to 4,259.7 million euros in 2019. It fell by 4,172.2 million euros in 2020 and is expected to be about 4173.3 million euros in 2025. In comparison, Hungary credited its economy with 4,081.2 million euros of value-added in 2011; the amount climbed gradually until 2019 (4,883.8 million euros).

Fig. 3. Impact of the pandemic on value-added in agriculture, forestry, and fishing SMEs in Central European countries

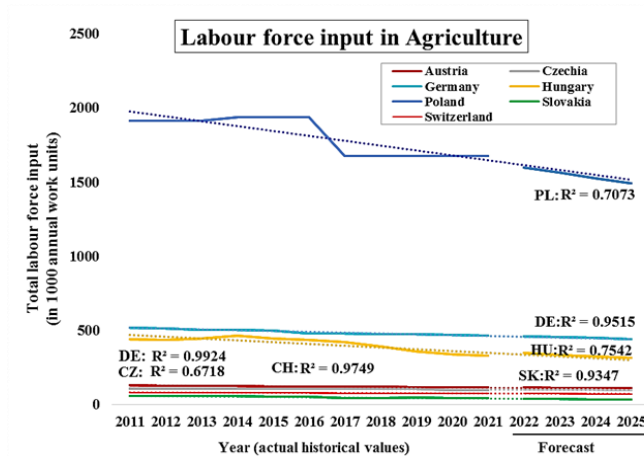


During COVID-19, it declined somewhat (4,614.6 million euros) in 2020. Hungary's value-added in agriculture, forestry, and fisheries is expected to reach over 5359.7 million euros in 2025. Switzerland's value-added has steadily increased from 3,490.2 million euros in 2011 to 4121.9 million euros in 2019. In 2020, it increased by 4,548.3 million euros, which is predicted to be about 4945.8 million euros in 2025. Czechia credited its economy with 3,275.2 million euros of value-added in 2011, continuously increasing through 2019. (4,198.3 million euros). It fell slightly (4,123.5 million euros) in 2020 during COVID-19. In 2025, Czechia's value-added in agriculture, forestry, and fisheries is predicted to exceed 4592.5 million euros. Compared to the other Central European nations, Poland and Switzerland's agricultural value-added was higher during the pandemic, while Germany, Hungary, Slovakia and Austria's value-added was relatively low and changed little over the decade and then declined again in 2021. Czechia had a relatively stable value-added during COVID-19. Central European nations involved farmers shifting their position in the supply chain, developing direct links between themselves and consumers, and adjusting production procedures to alter and retain certain fundamental features of their farm goods.

4.4 Labour Force Input

In Poland and Germany, people were directly engaged in the agriculture industry 1914.8 and 517.5 in thousand units, respectively, in 2011 compared with other European nations, as shown in figure 4 for agricultural labour force input. Between 2014 and 2016, the number of people working in the agriculture business in Poland climbed from 1914.8 to 1937.1 in thousand units and then declined dramatically from 2017 to 2018, and the line stayed stable until 2021. Although Hungary had a minor reduction in agricultural work during the pandemic in 2021, other European countries also saw much workforce in the industry. The impacts of COVID-19 on agriculture SMEs have been reported, with the main issues being labour and machinery shortages, limited access to crop fields and markets, poor access to agricultural inputs, services, and consultancy services, supply chain interruption, and product perishability due to limited access to markets and insufficient post-harvest handling. Furthermore, the lockdown considerably influenced the flow of agricultural commodities and product promotion.

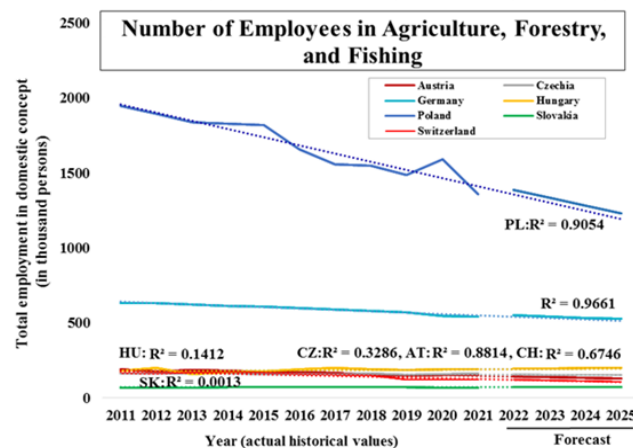
Fig. 4. Impact of the pandemic on labour force input on agricultural, forestry, and fishing SMEs in Central European countries



4.5 Number of Employees

Figure 5 shows the number of agricultural, forestry, and fishing employees in Central European countries un SMEs from 2011 to 2021. According to preliminary estimates, in 2011, the agricultural industry employed the most people in Poland and Germany 1,945, 000 and 631,000, respectively; other European countries had lower employment rates than Poland.

Fig. 5. Impact of the pandemic on the number of employees of agricultural, forestry, and fishing SMEs in Central European countries



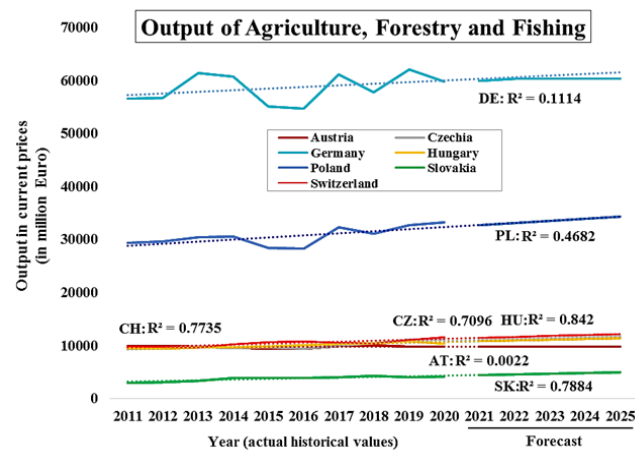
From 2011 to 2020, the employment rate in other European countries changed marginally, whereas, during the pandemic, Poland, Switzerland, and Germany hired fewer employees in 2021. The COVID-19 pandemic problem has influenced employment, productivity, and businesses in ways that have resulted in increased inequities. Most companies had had to close their doors, resulting in unprecedented concerns such as lost business, income, and job losses. The extreme measures necessary to stop the spread of COVID-19 necessitated many legislative initiatives that obstructed society's regular functioning. These examples were wearing face masks, social isolation, remaining at home, and the eventual restriction of all mobility. As a result, typical business operations could not be carried out for fear of spreading the disease.

4.6 Output of Agriculture

Agriculture, forestry, and fishing production output are significant for various reasons. Aside from supplying more food, boosting farm productivity influences the region's potential for agricultural market expansion and competitiveness, income distribution and savings, and labour migration. Figure 6 represents agricultural, forestry, and fishing output SMEs from 2011 to 2021. The output volumes of German, Poland, and Slovakia's agricultural SMEs fell in a generally consistent downward trend. The increasing output volumes were paralleled by the number of input commodities in Germany and Poland in 2014, which then fluctuated output until 2019 and decreased during the COVID-19 pandemic in 2020. In addition, central European countries had the lowest production compared to Poland and Germany. The COVID-19

pandemic altered the functioning of the entire agricultural production in Central Europe and across the world. The economy's shutdown and the resulting economic recession, limits on foreign commerce, and stalled production demand all damaged the financial foundations of local agricultural producers, the processing sector, transportation, energy, and trade firms.

Fig. 6. Impact of the pandemic on the output of agriculture on agricultural, forestry, and fishing SMEs in Central European countries



5 Conclusion and Recommendations

The COVID-19 outbreak significantly negatively influenced agricultural output, labour force input, number of employees, GDP, value-add, wages, and salaries in SMEs of agricultural, forestry, and fishing in Central European countries, impacting the worldwide food distribution network. We estimated that the pandemic affected the world's foods, agricultural SMEs, trade, and GDP based on the abovementioned. This severe pandemic has impacted livestock, fisheries, and agriculture. Food security and food safety are essential concerns globally in the present economy; COVID-19 significantly influenced the distribution network, threatening food security and safety worldwide. Agricultural consumption and production were being harmed internationally due to transportation limitations and decreased purchasing power. Besides, most migrants, mainly temporary seasonal agricultural and domestic workers, were relocated, which may influence the food supply. The COVID-19 outbreak is a worldwide issue that has impacted the food and agriculture industries. There is an urgent need to respond promptly to secure the sustainability of the Agri-based product distribution network, both domestically and internationally, to limit the possibility of major disruptions, which may significantly influence the poor and weak populations. Despite the assumption that there had been few disruptions to the food distribution network, it nevertheless confronted significant strategic concerns. Agri-product must transcend unbounded borders while adhering to established food safety requirements to reduce the pandemic's impact on agricultural production. The Food and Agriculture Organization encourages nations to achieve the international food needs of vulnerable individuals, improve social safety policies, continue world food trade progression, implement country's food distribution network approaches, and encourage small-scale farmers' ability to boost agricultural output. Economies with international issues are more likely to contract the COVID-19 outbreak. Although several national requirements may arise due to the outbreak, donor economies must continue to guarantee that emergency aid is supplied despite acute food shortages. The illness has little regard for national boundaries. The entire human population will be endangered if this issue is not solved. Consequently, the government must consider regulating pandemics without endangering its population's Agri-product security, safety, and distribution network problems.

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References

- Al-Fadly, A. (2020). Impact of covid-19 on SMEs and employment. *Entrepreneurship and Sustainability Issues*, 8(2), 629–648. DOI: 10.9770/jesi.2020.8.2(38)
- Beckman, J., Baquedano, F., & Countryman, A. (2021). The impacts of COVID-19 on GDP, food prices, and food security. *Q Open*, 1(1), DOI: 10.1093/qopen/qaab005

- Brown, R. (2020). The impact of COVID-19 on Scottish small and medium-sized enterprises (SMEs): Prognosis and policy prescription. *Economic Commentary*, 44, 1–15. www.arjhss.com
- Buchta, S. (2018). The possibilities of solving unemployment of workers in agriculture and construction. *Agricultural Economics (Zemědělská Ekonomika)*, 49(7), 310–316. DOI: 10.17221/5403-agricecon
- Caiazza, R., Phan, P., Lehmann, E., & Etzkowitz, H. (2021). An absorptive capacity-based system view of Covid-19 in the small business economy. *International Entrepreneurship and Management Journal*, 17(3), 1419–1439. DOI: 10.1007/s11365-021-00753-7
- Chen, H., Singh, B., & Aru, W. S. (2020). Relationship between government expenditure and economic growth: evidence from Vanuatu. *Journal of the Asia Pacific Economy*. DOI: 10.1080/13547860.2020.1844610
- Cristea, D. S., Rosenberg, S., Pustianu Mocanu, A., Simionov, I. A., Mogodan, A. A., Petrea, S. M., & Moga, L. M. (2021). Modelling the Common Agricultural Policy Impact over the EU Agricultural and Rural Environment through a Machine Learning Predictive Framework. *Agronomy*, 11(11), 2105. DOI: 10.3390/agronomy11112105
- Elizabeth, R. (2021). Akselerasi inovasi teknologi spesifik lokasi strategi peningkatan produksi di masa pandemi covid-19. *Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis*, 7(1), 532. DOI: 10.25157/ma.v7i1.4717
- Grondys, K., Ślusarczyk, O., Hussain, H. I., & Androniceanu, A. (2021). Risk assessment of the SME sector operations during the covid-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(8). DOI: 10.3390/ijerph18084183
- Hu, Y., Fang, Y., Guo, G., & Zhuang, L. (2020). How Can SME Turn Crises into Opportunities under the Epidemic? DOI: 10.2991/assehr.k.201030.055
- HUANG, J. kun. (2020). Impacts of COVID-19 on agriculture and rural poverty in China. *Journal of Integrative Agriculture*, 19 (12), 2849–2853. DOI: 10.1016/S2095-3119(20)63469-4
- Islam, M. M., Jannat, A., Al Rafi, D. A., & Aruga, K. (2020). Potential Economic Impacts of the COVID-19 Pandemic on South Asian Economies: A Review. *World*, 1(3), 283–299. DOI: 10.3390/world1030020
- Kaminskyi, A. B., Nehrey, M. V., & Zomchak, L. M. (2021). COVID-19: crisis or new opportunities time for the agricultural sector of Ukraine. *IOP Conference Series: Earth and Environmental Science*, 628(1), 012031. DOI: 10.1088/1755-1315/628/1/012031
- Khanal, N. (2020). Impact of Corona Virus pandemic on Different sectors of Nepalese economy. *Management Dynamics*, 23(2), 243–254. DOI: 10.3126/md.v23i2.35825
- Kołodziejczak, W. (2020). Employment and gross value added in agriculture versus other sectors of the European Union Economy. *Sustainability (Switzerland)*, 12(14). DOI: 10.3390/su12145518
- Kuandykova, M. B., Omarbakiyev, L. A., & Kamysbayev, M. K. (2021). Agricultural entrepreneurship of Akmola region of Kazakhstan on the background of pandemic. *Problems of AgriMarket*, 2, 123–129. DOI: 10.46666/2021-2.2708-9991.15
- Lusk, J. L., & Chandra, R. (2021). Farmer and farm worker illnesses and deaths from COVID-19 and impacts on agricultural output. *PLoS ONE* 16. DOI: 10.1371/journal.pone.0250621
- Mariyah, M., Nurfilah, S., Lesmana, D., & Nugroho, A. E. (2021). Socioeconomic aspect of agribusiness affected during the COVID-19 pandemic. *Sociohumaniora*, 23(1), 89. DOI: 10.24198/sosiohumaniora.v23i1.29585
- Matsyhora, T. (2020). Investment potential of the agrarian sector of the economy of Ukraine: formation and development. *Ekonomika APK*, 308(6), 49–58. DOI: 10.32317/2221-1055.202006049
- Mekonen, E. K. (2020). Agriculture Sector Growth and Inflation in Ethiopia: Evidence from Autoregressive Distributed Lag Model. *Open Journal of Business and Management*, 08(06), 2355–2370. DOI: 10.4236/ojbm.2020.86145
- Metodieva, T. H., & Bartos, H. H. (2021). Autoregressive approach for exploring the gross value added in agriculture and the number of agricultural holdings in Bulgaria. *Bulgarian Journal of Agricultural Science*, 27(1), 51–58.
- Mihnenoka, A., & Senfelde, M. (2015). Wage Share as a Factor of Income Inequality in the Context of the Structure of National Economy. *Procedia Economics and Finance*, 26, 1035–1043. DOI: 10.1016/s2212-5671(15)00927-2
- Nakasone, K., Ghimire, R., & Suvedi, M. (2021). Trends in crop production and land productivity in northern Ghana: A case study of Tolon-Kumbung. *Food Security*, 13(1), 83–94. DOI: 10.1007/s12571-020-01123-x
- Nguyen, H. K. (2021). Applications optimal math model to solve difficult problems for businesses producing and processing agricultural products in Vietnam. *Axioms*, 10(2). DOI: 10.3390/axioms10020090
- Nurunnabi, M. (2020). Recovery planning and resilience of SMEs during the COVID-19: experience from Saudi Arabia. *Journal of Accounting and Organizational Change*, 16(4), 643–653. DOI: 10.1108/JAOC-07-2020-0095
- Özkan, B. (2021). Impacts of COVID-19 Pandemic on Global Agriculture, Livelihoods and Food Systems. *Tarım Bilimleri Dergisi*, 239–246. DOI: 10.15832/ankutbd.941162
- Pardhan, S., & Drydakakis, N. (2021). Associating the Change in New COVID-19 Cases to GDP per Capita in 38 European Countries in the First Wave of the Pandemic. *Frontiers in Public Health* 8. DOI: 10.3389/fpubh.2020.582140

- Salimova, G., Ableeva, A., Lubova, T., Zalilova, Z., & Sharafutdinov, A. (2020). The Role of Agriculture in Gross Added Value. *Montenegrin Journal of Economics*, 16(1), 183–191. DOI: 10.14254/1800-5845/2020.16-1.12
- Ssenyonga, M. (2021). Imperatives for post COVID-19 recovery of Indonesia's education, labor, and SME sectors. *Cogent Economics and Finance* 9(1). DOI: 10.1080/23322039.2021.1911439
- Valdés, P. C. (2020). Relations between income profile of domestic units and wages in the agricultural sector in Chile and Mexico. *Revista Austral de Ciencias Sociales*, 2020(38), 227–245. DOI: 10.4206/rev.austral.cienc.soc.2020.n38-1230.
- Xing, H., & Xiaofeng, L. (2021). Agricultural labour market equilibrium based on FPGA platform and IoT communication. *Microprocessors and Microsystems*, 80. DOI: 10.1016/j.micpro.2020.103332
- Xu, B., Sendra-García, J., Gao, Y., & Chen, X. (2020). Driving total factor productivity: Capital and labour with tax allocation. *Technological Forecasting and Social Change*, 150. DOI: 10.1016/j.techfore.2019.119782
- Yuan, B., & Chen, C. (2019). Evolution of a development model for fruit industry against background of rising labour cost: Intensive or extensive adjustment? *Sustainability (Switzerland)*, 11(14). DOI: 10.3390/su11143864
- Zemtsov, S. P. (2020). Institutions, entrepreneurship, and regional development in Russia. *Zhurnal Novoi Ekonomicheskoi Associacii /Journal of the New Economic Association*, 46(2), 168–180. DOI: 10.31737/2221-2264-2020-46-2-9
- Zhang, Y., & Diao, X. (2020). The changing role of agriculture with economic structural change – The case of China. *China Economic Review* 62. DOI:10.1016/j.chieco.2020.101504

Development of the Serbian sugar industry in the European context

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Abstract: The paper deals with the development of the sugar industry in the Republic of Serbia in the context of changes in the business environment, which are largely related to the application for accession to the European Union submitted on 19 December 2009. Serbia was granted candidate status on 1 March 2012. This is the period when the European Union (EU) Member States had to apply measures within the sugar beet-sugar commodity vertical resulting from the Common Market Organisation (CMO), which aimed to increase the competitiveness of the European sugar industry, in particular through a quota regime and minimum purchase prices. The analysis consists in the evaluation of the basic production indicators of the different phases of this commodity vertical in Serbia. The indicators found are then compared with the trends of the EU Member States. On the basis of this comparison, Serbia's approach to the individual reforms applied under the EU Common Agricultural Policy, which as a country in the pre-accession period it has to integrate into its national legislation, is also assessed.

Keywords: sugar beet, Common agricultural policy, Common organization of sugar market, sugar reform

JEL Classification: Q10, Q18

1 Introduction

Sugar beet can objectively be considered a crop with a wide variety of uses. In the temperate zone, sugar beet is grown primarily for sugar production because of its high sucrose content. However, the potential of sugar beet to produce alcohol for fuel (bioethanol) production is increasing (Pulkrábek, 2007) and the waste products from sugar production are used as feed in livestock production (Pulkrábek and Šroller, 1993). The aforementioned wide use of sugar beet is conditioned by the high agro-ecological requirements for its cultivation and a certain experience of the grower, because sugar beet also has high requirements for individual agro-technological procedures (Pulkrábek, 2007).

The sugar beet and sugar market is monitored within the EU through the Common Market Organisation (CMO) for sugar (European Commission). Under the CMO, market measures have been in place since 1968 to directly intervene in the sugar and sugar beet market. Through these interventions, the CMO responded to changes in the business environment for this commodity in order to ensure an adequate income for European growers (European Commission, 2004). Due to the enlargement of the EU to include new Member States, it was necessary to reform the business environment for this commodity. A key re-form came into force in 2006 with the aim of strengthening the competitive players within the sector (verticals) at the expense of those who were not competitive within the markets for this commodity. The non-competitive operators (sugar factories) were able to benefit from compensation payments that provided them with financial compensation for closing down their activities. The main elements of this reform were the reduction of quotas for sugar production and the reduction of minimum prices for sugar beet and sugar (Krouský, 2008). Increasing the competitiveness of the sector was crucial and targeted. Then, in 2017, all measures that Member States had to follow within the sector were already abolished, which further strengthened the competitive environment (Ministerstvo zemědělství, 2017).

The cultivation of sugar beet with subsequent sugar production has a long tradition in Serbia, dating back to 1913, when the first sugar factory called Bačka (Sunoko) was established in the Vojvodina region. The Vojvodina region is one of the most important agricultural areas in Serbia, as it has fertile black soil, which is ideal for sugar beet cultivation. The Vojvodina region is also crucial for Serbian agriculture because it accounts for 35 % of Serbia's agricultural area. From the sugar beet cultivation point of view, this region is key and accounts for 96% of the sugar beet production (Novkovic, Mutavdžić., Vukelić., 2013).

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Serbia applied for EU membership in 2009. On the basis of the submission, the EU Council changed Serbia's status to candidate country in 2012. The granting of candidate status meant that the sugar beet and sugar sector had to apply the measures resulting from the CMO (European Commission). The candidate status allowed Serbia to benefit from funding for strengthening the competitiveness and transformation of its agriculture, including the sugar beet and sugar sector, through the EU's pre-accession assistance for rural development (IPARD) (European Commission).

2 Methods

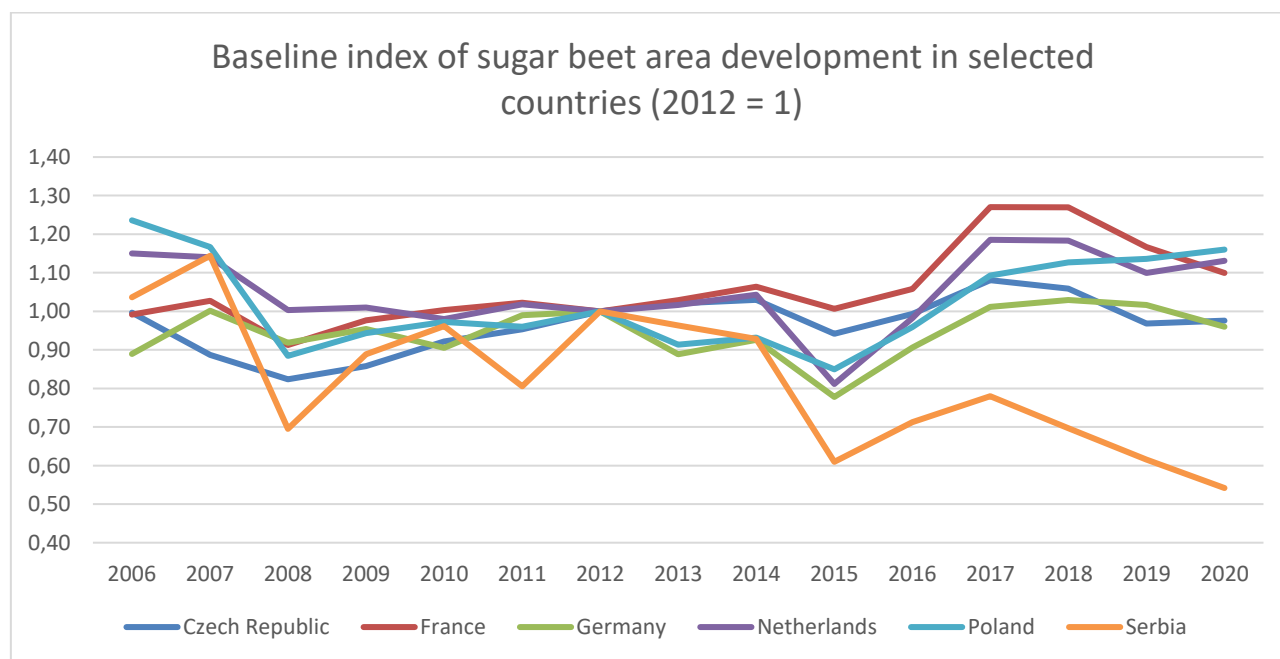
The paper deals with the evaluation of the response of the Republic of Serbia to the implementation of the European legislation, specifically the legislation resulting from the EU Common Agricultural Policy, which it has to integrate into the national legislation within the framework of the candidate country status. In the case of the sugar beet and sugar commodity, it concerns the reaction to individual measures resulting from the CMO reforms, which the Member States had to apply in the past and Serbia had to apply additionally in this sector. The analysis carried out compares key indicators characteristic of the beet and sugar sector. The comparison is assessed on the basis of a base index or comparison of values for the period 2006-2020. The base year for comparison is 2012, which is a key year due to the granting of candidate status. For a better assessment, the selected indicators are compared with selected EU Member States. This comparison allows a better assessment of the response of the original Member States and Serbia.

3 Research results

3.1 Sown areas

Planted area is one of the basic indicators among agricultural crops. The area under cultivation tells us how much of the area of a country is occupied by the crop under consideration. The basal area index in Figure 1 allows a better evaluation of the parameter under study without the bias caused by the different size of the different states.

Figure 1: Baseline index of sugar beet area development in selected countries (2012 = 1)



Source: data from Faostat, own processing

Based on the comparison made in Figure 1, we can observe a different development between the original EU Member States and Serbia. The EU Member States have a similar development in the period under review with minor variations. In the general context, the base index of these countries followed a downward trend after the introduction of the reform in 2006, but thanks to the possibility to buy sugar quotas since 2009, the base index shows a steady state even around the base year 2012. A common feature of these countries is the decline caused by the uncertainty with the planned end of sugar quotas by 2015, which finally occurred only in 2017. These countries took advantage of the time available to prepare and deliberately increased their sown area as the end of sugar quotas approached in order to secure a higher share of the European market. Typically, there is again a slight decline after 2018, caused by the fall in sugar prices due to overproduction in previous years.

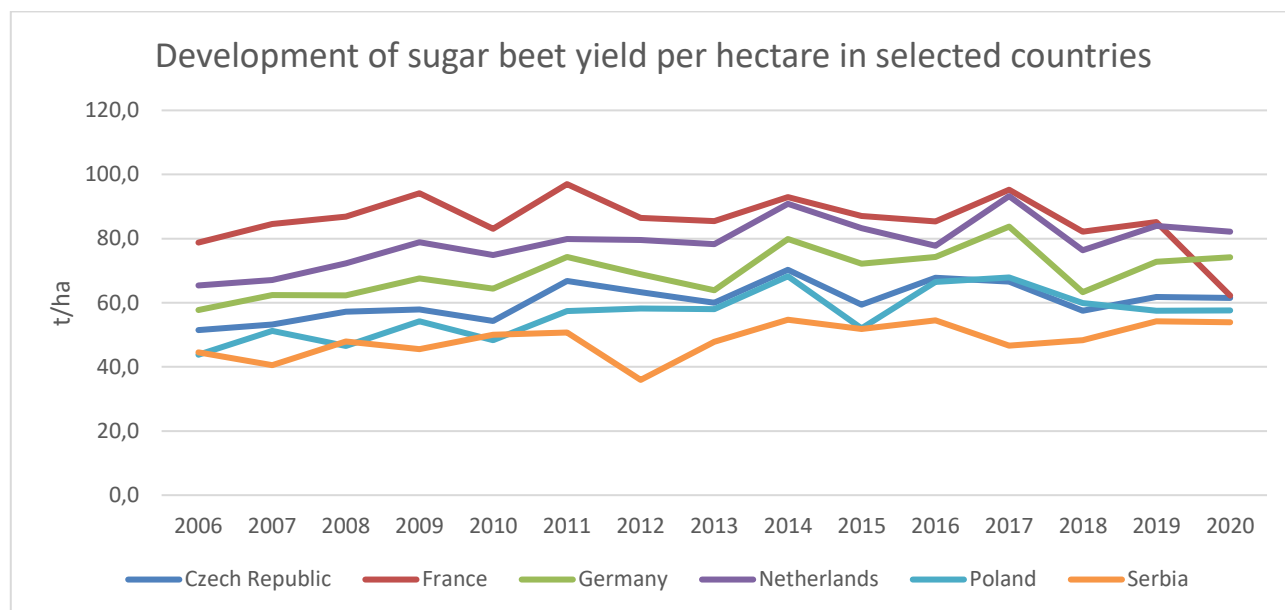
In the case of Serbia, we can observe high volatility in the base index in the period before the base year 2012, where such significant volatility in the case of agricultural commodities can be attributed to the weather. After 2012, the base index follows a similar trend as for the other Member States. With 2015 came a fall in the base index, as in the case of

the other countries, but in the case of Serbia it was much more pronounced and amounted to 0.32 basis points year-on-year. This decline was partly offset by the increase by 2017, but its dynamics did not correspond to the growth dynamics of the other countries. After 2017, the basis index has already had a persistent decline, which may be partly due to the less competitive position of local growers in the face of the significant price drop that occurred in the sugar beet market. The other major factor was the discovery in 2019 of a disease called bull rot, against which there was no known protection.

3.2 Hectare yields

The production of sugar beet pulp is one of the important parameters targeted by the CMO in its reforms. Total production is the result of the size of the sugar beet harvested area and, in particular, the hectare yield of sugar beet. The hectare yield values in Figure 2 allow us to better assess the technological and agrotechnical maturity of the growers in a given state. As mentioned in the introduction of the paper, sugar beet is a highly demanding crop both in terms of agro-ecological conditions and grower knowledge.

Figure 2: Development of sugar beet yield per hectare in selected countries



Source: data from Faostat, own processing

Based on the values shown in Figure 2, France has consistently achieved the highest yields per hectare in the long term, with yields consistently around 90 t/ha of sugar beet pulses. This level has also been achieved in the Netherlands in recent years, thanks to the high intensity of agricultural production. Germany has long achieved yields of around 70-80 t/ha, while the Czech Republic and Poland have yields of around 60-70 t/ha. If we look at trends rather than specific values, the trend in the countries studied is similar, with year-on-year fluctuations caused by climatic factors or the impact of pests and diseases. The aforementioned diseases, specifically beet yellows virus, have caused a decrease in hectare yields in France since 2019.

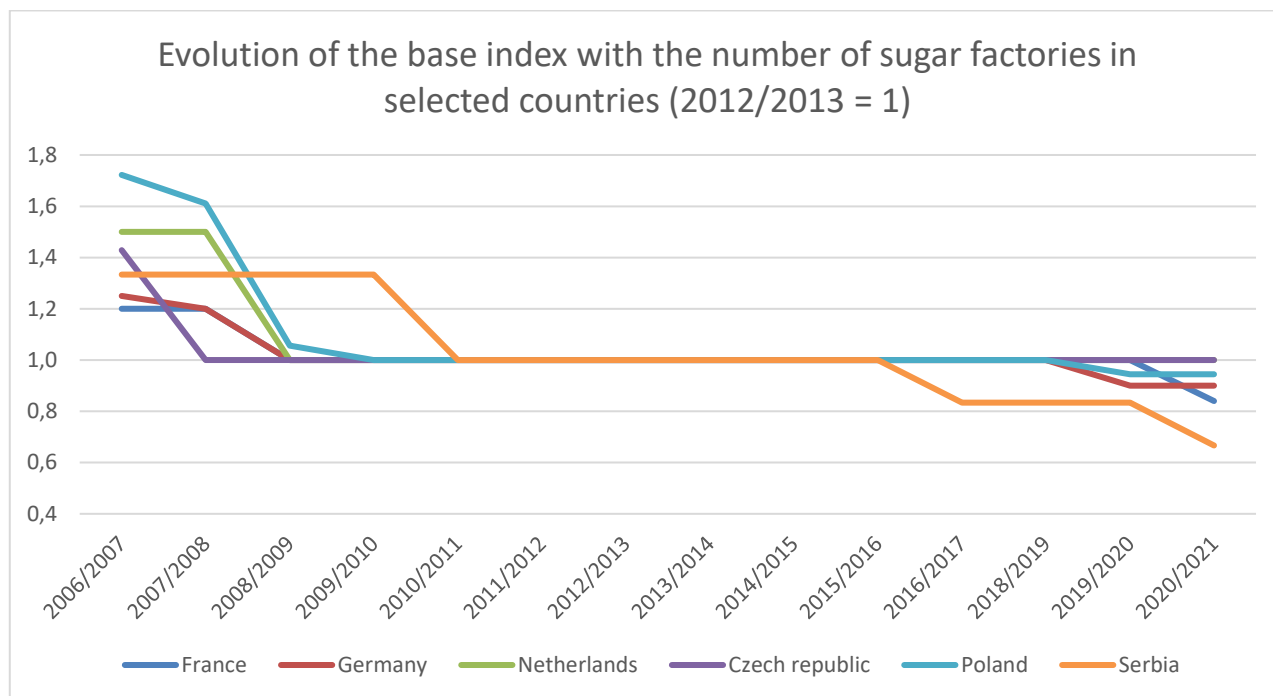
Serbia, which has lower yields per hectare than other countries, has seen a growing trend in yields per hectare since 2006. In 2006, the hectare yield in Serbia was around 40 t/ha. After a fluctuation in 2012, this trend has been reversed and hectare yields are currently around 50-60 t/ha. Overall, it can therefore be concluded that Serbian sugar beet growers are increasing their competitiveness through modern agricultural practices and technologies, but this trend is largely influenced by the decline in the production area that has occurred since 2014, which is confirmed by the trend in sugar beet seeded area shown in Figure 1.

In the future, the ability to cope with climate change can be expected to be key to high yields in all the countries studied, as sugar beet is not suited to long dry spells. Last but not least, the impact of diseases, pests and early intervention against them will also play a role.

3.3 Processing assumptions - number of sugar factories

The presence of a downstream processing industry in a given country is very important for the successful development of sugar beet production. As sugar beet is a bulk commodity, there is a problem of the number of sugar factories, the issue of transport for processing and the high cost of transport over long distances between countries. The evolution of the basic index with the number of sugar factories in each country can be seen in Figure 3.

Figure 3: Evolution of the base index with the number of sugar factories in selected countries (2012/2013 = 1)



Source: own processing

Based on the data shown in Figure 3, it is clear that the development in terms of the number of sugar factories in Serbia is different compared to other countries. In the context of the post-2006 CMO reforms, the most significant reform came into force, which sought to reduce the amount of sugar produced in the EU. This fact is confirmed in Figure 3, where for all countries the base index has a decreasing character, which is related to the possibility to benefit from financial compensation for the cessation of sugar production in a given sugar factory. These compensation payments were paid until the marketing year 2009/2010. Since that year, there has been no further change for the countries concerned. The further decline in the base index is in the case of Germany and Poland in parallel after the marketing year 2018/2019, when the CMO reform was expected to end. A much more pronounced decline occurred after the 2019/2020 marketing year in France, where there was a 0.2 point drop in the base index, which is to some extent related to the dramatic fall in the world sugar price during this period.

In the case of Serbia, the evolution of the base index is different. A significant decrease occurred in the marketing year 2009/2010, which was related to the ongoing transformation of processing capacities. The next significant drop of 0.2 basis points came after the marketing year 2015/2016 and the last drop of 0.1 basis points came after the marketing year 2019/2020. It can be noted that overall there has been an increase in concentration in the sugar market, with 4 sugar refineries operating in Serbia as of this year, 3 of which are owned by a single owner. The sugar beet processing market in Serbia shows an oligopolistic character similar to that of other European countries.

3.4 Sugar production

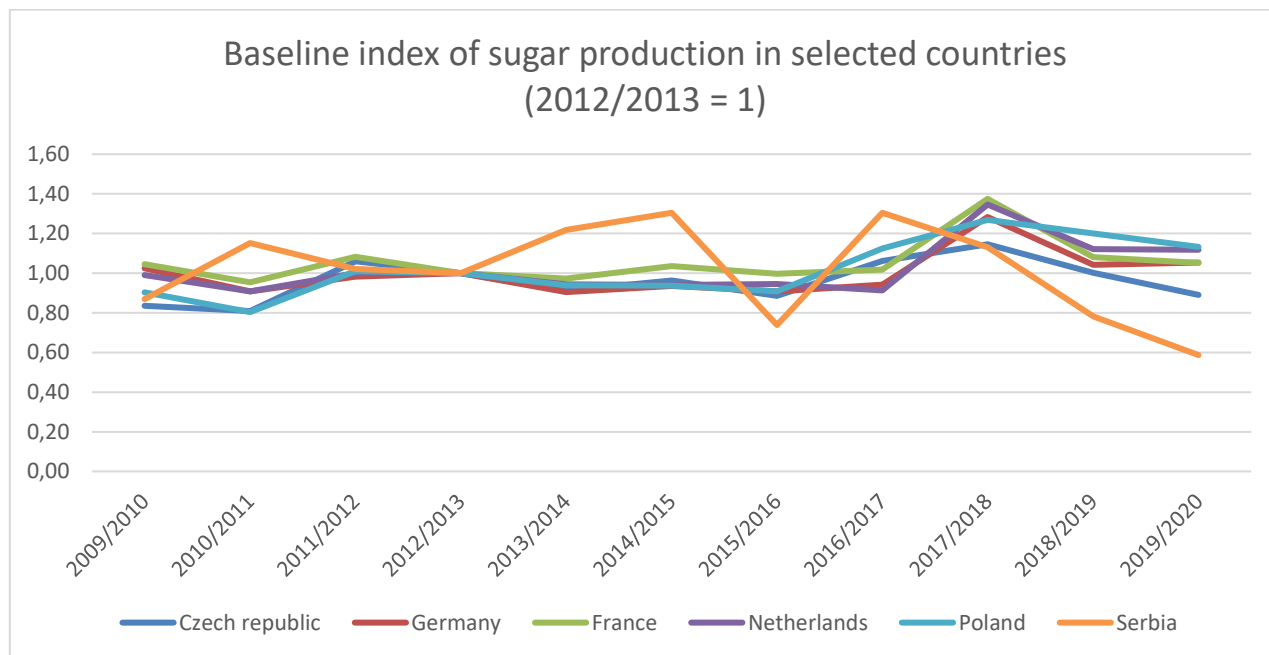
In Figure 4 we can see a comparison of the evolution of the base index in sugar production of the countries under consideration. Sugar production in each country reflects the above-mentioned basic indicators, which practically determine the dimension of sugar production.

For the EU Member States, a virtually parallel trend in the evolution of the base index can be observed. This parallel trend confirms the reality of how Member States have been affected by the CMO reforms which have constrained their

sugar production. The significant increase in the base index came only with the end of sugar quotas, which was reflected in the 2017/2018 marketing year. However, this increase was followed by a decline, which was largely linked to the fall in the sugar price.

The base index in the case of the Republic of Serbia shows more volatility and does not correspond to the evolution of the EU Member States' base index, given that the Serbian processing industry did not have to comply with the measures resulting from the CMO reforms. The decrease in the base index has been occurring since the marketing year 2016/2017, which is related to the reduction in the number of sugar factories and the decrease in the area under cultivation and as a result means less raw material input for sugar production. This downward trend has accelerated in subsequent years. It has been reinforced by the decline in the number of sugar factories and the reduction in the area sown, while the increase in yield per hectare has not been able to compensate for this decline.

Figure 4: Baseline index of sugar production in selected countries (2012/2013 = 1)



Source: own processing

On the other hand, there have been some positive developments in manufacturing. Comparing the evolution of the base indices in Figure 3 and Figure 4 over the period under review, it can be seen that this part of the commodity vertical reflects the impact of the increase in the technological level and processing capacity in functional sugar factories, as the processing industry was able to produce more sugar with fewer factories. This improvement may be due to some extent to the extension of the length of the beet campaign, but the sugar factories try not to extend the length of the beet campaign, as the quality of the beet decreases over time and hence the yield of the resulting sugar production is lower.

4 Conclusions

Sugar beet is a traditional crop of European and Serbian agriculture, thanks to the suitable agro-ecological conditions, and in both cases the downstream processing industry plays a role, which is absolutely necessary for the maintenance and efficient use of the production of this crop. Serbia, which applied for EU membership in 2009 and was subsequently granted candidate status in 2012, has to integrate European legislation into its national legislation as part of the pre-accession period. These changes also concern agricultural policy, which must be in line with the strategy and objectives of the EU's Common Agricultural Policy. IPARD funds are earmarked to support the transformation and increase the competitiveness of Serbian agriculture and downstream industry.

In the case of sugar beet and sugar production, Serbian agriculture, unlike Member States, did not have to fully apply the reforms and measures resulting from the CMO regulation, which affected European sugar beet and sugar producers since 2006, when these measures were abolished in 2017.

Based on the comparison of several basic indicators in the sugar beet and sugar sector, a different trend from the EU Member States is evident in all the monitored indicators. The observed differences are related to the fact that the integration process is long-term and in the case of sugar beet cultivation and sugar production, the measures resulting from the CMO reforms have not been applied in Serbia.

A decreasing trend was found for most of the monitored indicators, in contrast to the other countries. This downward trend could pose a problem for maintaining the position of this sector in the Republic of Serbia after its accession to the EU, when its country-agricultural policy will be based on the CAP and the pressure on the efficiency and competitiveness of this sector will further increase.

References

- European Commission. (n.d.). *Sugar*. https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/sugar_en
- European Commission (n.d.) *Serbia*. https://neighbourhood-enlargement.ec.europa.eu/enlargement-policy/serbia_en
- European Commission (n.d.) *Overview of EU pre-accession assistance for rural development (IPARD)* https://agriculture.ec.europa.eu/international/international-cooperation/enlargement/pre-accession-assistance/overview_en
- European Commission. (2004, 1. July). *EU sugar sector: Facts and figures*. https://ec.europa.eu/commission/presscorner/detail/en/MEMO_04_177
- Krouský, J.(2008). Cukerní reforma je jednou z etap vývoje řepářství. *Listy cukrovarnické a řepářské*, 124(7-8), 191-195
- Novkovič. N., Mutavdžić. B., Vukelić. N.(2013). VOJVODINA'S AGRICULTURE – ANALYSIS & POSSIBILITIES. In N. Bogdanov, S. Stevanović (Eds.), *Agriculture and Rural Development - Challenges of Transition and Integration Processes* (s. 90-97). Department of Agricultural Economics, Faculty of Agriculture, University of Belgrade. DOI: 10.22004/ag.econ.161793
- Ministerstvo zemědělství (2017, 15. září). *V Evropské unii končí výrobní kvóty cukru, české cukrovary patří mezi evropy*
- Pulkrábek, J., Šroller, J. (1993). *Základy pěstování cukrovky*. Institut výchovy a vzdělávání Ministerstva zemědělství ČR
- Pulkrábek, J. (2007). *Řepa cukrová - pěstitelský rádce*. Kurent, s.r.o.
- Sunoko (n.d.) *Vrbas*. <https://www.sunoko.rs/en/production-centers/vrbas/>

Integration of the Czech Republic' food industry in the global value chains

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Abstract: The food and beverages market has undergone dynamic development in recent decades. Among other fundamental changes, the current food system is characterized by changes which tend to put a growing concern on coordination (both horizontal and vertical), integration and competition. The long-term competitiveness and dynamic efficiency of food companies is affected by the way in which the company is embedded in food chains and networks, at present spread globally over multiple countries. Given that integration into global value chains (GVCs) provides opportunities for economic growth and development, the research on firm GVC participation and position has experienced a rapid rise in recent decade. This article investigates the effects of fragmentation of production on the food processing industry in the Czech Republic between 1995 and 2018 using data from Trade in Value Added database. The participation index and the position index are used to evaluate the form of integration of the food processing industry in the Czech Republic. The findings in this study can help inform industrial, agriculture and trade policy makers when assessing the nature of liberalization and structural transformation of agribusiness sectors in their countries as well as when assessing the potential benefits and risks.

Keywords: fragmentation, value added, global value chain, food processing

JEL Classification: F14, F15

1 Introduction

The business environment that has influenced the development and functioning of the food processing industry in the Czech Republic was different from the economic development in the Western world. Before 1989, the socialistic economy in the Czech Republic was governed by central planning emphasizing the growth of industrial production. However, as mentioned by Kopačka (2004), when using the growing amount of raw materials, energy and capital, there was not adequate growth in productivity or technological development. The centrally planned economy also did not allow companies to respond adequately to changes in the world economy and thus meant retraction in technological development and the inability to compete (Židek, 2006). In the 1990s, as a result of the transformation process, changes and developments towards a market environment were triggered.

First, the structure of companies has started to change significantly (Blažková and Dvouletý, 2019). Before 1989, there were only 12 large food processing companies in the Czech Republic, which were divided into approximately 250 state-owned companies during the 1990s. These companies were included in the two-wave privatization process (i.e. in 1992 and 1994), which gave birth to more than 550 small and medium-sized enterprises (Ministry of Agriculture of the Czech Republic, 1998). Moreover, new food processing enterprises also began to emerge due to the boom of business activity in general and on the initiative of primary production – according to the Czech Statistical Office (Czech Statistical Office, 2021), there were 11,317 active enterprises in the Czech food and beverages industry in 2019. However, as mentioned by Blažková and Dvouletý (2019), the process of gradual concentration in all Czech food sectors has become more apparent again in the recent periods.

Second, there has been a significant increase in food prices, not only due to the removal of the negative turnover tax (i.e. state subsidies for consumer food prices), but also due to rising prices for other consumable goods and raw materials. This resulted in a reduction in food consumption leading to a gradual reduction in food production (Mezera and Dvořák, 1995), which was further exacerbated by the development of the volume of agricultural production in the Czech Republic

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(Bečvářová et al., 2009) and the foreign trade, i.e. by an increase in imports and, conversely, a decrease in exports (Homolka, 1995).

Another important milestone that significantly affected the food industry was the entry of retail food chains on the Czech market in the 1990s, whose aggressive centralized purchasing policy significantly damaged Czech agriculture and food producers due to their greater market power (Sexton, 2013). Therefore, the growing concentration in the Czech food industry was an inevitable reaction for food processors to succeed in a competitive market (Blažková and Dvoutělý, 2019).

The food and beverages market has undergone dynamic development in recent decades. The market of deficit supply with a clear dominance of the supplier became a market with a predominance of demand and dominance of retail companies and a growing influence of the customer (de Backer and Miroudot, 2014). The food system is characterized by changes which tend to put a growing concern on coordination (both horizontal and vertical), integration and competition. As emphasized by Galizzi and Venturini, (2012), the long-term competitiveness and dynamic efficiency of food companies is affected by the way in which the company is embedded in chains and networks, at present spread globally over multiple countries. Given that integration into global value chains (GVCs) provides opportunities for economic growth and development, the research on firm GVC participation including its drivers and implications has experienced a rapid rise in the most recent decade (e.g. Gereffi, 2014; Fernandes et al., 2020; Reddy et al., 2021). Although the effects of global value chain (GVC) participation on the economic growth of agricultural and food sectors have already been examined in previous studies (i.g. Lim, 2021; Montalbano and Nenci, 2022; Giovannetti and Marvasi, 2016), the situation in Eastern and Central European countries has not received adequate attention. To fill this research gap, this study aims to investigate the effects of fragmentation of production on the food processing industry in the Czech Republic between 1995 and 2018 using data from Trade in Value Added data-base. The battery of methods is used to evaluate the intensity and the form of integration of the food processing industry in the Czech Republic into the global value chains.

2 Methods

Data comes from The Trade in Value Added (TiVA) database, 2021 edition (TiVa, 2022). TiVa is a collection of measures that can provide insights into global production networks and supply chains beyond what is possible with conventional trade statistics. The TiVA database contains a selection of principal indicators that track the origins of value added in exports, imports and final demand for the years 1995-2018. Indicators are available for 45 industries within a hierarchy based on ISIC Rev. 4. The indicators are derived from the 2018 version of OECD's Inter-Country Input-Output Database (Martins Guilhoto et al., 2022). Multiple methods were used to interrogate the integration of the Czech Republic' food industry in the global value chains.

First, the traditional trade openness index was used to analyze the degree to which the Czech Republic' food industry is open to international trade and it reports upon the level or grade of the internationalization of the sector. For the purpose of this study, the indicator is defined as follows (at current prices, current exchange rates):

$$\text{trade openness index} = \frac{\text{export} + \text{import}}{\text{production}} \quad (1)$$

Where export, import and production embody food products, beverages and tobacco as defined in TiVa database.

Second, using data from the TiVA, shares of intermediate products in the structures of food imports and exports were analyzed. The indication of a sectoral/country integration into the global value chains is increasing proportion of trade with intermediate products. Increased internationalization and fragmentation of production might imply that an economy uses potential comparative advantages by specializing in one stage of the production process that it can focus on to maximize output or value added as opposed to producing a larger proportion of the value chain that include some stages of production that generate less value to the country. (Cieslik et al., 2016).

The use of the international input-output table by TiVA allows decomposing gross trade into value added components. The decomposition of gross exports provides information about domestic value added (DVA), foreign value added (FVA) content of exports and domestic value added sent to third economies (IV). Domestic value added embodied in gross exports (DVA; or EXGR_DVAc, I, p in TiVA) refers to the domestic value added content of exports, by industry i in country/region c to partner country/region p and represents the exported value added that has been generated anywhere in the domestic economy (i.e. not just by the exporting industry). Foreign value added embodied in gross exports (FVA; EXGR_FVAc,i) refers to the value of intermediate goods and services that are embodied in a domestic industry's exports. The value added can come from any foreign industry upstream in the production chain. Domestic value added sent to third economies (IV; EXGR_DVAFXSHc,i) represents the country c domestic value added content embodied in the gross exports of industry i in foreign countries. It is often considered as a measure of 'forward linkages' in analyses of GVCs.

The indication of a sectoral/country integrating into the global value chain is decreasing share of domestic value added in its gross exports, indicating a larger proportion of foreign value added in gross export and stronger linkages within global value chains (Cieřlik et al., 2016).

Also, following Koopman et al. (2010), Johnson and Noguera (2012) and Borin and Mancini (2020), these metrics (DVA, FVA and IV) can be used to measure of GVC participation (1) and GVC position (2).

$$GVC_{participation} = \frac{FVA+IV}{Export_{gross}} \quad (2)$$

The GVC participation index indicates the share of country's export that is part of multi-stage trade process. The higher the value of index the higher is the country's participation in GVC.

The measure of GVC participation can be used together with the GVC position index. That allows indication of location (vertical specialization) of the country in the production chain.

$$GVC_{position} = \log\left(1 + \frac{IV}{Export_{gross}}\right) - \log\left(1 + \frac{FVA}{Export_{gross}}\right) \quad (3)$$

The positive value (IV is higher than FVA) means the country lies upstream in the GVC. The negative (IV is smaller than FVA) value signals the country lies downstream in the GVC. The country that exports raw materials or intermediate products lies upstream in the GVC; the country that uses a large portion of imported intermediate products to produce final goods for export lies downstream in the GVC.

3 Research results

The trade openness index was used to measure the importance of international trade in the food sector in the Czech Republic. It can give an indication of the degree to which the sector is open to international trade and it reports upon the level or grade of the internationalization of the sector. Table 1 presents levels and changes in the production, export, import and openness of the food processing industry in the Czech Republic. In the period between 1995 and 2018, the value of production increased 2.08 times; exports increased 4.92 times and imports increased 5.98 times. The increase in the values of the production and especially of exports and imports occurred after the Czech Republic joined the European Union in the 2004. The new Czech Republic food industry in the liberal environment of the Common market of the European union stimulated the trade exchange with other EU countries. Also, the inflow of foreign direct investments stimulated the sectoral integration into the structures of multinational companies. As a result of these changes, it can be seen that the openness of the Czech Republic' food industry increased from 25.4 % in 2003 to 68.7 % in 2018.

Table 1 The values of production, export, import and sectoral openness for the Czech Republic' food industry; selected years

	units	1995	2000	2003	2005	2010	2015	2018
Production	US Dollar, Millions	8,165.3	7,401.6	10,774.3	13,528.2	16,646.6	13,928.9	16,996.9
Export	US Dollar, Millions	1,135.9	931.6	1,302.9	2,530.0	4,235.3	4,926.5	5,584.5
Import	US Dollar, Millions	1,017.8	940.5	1,433.4	2,489.4	4,484.9	5,246.1	6,085.5
Openness	(EX + IM)/ PROD. (%)	26.4	25.3	25.4	37.1	52.4	73.0	68.7

Source: own calculations, data from TiVA

The first indication of a sectoral/country integrating into the global value chain is increasing proportion of trade with intermediate products. Increased internationalization and fragmentation of production might imply that an economy which uses potential comparative advantages, due to sourcing from other countries, is having a comparative advantage in other stages of production or producing intermediate goods more cheaply than what domestically they might gain in competitiveness in other sectors, leading to better growth performance in terms of output or value added (Cieslik et al., 2016).

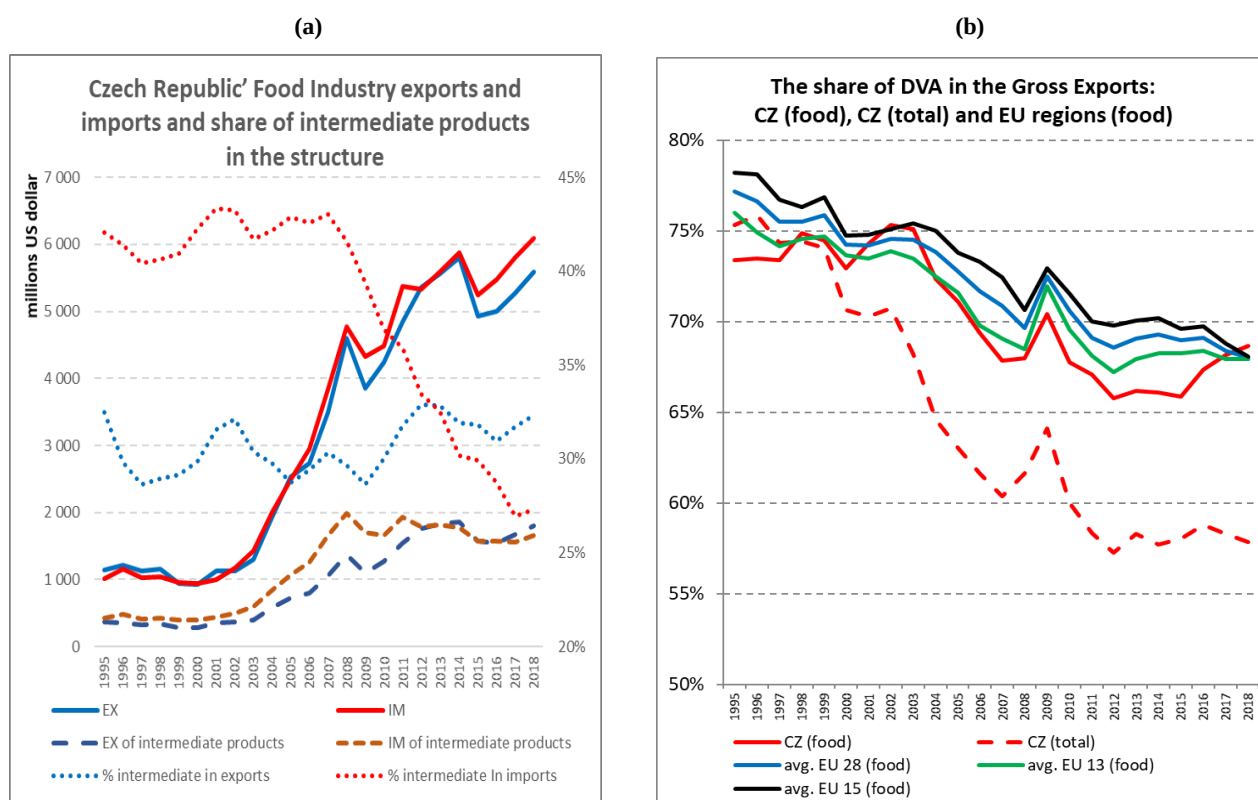
Figure 1 (a) shows the Czech Republic' food industry exports and imports in total and particularly with intermediates. It also shows the share of intermediate products in the structure of the food trade. The change in food exports and imports can be linked to the role of the accession of the Czech Republic into the European Union in 2004. Both food exports and imports increased intensely as well as the exports and imports of intermediate food products. However, imports of food

intermediate products reached its maximum in 2008 (in absolute terms) and exports of food intermediate products reached its maximum in 2014. Since then both trade flows remain on the same level.

When comparing food exports and imports, the share of intermediate products in the structure of food exports and imports differ. The share of intermediate food products in the total value of food exports fluctuated around 30 % and started slightly increasing at the end of the period under review. The rest of the food exports are the finalized products. The share of intermediate food products in the total value of food imports was fluctuating and slightly increasing around 40 % of the total value of food imports. But since the end of the Great recession in 2008, the share of intermediate products in the total value of food imports started to decrease and was around 27 % in 2018. This suggest that the proportion of finalized products in the structure of food imports increased in the last decade. Also, this indicates an opposite process to the more intense integration into the global food value chains.

Another indication of a sector/country integrating into the global value chain is the decreasing share of domestic value added in its gross exports, indicating a larger proportion of foreign value added in gross export and stronger linkages within global value chains (Cieřlik, 2017). Figure 1 (b) presents the levels and changes in the share of domestic value added in the gross export of the Czech Republic' food industry. Also, it is compared to the share of domestic value added in the gross export at the national level (all sectors; CZ total) and to average levels and changes in the share of domestic value added in the gross export of the food industries in the EU28 (average of EU countries), EU15 (old member states) and EU13 (new member states).

Figure 1 a and b The share of Domestic Value Added in the Gross Export (1995-2018)



Source: own calculations, data from TiVA (<http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm>).

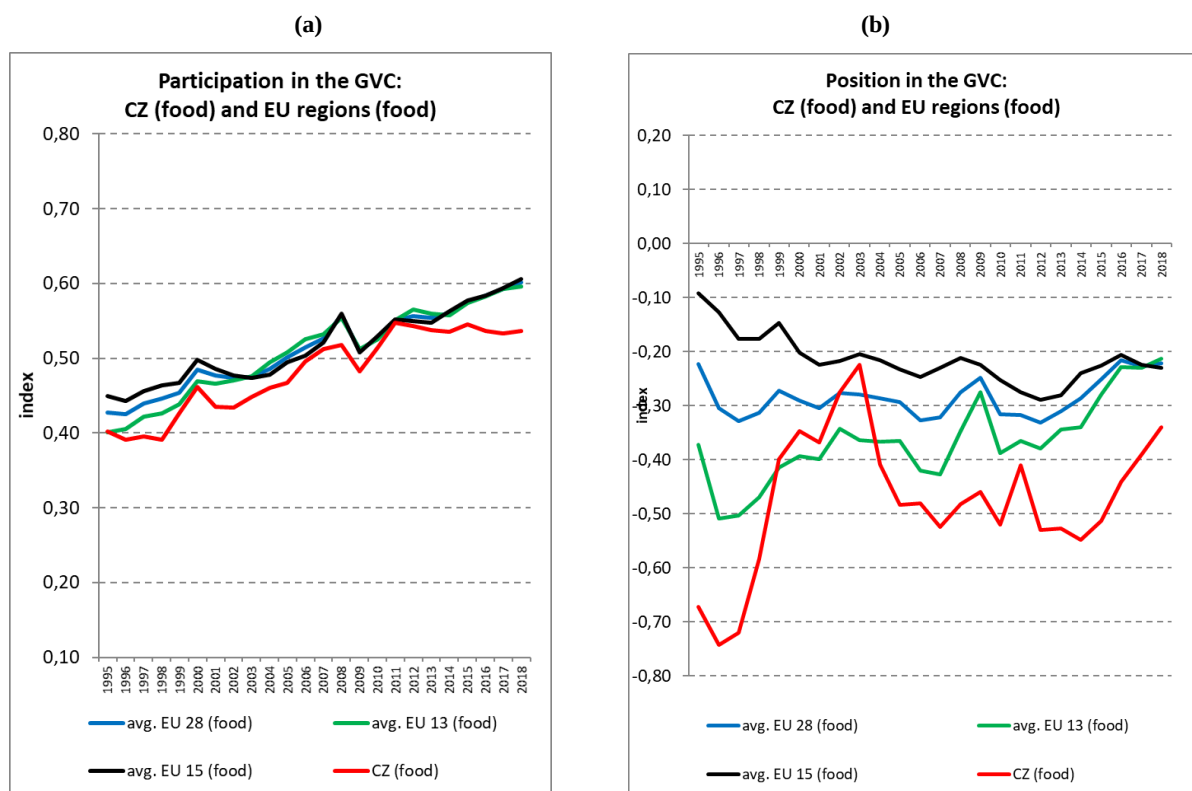
The figure 1 (b) shows that the share of domestic value added in the gross export of the Czech Republic' food industry is higher when compared to the Czech economy as a whole. This indicates lower intensity of integration of the Czech Republic' food industry in the global value chains comparing to the rest of the Czech economy. On the other hand, the level of integration is slightly higher when compared to the average for food processing industries in the EU28, EU15 and EU13 regions, but it general, it follows the pattern of EU regions. The share of domestic value added in the gross export of the Czech Republic' food industry was volatile through the period under review, but has slightly increased from 73.4% in 1995 to 75.1% in 2004. It indicates opposite process to integration into the global value chains as the sector used rather more of the domestic value instead of the foreign one. But after the 2004, the share of domestic value started to decrease rapidly till the end to the Great Recession. In the last decade, the share of domestic value added in the gross export of the Czech Republic' food industry started to stagnate around the value 67.0% and then started to increase again at the end of the period. This suggests that membership of the Czech Republic in the European union led to the

significantly higher integration into the global value chains. On the other hand, this process has stopped recently and reversed.

Besides the trade openness, the share of intermediates in the exports and imports and the share of DVA in the gross agrarian export already provides information about the level and change in integration into the GVC, the indicators of participation and position in GVC allow assessing the form of integration in more detail (Fig. 2).

Figure 2 (a) shows that between 1995 and 2018 the intensity of participation of food industries of the EU member states in the global food value chains have increased in the case of EU28 (on average), as well as in the case of old EU member states (EU15) and the new member states (EU13). Also, at the beginning on the period under review it is visible that the intensity of participation was slightly higher in the old member states when compared to the new member states. The level of participation of the Czech Republic's food industry is slightly lower when compared to the average levels of EU28, EU15 and EU13 through the period and in the post-crisis period of economic recovery, it seems that in the case of the Czech Republic's food industry the intensity of participation remains at the same level, contrary to the intensity of participation of EU regions that are increasing its participation also in the post-crisis period.

Figure 2 Participation and position of the Czech Republic's food industry



Source: own calculations, data from TiVA (<http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm>)

Figure 2 (b) shows that the relative position of the Czech Republic's food industry, as well as the positions (on average) of food industries in EU28, EU15 and EU13 countries in the global value chains are downstream. There is also different dynamic when comparing the tendencies between the old (EU15) and new (EU13) member states. The old member states were in a weaker downstream position in 1995, but are now moving more downstream. Contrary, the new member states were in strong downstream position in 1995, but moving upstream direction. During the period under inquiry the Czech Republic's food industry changed its tendency in relative positioning in the global value chains more than once. The Czech Republic's food industry started in downstream position (in even stronger downstream position than other new member states) in 1995 but was moving to more upstream position very quickly in the pre-accession period till 2003. Then the tendency changed and between 2003 and 2014 the Czech Republic's food industry started to position itself more downstream. After 2014 the tendency has changed again and the direction was more in upstream direction again. In other words, the relative position of the Czech Republic's food industry still takes a form of rather importing a large portion of intermediate products to produce final goods but it is reaching more towards the model of rather exporting of intermediate products that are finalized and exported by other countries in the global value chain.

4 Conclusions

This study aims to investigate the effects of fragmentation of production on the food processing industry in the Czech Republic between 1995 and 2018 using data from Trade in Value Added data-base. The battery of methods is used to evaluate the intensity and the form of integration of the food processing industry in the Czech Republic into the global value chains.

Results suggest that the degree to which the food processing industry in the Czech Republic is open to international trade has increased significantly during the period from 1995 and 2018 as well as the grade of the internationalization of the sector. Also, Czech Republic' food industry exports and imports (as well as the share in the structure of food export s and imports) with intermediate products increased, especially when the Czech Republic became the member state of the European union. The increasing proportion of trade with intermediate products is an indication of a sectoral integrating into the global value chain driven by increased internationalization and fragmentation of production. This conclusion is also supported by the decrease of domestic value added in the structure of gross food exports and is supported also by the change in scores of the index of participation. However, in the last decade the process of integration of the food industry in the Czech Republic into the global agri-food value chains has slowed down resp. reverse (slight decrease in openness, decrease in the share of imported intermediate products, stagnation of the share of domestic value add in the gross food exports, stagnation in the participation). The results also suggest that the relative position of the food processing industry in the Czech Republic in the global value chains is downstream, but changing towards upstream position (rather exporting of intermediate products that are finalized and exported by other countries in the global value chain). The findings in this study can help inform industrial, agriculture and trade policy makers when assessing the nature of liberalization and structural transformation of agribusiness sectors in the Czech Republic as well as when assessing the potential benefits and risks of such an integration.

The study shows that import of finalized food products is increasing. On the contrary, the share of intermediate products in the structure of food exports is increasing and the share of finalized food products is decreasing. The intermediate products made in the Czech Republic are being finalized in other countries. This has of course implication on value added and job creation in the Czech food industry. Such a state and tendency is also in contrast with goals set in the *Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030* (MZE, 2016). One of the goals in this strategy is to (goal C1) increasing export performance, especially of products with higher added value and searching for new markets outside the EU.

There are a few other next steps for this research. First, the historical interpretations of the changing integration of the food processing industry in the Czech Republic in the GVC relative to our findings lead to additional questions to inquiry. For example, according to the expectation, the change and the tendency of the share of DVA in gross exports should match the changes and opposite tendency in the shares of intermediate products in the structures of food exports and imports. But in the case of the food processing industry in the Czech Republic, the match is only partial. Further, there is also space for further research in this area to identify underlying factors influencing the participation and position and to assess the effects of participation and position in the GVC on structural transformation on the food processing industry in the Czech Republic.

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References

- Bečvářová, V., Vinohradský, K., & Zdráhal, I. (2009). *Czech Agriculture and Development of Price Environment in the EU Common Market*. Brno: MZLU Brno, Folia II (11),
- Blažková, I., & Dvouletý, O. (2019). Investigating the differences in entrepreneurial success through the firm-specific factors: Microeconomic evidence from the Czech food industry. *Journal of Entrepreneurship in Emerging Economies*, 11(2), 154-176.
- Borin, A., & Mancini, M. (2019). *Measuring what matters in global value chains and value-added trade*. Policy Research Working Paper;No. 8804. World Bank, Washington, DC. © World Bank.
- Cieslik, E., Bieganska, J., & Środa-Murawska, S. (2016). The Intensification of Foreign Trade in Post-Socialist Countries and Their Role in Global Value Chains, *Acta Oeconomica* 66(3):465-487, DOI: 10.1556/032.2016.66.3.5
- Cieslik, E. (2017). Central and Eastern European states in global production linkages: country-level and sector-level analysis, *Przegląd Europejski*, 2(44), DOI: 10.1080/13504851.2019.1606406
- Czech Statistical Office (2021). Statistical Yearbook of the Czech Republic – 2021. Available at: <https://www.czso.cz/csu/czso/15-industry-n5dg5um65z> (accessed 10 January, 2022).
- De Backer, K., & Miroudot, S. (2014). *Mapping Global Value Chains*. ECB Working Paper No. 1677.

- Fernandes, A. M., Kee, H. L., & Winkler, D. E. (2020). Determinants of Global Value Chain Participation: Cross-Country Evidence. *World Bank Policy Research Working Paper*, (9197).
- Galizzi, G., & Venturini, L. (Eds.). (2012). *Vertical relationships and coordination in the food system*. Springer Science & Business Media.
- Gereffi, G. (2014). Global value chains in a post-Washington Consensus world. *Review of International Political Economy*, 21(1), 9–37.
- Giovannetti, G., & Marvasi, E. (2016). Food exporters in global value chains: Evidence from Italy. *Food Policy*, 59, 110–125.
- Homolka, J. (1995). Problematika potravinářského průmyslu a jeho vztah k zemědělské výrobě. Česká zemědělská univerzita v Praze, Praha. Available at: www.agris.cz/Content/files/main_files/61/139510/Homolka.pdf (accessed 5 March 2020).
- Mezera, J., & Dvořák, J. (1995). *Strukturální změny a tendence v potravinářském sektoru*. VÚZE, Praha.
- Johnson, R., C., & Noguera, G. (2012). Proximity and production fragmentation, *American Economic Review*, 102(3): 407–11. DOI: 10.1257/aer.102.3.407
- Kopačka, L. (2004). Convergence and divergence trends in Czech economy before and after the geopolitical break in 1989. *European Spatial Research and Policy*, 11(1), 31–60.
- Koopman, R., Wang, Z., & Wei, S. (2014). Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*, 104(2): 459–94. DOI: 10.1257/aer.104.2.459
- Lim, S. (2021). Global Agricultural Value Chains and Structural Transformation. *the National Bureau of Economic Research (NBER) Working Paper Series* (2021). DOI: 10.3386/w29194
- Martins Guilhoto, J., Webb, C., & Yamano, N. (2022). *Guide to OECD TiVA Indicators, 2021 edition*, OECD Science, Technology and Industry Working Papers, No. 2022/02, OECD Publishing, Paris, DOI: 10.1787/58aa22b1-en.
- Ministry of Agriculture of the Czech Republic (1998). *Zelená zpráva 1997*. Available at: <http://eagri.cz/public/web/mze/ministerstvo-zemedelstvi/vyrocní-a-hodnotící-zpravy/zpravy-o-stavuzemedelstvi/zelena-zprava-1997.html> (accessed 1 March 2021).
- Ministry of Agriculture of the Czech Republic (2016). Strategie resortu Ministerstva zemědělství České republiky s výhledem do roku 2030. Available at: https://eagri.cz/public/web/file/538509/Strategie_MZe_final_s_grafikou.pdf (accessed 15 September 2022).
- Montalbano, P., & Nenci, S. (2022). Does global value chain participation and positioning in the agriculture and food sectors affect economic performance? A global assessment. *Food Policy*, 108, 102235.
- Reddy, K., Chundakkadan, R., & Sasidharan, S. (2021). Firm innovation and global value chain participation. *Small Business Economics*, 57(4), 1995–2015.
- Sexton, R.J. (2013). Market power, misconceptions, and modern agricultural markets. *American Journal of Agricultural Economics*, 95(2), 209–219.
- TiVA (2022). Trade in Value Added, [Online]. Available at: <https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm> [Accessed: 2022, August 20].
- Židek, L. (2006). *Transformace české ekonomiky 1989–2004*. C. H. Beck,

Mathematical – Statistical Modelling and Optimisation in Practice

Efficiency of public transportation in the Czech Republic during the start of the crisis of 2020 studied by the DEA methods

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Abstract: Public transport companies play a key and irreplaceable role in the field of transport services for cities and urban agglomerations. The operation of transport companies is a highly demanding economic activity that is directly related to the strategy chosen by city representatives. The concern is primarily so-called subsidies for the operation of individual companies, that is, demonstrable loss always covered from the budget of municipalities. In a narrower economic context, however, a transport company is an economic entity that uses production factors (inputs) to generate outputs (typically transported persons, here). The efficient use of resources and the efficient functioning of companies is undoubtedly the goal of all cities. In the presented contribution, we make use of quantitative data envelopment analysis to verify relative economic efficiency of 12 Czech public transport companies in two particular years, 2019 and 2020, with the aim of demonstrating their ability to deal with the arrival of the crisis period of the covid-19 pandemic.

Keywords: efficiency, public transportation, data envelopment analysis

JEL Classification: C02, C52, C61, R40

1 Introduction

The main goal of our contribution is to measure and evaluate the efficiency of subjects by the methods of data envelopment analysis. The subjects in question are public transportation companies of 12 chosen cities in the Czech Republic; the choice was made with respect to the size and the situation of both the agglomeration and the company. We exclude companies incomparable by size and also the ones reforming their organization. We focus our attention on the years 2019 and 2020, as the timeline corresponds to the last pre-pandemic season and the first season under heavy pressure both by the pandemic and the restrictions implemented to slow it down. The selected aspects of the companies are classified into inputs and outputs. The inputs in our model are production consumption, depreciation, and personnel cost; the outputs are the sales and the number of transported people. The production-consumption is a sum of costs of material, energy and other supply with any supply from subcontractors, including products and services. Depreciation describes the change in prices of both intangible assets and tangible assets. This change of price means the systematic allocation of a percentage of the price of the asset during the whole time of its usage, not necessarily physical and moral amortization. Note that four of the parameters have a strictly financial nature but the fifth, the number of transported people, is of a different type, as meaningful efficiency analysis of the public transportation company should include some measurement of services provided and one should not focus on profit only. There are several different ways how to measure the scale of public services provided by the company, such as the area covered by transport means, the number of transport lines or the number of rides of the public transport vehicle, etc. However, the model requires limiting the number of outputs and using only the most significant ones. This last parameter, the number of passengers and demand for services in general, is obviously the one being reduced during the past two years in every city in the Czech Republic for several different reasons, such as safety reasons, increased usage of home office regime, closure of many services etc. At first sight, it seems in vain to study efficiency during a turbulent time pandemic, but our view is quite opposite: it is even more crucial to study the adaptability and efficiency of companies during the season of crisis as it reveals possibilities for improvements and tests the state of affairs. Before we test the companies, we could assume that the scale of damage

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caused by the pandemic may vary a lot, especially as the restrictions and crisis had different influences on different fields, for example, tourism was stopped almost totally, but construction works, heavy industry or agriculture were still going on in some slightly reduced forms. The convolution and synergy of econometric methods and economic aspects may provide insight both on theoretical and practical levels. The immediate practical outcome of the article is the revelation of the subjects coping with the crisis in a successful way, as their methods should inspire the less successful ones. The methods of efficient companies may be copied and implemented to help mitigate the effects of a similar crisis. Another outcome is complex usage and the evaluation of data itself. The data are obtained from annual reports and accounting evidence of companies. Authors have to point out discomfort in the diversity of reports that complicates collecting the data in a comparable manner. Our first recommendation is the unification of the forms of annual reports and accounting documentaries in order. This step may be beneficial not only from the academic point of view also but also for straightforward comparison of states of similar companies.

Historically, many authors from all over the world have devoted themselves to the research of the efficiency of transport companies, and the methods used correspond the state of scientific knowledge of their time. Around the 1970s, one can observe the first cases with well-founded capture of the efficiency of transport companies in selected cities (e.g., Merewitz, 1977, etc.), which were followed in the 1990s by deeper analyses of the efficiency of transport companies (e.g., Fazioli, Filippini, & Prioni, 1993; Kersten, 1996 et al.). To evaluate the efficiency of transport companies, multi-criteria decision-making methods were used first of all (e.g., Yeh, Deng, & Chang, 2000, etc.), but methods using *data envelopment analysis* (DEA) and its variants applied with regard to the nature of the region followed (e.g., Boame, 2004; Barros & Peypoch, 2010; Von Hirschhausen, & Cullmann, 2010; Hahn, Kim, Kim, & Lee, 2013; Ayadi & Hammami, 2015; Balboa la Chica, Mesa Mendoza, Suárez Falcón, & Pérez Castellano, 2016 et al.). The DEA methods are already capable of including more factors affecting the overall efficiency of production units. The Malmquist index is often used (Klieštk, 2009) if the time parameter is in question. In the Czech environment, e.g., Matulová and Fitzová (2016) recently reported on the efficiency of urban transport companies. Although e.g. Vavrek and Bečica (2020) return to the multi-criteria decision-making method, it follows from the research of recent years (e.g., Alfiero, Cane, Doronzo, & Esposito, 2018; Karim & Fouad, 2019 etc.) that DEA methods with their variants provide, when used correctly, a sufficiently accurate tool for evaluating the efficiency of transport companies. The obtained results enable the formulation of innovative recommendations, the main goal of which is to optimize the activities of business entities in the field of urban public transport.

Of course, the input/output variable selection vary across different studies. For example, the most frequently used inputs are the capital, labor, energy, material and services (e.g. Von Hirschhausen & Cullmann, 2010; Ayadi & Hammami, 2015). Other particular input variables are the total number of vehicles (e.g. Kerstens, 1996; Karim & Fouad, 2019 etc.), production consumption, depreciation, the number of employees (or number of bus drivers, e.g. Klieštk, 2009; Kerstens, 1996; Barros & Peypoch, 2010, Balboa et al., 2016, etc.), personnel costs (e.g. Balboa et al., 2016, etc.), the number of liters of fuel consumed (e.g. Kerstens, 1996; Barros & Peypoch, 2010, etc.), credit load (e.g. Klieštk, 2009 etc.), the length of the network (e.g. Karim & Fouad, 2019 etc.), the total number of seats, effective driving hours, seat kilometres per 1000 km (e.g. Klieštk, 2009; Von Hirschhausen & Cullmann, 2010 etc.), equipment (oil and tires), average age of the vehicle park, transportation working hours, maintenance working hours, insurance costs, vehicle capacity (e.g. Barros & Peypoch, 2010) etc. The most common outputs are mostly net sales, the number of passengers transported (e.g. Klieštk, 2009; Barros & Peypoch, 2010; Balboa et al., 2016, etc.) or the number of vehicle kilometres and the number of seat kilometres (e.g. Kerstens, 1996; Klieštk, 2009, etc.). Our actual selection of inputs/outputs specified at the beginning may be considered as more general, considering for example total company consumption as an input instead of its particular components.

2 Methods of data envelopment analysis

2.1 Idea of data envelopment analysis

Data envelopment analysis (DEA) is a bundle of methods devoted to comparing the efficiency among a group of units, it means object measured by a set of inputs and outputs. By comparison to other units, we can decide if the unit is efficient, which means no better result can be achieved based on data of the group in some sense, or if the unit is not efficient, it means that similar but better results can be achieved as a combination of inputs and/or outputs of other considered units. Several extensions (such as the Malmquist index and its derivatives) may be used to the basic models in order to incorporate the time aspect into consideration. This may help us to identify the development of the unit and also the changes in the field of study, give for example technical progress or changes in the law or regulations by the government.

Even though the method is well established, we briefly describe the basic concept and aspects we consider. As we use the method in its most established form, we assume that input is something we intend to minimize and output is something we intend to maximize, also we assume that all data have non-negative values. The efficiency is calculated as the weighted

sum of inputs divided by the weighted sum of outputs, conditioned by the requirement that the efficiency for any unit cannot exceed one, using the same weights for each unit considered. Indeed, consider an input vector $\mathbf{x}_0$ and an output vector $\mathbf{y}_0$ of an examined unit, with associated nonnegative weights $\mathbf{w}_x$ and $\mathbf{w}_y$ (whose optimal setting has to be found), and vectors $\mathbf{x}_k, \mathbf{y}_k, k = 1, \dots, K$ of inputs and outputs of all K units in question, then our aim is to find

$$\max \theta_0 := \frac{\mathbf{w}_y^T \mathbf{y}_0}{\mathbf{w}_x^T \mathbf{x}_0} \text{ subject to } \frac{\mathbf{w}_y^T \mathbf{y}_k}{\mathbf{w}_x^T \mathbf{x}_k} \leq 1, \quad k = 1, \dots, K, \quad \mathbf{w}_x, \mathbf{w}_y \geq \mathbf{0}. \quad (1)$$

The method may be interpreted as multicriteria decision-making, but the main difference is, that DEA does not use the fixed weights to represent the importance of particular inputs and outputs, but the weights are set by optimization to get the maximal possible efficiency result. It means we search for the non-negative weights of the inputs and outputs such that the efficiency of all units would be smaller or equal to 1 and the efficiency of the studied unit would be maximal. If there is a set of weights such that the efficiency would be 1, we call the unit efficient.

2.2 Data choice and size

To perform DEA, we need a set of units and their inputs and outputs. All the units need to have the same type of data and if we consider time, the data must be available in all time values. The type of inputs and outputs should satisfy several conditions. First of all, the data have to be chosen based on importance, not based on availability. Second, the data should not be duplicated. It means we should not use two different values that have a big correlation, for example, if we consider restaurants, we should not use both the number of customers and the number of cooked meals, as most of the customers eat one meal and these two numbers have a significant correlation. Third, we need to have multiple times more units than data of inputs and outputs. If there are a lot of outputs and inputs and only a few units, most of the units are likely to appear to be efficient. The ratio between the number of units and the number of inputs and outputs combined is 2.4 in our study, which is almost a border case and if it decreased, the method should not be suitable. Nevertheless, the lowest possible threshold ratio varies in the literature (see e.g. Klieštík, 2009).

As stated in the introduction, we have selected three inputs (production consumption, depreciation, personnel cost) and two outputs (sales, number of transported people) to characterize each transport company. We provide some summary statistics of our set of inputs and outputs in Table 1.

Table 1 Summary statistics for input and output data

statistic	year	consumption	depreciation	personnel costs	sales	passengers
minimum	2019	35,001	12,578	95,596	59,360	15,719
	2020	34,586	12,623	97,834	46,683	13,294
mean	2019	171,785	93,700	300,349	198,322	48,303
	2020	155,408	97,509	312,099	156,957	41,277
standard deviation	2019	138,810	92,384	263,996	142,245	33,402
	2020	134,214	102,855	279,539	122,428	31,187
maximum	2019	554,515	315,165	1,035,924	543,938	124,977
	2020	543,434	348,162	1,092,492	470,778	119,524

Source: Own processing based on the collected data from annual reports of selected transport companies

2.3 The setting of the DEA models

There are several aspects of the DEA model, that may be derived from the basic idea represented by the optimization problem (1). First of all, this is the problem of so-called fractional programming which may be transformed (with an additional technical constraint addressing the ambiguity of solutions) to a standard linear optimization problem to find

$$\max \theta_0 := \mathbf{w}_y^T \mathbf{y}_0 \text{ subject to } -\mathbf{w}_x^T \mathbf{x}_k + \mathbf{w}_y^T \mathbf{y}_k \leq 0, \quad k = 1, \dots, K, \quad \mathbf{w}_x^T \mathbf{x}_0 = 1, \quad \mathbf{w}_x, \mathbf{w}_y \geq \mathbf{0}. \quad (2)$$

Equation (2) is known as the *multiplier form* of an *input-oriented model* under *constant returns-to-scale* (Charnes, Cooper & Rhodes, 1978). Its dual, the *envelopment form* of the optimization model

$$\min \theta_0 \text{ subject to } \mathbf{X}\boldsymbol{\lambda} \leq \theta_0 \mathbf{x}_0, \mathbf{Y}\boldsymbol{\lambda} \geq \mathbf{y}_0, \boldsymbol{\lambda} \geq \mathbf{0}, \theta_0 \text{ unconstrained}, \quad (3)$$

emphasizes the possible modifications of the basic idea, in particular the focus on decreasing the inputs instead of incrementing the outputs (the output-oriented models), and the possibility to implement additional types of returns to

scale conditions. Here, $\mathbf{X}$ and $\mathbf{Y}$ are matrices having as columns the input and output vectors, respectively, of the units considered. The decision vector λ provides, for a non-efficient unit, its reference inputs as the composition of the inputs of the other (efficient) units. The variable θ_0 is another decision variable here, and its position determines the orientation of the model; shifting it to $\mathbf{Y}$, y_0 -constraint and maximizing it instead of minimization, the resulting model is called *output-oriented*, with the aim to find a way to increase outputs instead of decreasing inputs of the examined unit. The constraint $\lambda \geq 0$ represents the constant returns-to-scale condition, that is, the outputs for an efficient unit are purely proportional to its inputs. *Variable returns-to-scale* may be imposed by adding the constraint $\sum_k \lambda_k = 1$ apart from the nonnegativity constraint on λ (Banker, Charnes & Cooper, 1984). The resulting production possibility set (the allowed combinations for the input and outputs of the units considered, or, equivalently, the feasible set of the optimization problem (3)) is then formed as convex envelopment (combination) of the input-output pairs of the unit considered. For example, the *output-oriented model in envelopment form under variable returns-to-scale* reads as to find

$$\max \theta_0 \quad \text{subject to } \mathbf{X}\lambda \leq \mathbf{x}_0, \mathbf{Y}\lambda \geq \theta_0 \mathbf{y}_0, \sum_k \lambda_k = 1, \lambda \geq 0, \theta_0 \text{ unconstrained.} \quad (4)$$

Other convenient extensions and modification of these basic methods may be used; we refer the reader to the monographs Cooper, Seiford & Tone (2007) and Cooper, Seiford, Zhu (2011), in particular. Nevertheless, we will not leverage these extensions in our actual contribution.

3 Research results

In our research, we make use of three DEA models: an input-oriented model under constant returns-to-scale (CRS-I), and both input and output-oriented models under variable returns-to-scale (VRS-I and VRS-O). The output-oriented version of the CRS model is not considered as the efficiency scores are the same as for the input-oriented model. The production possibility set is a linear or convex envelope, respectively, of input-output pairs of 12 Czech public transport companies, individually in two years 2019 and 2020. Each year is considered separately, that is, we have 72 DEA optimization problems in total. Solving them, we finally obtain six lists of efficiency scores summarized in Table 2.

Table 2 Technical efficiencies of public transport companies for individual years, rounded to two decimal places

model	CRS-I		VRS-I		VRS-O	
city	2019	2020	2019	2020	2019	2020
České Budějovice	1	1	1	1	1	1
Hradec Králové	0.83	0.74	0.90	0.74	0.93	0.81
Jihlava	1	1	1	1	1	1
Karlovy Vary	1	1	1	1	1	1
Liberec–Jablonec n/N.	0.82	0.65	0.82	0.66	0.82	0.72
Most–Litvínov	0.85	0.76	0.87	0.76	0.88	0.78
Olomouc	0.99	0.93	1	1	1	1
Ostrava	1	1	1	1	1	1
Pardubice	1	1	1	1	1	1
Plzeň	0.98	0.94	1	1	1	1
Ústí nad Labem	0.66	0.57	0.66	0.60	0.68	0.59
Zlín–Otrokovice	1	1	1	1	1	1

Source: Own processing

Firstly, we notice that companies being technically efficient in 2019 have remained efficient also in 2020 regardless of the model. Secondly, the technical efficiencies of non-efficient companies are generally worse in 2020 than in 2019 – it means that the differences between efficient and non-efficient companies have been made more evident in covid-year 2020. Note, in this context, that the results are relative, the production possibility sets for 2019 and 2020 do not interfere here – we do not compare 2020 company inputs and outputs against 2019 ones in models presented in Table 2.

To emphasize previous claims, we add another list of DEA models in which the production possibility set is composed of data from both the 2019 and 2020 years together, in which we may better analyse the impact of covid conditions on the technical efficiencies of public transport companies. The results are provided in Table 3. The results confirm our previous claim that the efficiencies are generally worse for the year 2020: all companies holding technical efficiencies in

the year 2019 lose it when passing to the year 2020. The only exception is the public transport company of Jihlava, which retains the technical efficiency even for the year 2020 in less restrictive models with variable returns to scale. In all models, the worse results are assigned to the public transport company of Ústí nad Labem, with a significant distance from other companies. On the opposite side, we find several efficient companies: apart already mentioned Jihlava we note the public transport companies of České Budějovice, Zlín-Otrokovice, Ostrava, Karlovy Vary, and Pardubice, all having technical efficiencies equal to 1 (in individual models with separated years), and sorted with respect to the efficiencies gained in 2020 in models with merged years. These are followed by the public transport companies of Olomouc and Plzeň, being technically efficient in less restrictive models with variable returns-to-scale.

To make an insight into the inefficiency of some units, we take the transport company of Ústí nad Labem, having the worst efficiency scores, as an example. In Table 4, we provide actual and reference (peer) inputs of this unit in four input-oriented model calculated using optimal λ in models (3) and (4). The reference units are České Budějovice and Zlín-Otrokovice (in CRS-I model), eventually extended with some other companies (e.g. Plzeň in VRS-I for 2019 and for merged years, or Jihlava in VRS-I for 2020).

Table 3 Technical efficiencies of public transport companies for years 2019 and 2020 merged, rounded to two decimal places

City	Year	CRS-I	VRS-I	VRS-O
České Budějovice	2019	1	1	1
	2020	0.98	0.99	0.99
Hradec Králové	2019	0.83	0.90	0.93
	2020	0.64	0.64	0.71
Jihlava	2019	1	1	1
	2020	0.84	1	1
Karlovy Vary	2019	1	1	1
	2020	0.80	0.88	0.80
Liberec–Jablonec n/N.	2019	0.82	0.82	0.83
	2020	0.60	0.60	0.65
Most–Litvínov	2019	0.85	0.87	0.88
	2020	0.69	0.69	0.71
Olomouc	2019	0.99	1	1
	2020	0.82	0.82	0.87
Ostrava	2019	1	1	1
	2020	0.87	0.88	0.87
Pardubice	2019	1	1	1
	2020	0.71	0.72	0.74
Plzeň	2019	0.98	1	1
	2020	0.82	0.94	0.96
Ústí nad Labem	2019	0.66	0.66	0.68
	2020	0.50	0.53	0.51
Zlín–Otrokovice	2019	1	1	1
	2020	0.94	0.95	0.94

Source: Own processing

Table 4 Reference inputs in input-oriented models for transport company of Ústí nad Labem

	year	actual input	reference CRS-I	reference VRS-I	reference CRS-I merged	reference VRS-I merged
consumption	2019	282,839	85,169	93,292	85,169	93,292
	2020	243,028	79,985	80,387	71,434	72,949
depreciation	2019	105,305	51,652	53,889	51,652	53,889
	2020	104,296	46,775	45,489	43,156	44,317
personnel costs	2019	250,893	165,084	166,533	165,084	166,533
	2020	269,310	154,670	161,588	134,339	143,288

Source: Own processing

To complement this investigation for Ústí nad Labem, it is also of interest that, in multiplier forms of all these DEA models, the optimal weights are nonzero only for the third input (personnel costs). It implies, firstly, that there are nonzero slacks (that is, so-called mix-inefficiencies) for production consumption and depreciation, and, secondly, the efficiency score for this company can be improved at the primal stage by decreasing its personnel costs. This is not the case for output weights: they are both nonzero (in all models) so that it is worth to increase both outputs radially (in the same ratio) to increase the efficiency score in output-oriented models. We can of course make similar investigation for the remaining units in the analysis; we do not provide these results due to limited space reserved for this contribution.

4 Discussion and conclusions

The results of the study primarily show that companies that were efficient in 2019 remained efficient in 2020, regardless of the model used. In 2020, the efficiency of transport companies, in general, deteriorated due to the covid pandemic, especially those that were already inefficient in 2019. The observed results indicate similar tendencies to the ones described in the cited publications. It is very surprising to us, that one unit achieved efficiency in several models using both data from 2019 and 2020 combined. Another surprising factor is, that despite regions being different by many factors, the influence of the crisis seems to hit all the inefficient companies on a comparable scale, even though we may expect significant varying based on urban specifics such as major industries and demographics. It seems that the influence of efficiency problems during a pandemic can be caused more by inefficiency before the crisis than by the crisis itself. Tough all results must be considered relative, they are nevertheless a good source for decision-making in the management of transport companies.

We can easily sum up the general necessity to analyze and do research about companies related to transportation. There are a couple of reasons. First, transportation and its performance are considered the key indicator connected with economic cycles. Second, transportation generates a huge part of social costs, and the aim of researchers should be to help reduce them. Especially in urban areas, effective operation of public transportation is very important. Questions necessary to answer are mainly frequency of bus connections, new investments into buses, scarcity of drivers, decreasing number of passengers and others. The mentioned financial or physical indicators are used in the model. Overall results can be very useful for the management of the companies for their decisions about future steps. Obviously, the biggest issue recently is increasing the prices of energy. With a little bit of hyperbole, we can assume that efficiency will not be the number one problem in companies. As we studied in the case of the past troublesome situations caused by the pandemic, similar questions about coping with inflation and especially energetic crisis should be asked and studied. We can not assume the outcome a priori, as many more factors would contribute. For example, previous investment in modernization and lowering consumption of vehicles or isolation of the buildings may provide huge benefits, which were kind of hidden and not measured enough in the models of us or the models of articles we studied.

References

- Ayadi, A., & Hammami, S. (2015). Analysis of the technological features of regional public transport companies: the Tunisian case. *Public Transport*, 7(3), 429–455.
- Balboa La Chica, P. M., Mesa Mendoza, M., Suárez Falcón, H., & Pérez Castellano, M. D. P. (2016). A regional analysis of technical efficiency of urban transportation companies in Spain. *Investigaciones Regionales*, 35, 129–148.
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078–1092.
- Barros, C. P., & PeyPOCH, N. (2010). Productivity changes in Portuguese bus companies. *Transport Policy*, 17(5), 295–302.

- Boame, A. K. (2004). The technical efficiency of Canadian urban transit systems. *Transportation Research Part E: Logistics and Transportation Review*, 40(5), 401–416.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444.
- Cooper, W. W., Seiford, L. M. & Tone, K. (2007). *Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software*, 2nd ed. New York: Springer.
- Cooper, W. W., Seiford, L. M. & Zhu, J. (2011). *Handbook on Data Envelopment Analysis*, 2nd ed. International Series in Operations Research & Management Science, vol. 164. New York: Springer.
- Fazioli, R., Filippini, M., & Prioni, P. (1993). Cost-structure and efficiency of local public transport: The case of Emilia Romagna bus companies. *International Journal of Transport Economics / Rivista Internazionale Di Economia Dei Trasporti*, 20(3), 305–324.
- Hahn, J. S., Kim, D. K., Kim, H. C., & Lee, C. (2013). Efficiency analysis on bus companies in Seoul city using a network DEA model. *KSCE Journal of Civil Engineering*, 17(6), 1480–1488. DOI: 10.1007/s12205-013-0467-x
- Karim, Z., & Fouad, J. (2019). An analysis of technical efficiency of public bus transport companies in Moroccan cities. *Management Research & Practice*, 11(1), 56–73.
- Kerstens, K. (1996). Technical efficiency measurement and explanation of French urban transit companies. *Transportation Research Part A: Policy and Practice*, 30(6), 431–452.
- Klieščík, T. (2009). Kvantifikácia efektivity činností dopravných podnikov pomocou data envelopment analysis. *E + M Ekonomie a management*, 12(1), 133–145.
- Kushwaha, S., Prawesh, S., & Venkatesh, A. (2021). Does capacity utilisation influence financial performance? A study of Indian public bus transport companies. *Benchmarking: An International Journal*, 29(4), 1241–1263.
- Matulová, M., & Fitzová, H. (2016). Performance evaluation of the Czech urban public transport companies. In Dagmar Špalková, Lenka Matějová. In *Proceedings of the 20th International Conference Current Trends in Public Sector Research 2016*. Brno: Masaryk University, 2016, 310–318.
- Merewitz, L. (1977). On measuring the efficiency of Public Enterprises: bus operating companies in the San Francisco Bay Area. *Transportation*, 6(1), 45–55.
- Vavrek, R., & Bečica, J. (2020). Capital city as a factor of multi-criteria decision analysis – Application on transport companies in the Czech Republic. *Mathematics*, 8(10), 1765.
- Von Hirschhausen, C., & Cullmann, A. (2010). A nonparametric efficiency analysis of German public transport companies. *Transportation Research Part E: Logistics and Transportation Review*, 46(3), 436–445.
- Yeh, C. H., Deng, H., & Chang, Y. H. (2000). Fuzzy multicriteria analysis for performance evaluation of bus companies. *European Journal of Operational Research*, 126(3), 459–473.

Subcontracting process as a chain of transactions in the information system SAP

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Abstract: Today, subcontracting (or outsourcing) represents standard process used widely in manufacturing companies. It is based on production of several parts which are then provided to the external company creating new products from them. These products are then delivered back to the manufacturing company where they are used as subcomponents for the target product. Monitoring of the state related to the original parts as well as the delivered ones could be very demanding because there are permanent changes of their numbers in company warehouses. The effort can be decreased by the use of suitable information system enabling the description of the subcontracting process. This article shows how to implement individual steps of subcontracting in the system SAP. It presents how to create bill of materials (BOM) for delivered product, how to send and account parts to the external company and how to deliver them back as assembled subcomponents. Straightforwardness of the scheme is supported by an example from technical praxis.

Keywords: subcontracting, outsourcing, SAP, warehouse, accounting

JEL Classification: L14, L23, L24, L62

1 Introduction

Information systems (Boell & Cecez-Kecmanovic, 2015) are widely used in the world of production companies. Typical representatives are very large firms with hundred thousand employees, like Ford, Amazon, IBM, DHL or Robert Bosch (Pushmann & Alt, 2001). All of them are using the system SAP. But before going in details how SAP can be operated, let's look how the information systems can be described. Information system is composed from hardware, software and processes which are performed by employees with target to collect data, process them and used them for planning, controlling and decision making (Hasan, 2018). Those systems are nowadays very important for the organizations of different type and scope. Without them, it would not be possible to process the transactions in the banks, government could not collect the taxes, hospitals could not take care of the patients. For all these activities, it is typical that large amount of data has to be processed. Data are represented e.g. by information about services and goods, about clients and their requirements, about deadlines, etc. They are very important and therefore, they need to be stored, administer and processed. And that is the role of the information systems.

Enterprise information systems (Romero & Vernadat, 2016) are the information systems used by companies and other organizations to execute crucial activities called enterprise processes. Let's look e.g. on the processes in the production area; before the delivery of our product to the customer, many activities have to be done: First, inquiry describing the parameters of the product and other requirement from the customer has to arrive, being discussed, quoted and send back. When agreement with him is reached, material from which our product is created has to be inquired and quoted. Then, it has to be ordered. When it arrives to the company, it has to be accepted and installed into the warehouse (and, of course, accounted). Next, bill of materials has to be created to describe which components and materials will be used for our product. Machines and employees have to be allocated to ensure that product will be really produced. And when product is completed, it has to put again into the warehouse, after certain time send to the customer and accounted.

As seen above, enterprise processes can be quite long and complicated, with necessity of confirmations at different personal level. Considering that those processes repeat for every new product, their structure calls for automation by the computer to increase the effectiveness and decrease costs. And these are the main benefits of the enterprise information systems (Anaya, 2013). Moreover, when using those systems, data are stored and secured at central location with different rights of access. They can be viewed not only inside the plant but also outside the office – it is easy to get actual

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information about inventory levels, project status and financial situation. The reports can be done in real time, summary of downtime, rejected products and machine utilization can be obtained very fast. Moreover, systems include customization, i.e. they can be adjusted according to real processes occurring in the plant. On the other side, there are of course also some challenges: the first, quite significant, is required massive investment in those systems; not only financial but it is also matter of time, because to customize the system takes long time (typically months, even years). Next topic is also security of data and potential failure of the system with appropriate impacts on production (Markus, 2000).

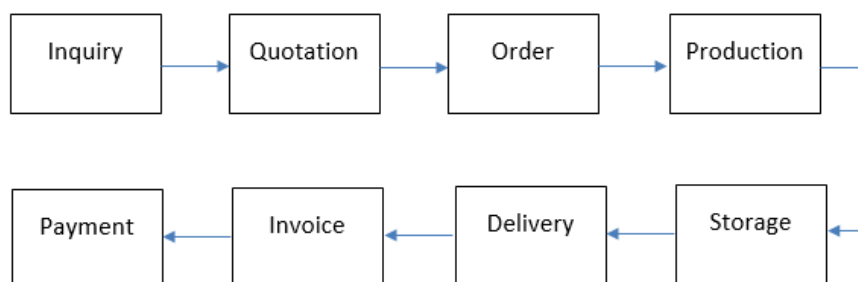
Nevertheless, even with considering some risks, information systems represent successful tool for management and reporting of company processes. In Czech and Slovak Republics, there are at least 800 installation of famous SAP system and 100 installations of Oracle systems. There is also local provider Asecco Solutions delivering system Helios. The following text is oriented on the use of SAP system because, as described earlier, it is very widespread in the world. Nowadays, there are more than 1 million of users worldwide (Overview, 2022). Moreover, on the education level, it is very good representative for students to show how individual processes can be described step by step.

2 Methods

The processes in SAP system are composed from transactions which represent the smallest piece describing one certain activity in enterprise. Transactions are usually used for creating new records, modifying, viewing, reporting, and more. Typically, an example of one transaction is an inquiry from the customer. Suppose that plant produces certain product which customer would like to buy. First, he sends the inquiry to define what he needs. Our company prepares it, sets it in SAP and generates an appropriate output sent to the customer.

Transactions can be chained into larger business activities. Considering the example from previous paragraph, there are next actions related to the inquiry. The customer reacts on our inquiry, and he requires the quotation. Receiving it with the proposed price of product, he can agree and the project starts. Then, it is necessary to prepare the order containing agreed business, i.e. required product, its amount and price per piece, date of delivery, etc. When order is prepared and manufactured, the required amount of pieces is stored in the warehouse and in the next step, it is delivered to the customer leading to the decrease of supply in our warehouse. Afterwards, invoice is prepared for customer (with limit date of payment included) and sent. The graphical representation of the chain is shown in Figure 1.

Figure 1 Example of chain of transactions



Source: Own processing

As you may see, the chain of actions can be quite long. Imagine that each action is accompanied with much information (parameters) that need to be set in the individual transactions of SAP system; to be aware of all of them, it is very exhausting. Of course, not all are required to be inserted but not to fill them, level of reporting quality becomes insufficient. Therefore, and it is common practice in business world, one employee works only on single transactions or on the small sets of transactions from his job scope. Hence, he operates in small piece of SAP system but with high degree of knowledge.

SAP system is windows-based product; it means that all activities are done in separate windows evoking when clicking on required transactions. The latter ones are stored in menu with spreading structure describing the enterprise areas where given transaction is typically used. As searching for it can take a lot of time, each transaction is equipped with transaction code. When typing this code in the command line, appropriate window appears immediately. This approach helps to user do his work faster and considering that he operates only with several windows (transactions), he can become real master in his area.

As described above, the chain of transactions can be quite long and complicated. Typical representative of that is subcontracting. What does this mean in business language? It is based on production of several parts which are then provided to the external company creating new products from them. These products are then delivered back to the manufacturing company where they are used as subcomponents for target product. Monitoring of the state related to the

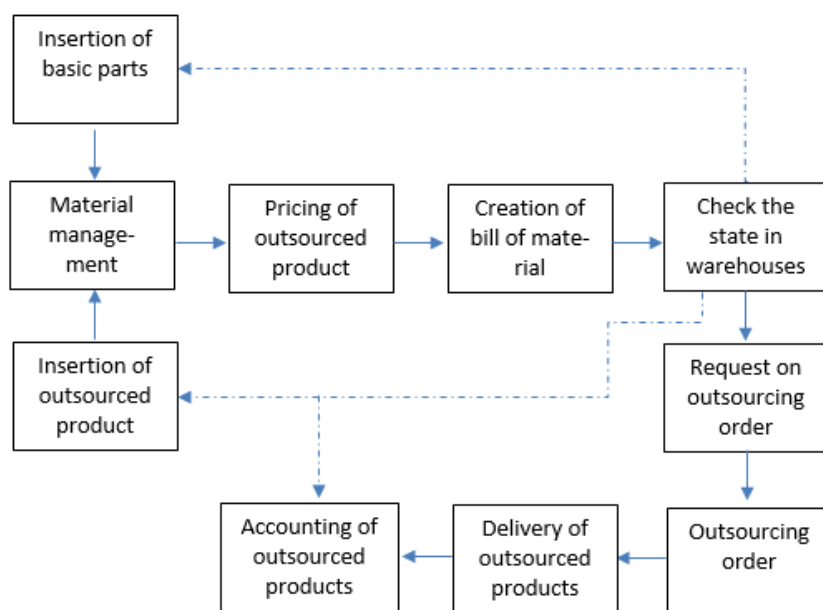
original parts as well as the delivered ones could be very demanding because there are permanent changes of their number in company warehouses.

Which transactions need to be executed to sufficiently complete subcontracting process? Suppose that our outsourced product is composed from several basic parts produced in our plant. First, all of them have to be inserted in our SAP via Material Management. Doing that, outsourced product needs to be financially assessed to reflect changes in the financial balance of company when leaving plant to the external company. When pricing procedure is finished, it is necessary to prepare bill of material (BOM) describing from which basic parts and in which amount our target product is composed. Next, fast check if the parts for outsourcing are even in warehouse of the plant needs to be done.

After preparation the basic parts and BOM, request on outsourcing process in form of order is inserted into the system. After the request, order itself is filled and then, basic parts can be delivered to the external company using appropriate SAP transaction. When the products required to be prepared outside are finished, they can be delivered back to our plant – of course, they have to be accounted to include them into plant. During all steps, check of the number of basic parts as well as outsourced product can be done via using appropriate transaction.

The chain of necessary transactions is depicted in the Figure 2. While full lines represent the flow of the transactions necessary for completion of the outsourcing process, semi-dashed lines correspond to optional transaction checking the number of products in warehouse at various state of the process.

Figure 2 Transaction scheme of subcontracting process



Source: Own processing

The implementation of the individual process steps in SAP system is described in the following section.

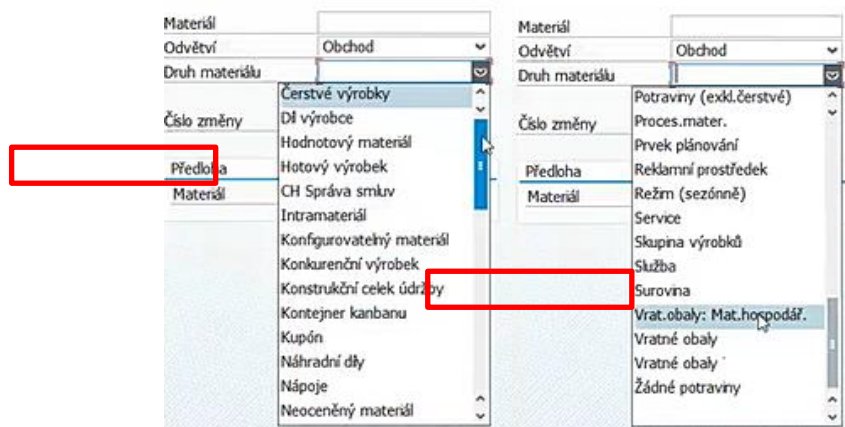
3 Research results

The described processes are implemented in SAP system via appropriate transaction windows. Let's show only the most challenging ones to present which settings need to be done to complete the transactions successfully. Note that all windows are in Czech language – to do the method more general, translation to English is done.

3.1 Material management, BOM and status in warehouse

As described earlier, the first step is represented by insertion of basic parts and outsourced product into the Material management using transaction code MM01. To distinguish between both types of materials, it is necessary to specify the basic parts as Raw material („Surovina“) and outsourced product as „Finished product“ („Hotový výrobek“). The insertion of the material can be verified by transaction MM03 (Display material).

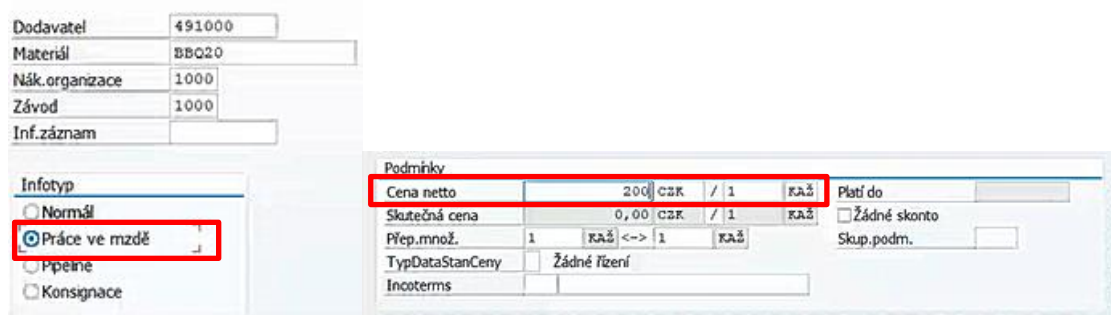
Figure 3 Material management window



Source: Own processing, generated in SAP

When all basic parts and outsourced product are inserted into SAP, a pricing procedure takes place. This transaction starts by the transaction code ME11 (Create info record) and its purpose is to add some price to the product to reflect that when the product leaves our plant, we lose some financial value. Note that in the first window, option „Subcontracting“ („Práce ve mzdě“) has to be chosen in Info category. In the second window, appropriate price is added in the sheet „Conditions“ („Podmínky“) and in the field Net price („Cena netto“).

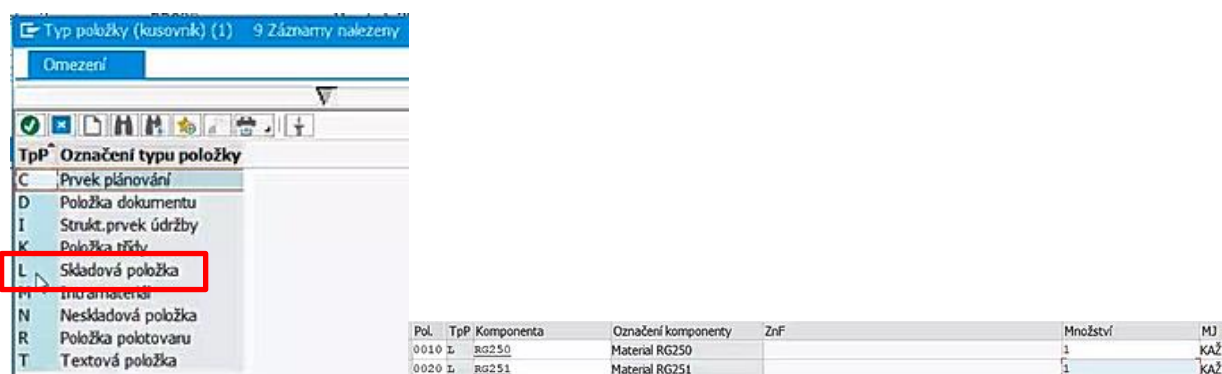
Figure 4 Pricing procedure



Source: Own processing, generated in SAP

When pricing is completed, it is time to prepare Bill of materials (BOM) to specify from which basic parts outsourced product is composed; transaction CS01 serves to do it. In evoked window, selection „Production“ („Výroba“) has to be chosen in the field „BOM usage“ („Použ.kus.“). Next window prompts us to define the bill – appropriate basic part and its amount are chosen. To specify that given part will be delivered to the outsourced company from warehouse, it is necessary to select in option „IcT“ („TpP“) the choice „Stock item“ („Skladová položka“). The example of BOM is depicted in the Figure 5; two basic materials RG250 and RG251 are considered for completion of outsourced product.

Figure 5 Preparation of bill of materials



Source: Own processing, generated in SAP

The amount of the basic parts available in the warehouse is shown using transaction MMBE. If the parts are newly inserted into system, there will be, of course, zero pieces displayed. The transaction MB1C serves to increase our supplies as shown in the Figure 6. To have parts available to our disposal, the field „Movement type“ („Druh pohybu“) should be filled via selection „561“. Then, required amount of parts (120 pieces for each basic product in our case) is inserted in the field „Quantity“ („Množství“).

Figure 6 Insertion of pieces to the warehouse

Přehled zásob: Základní sestava

Výběr
 Materiál: RG250
 Druh mater.: ROH
 Měr.jednotka: KAŽ

Přehled zásob

Klient / účetní okruh / závod / sklad / šarže / zvláštní zásoba	Vol.použitelné
Celkem	100,000
1000 Účetní okruh 1000	100,000
1000 Závod 1000	100,000
1040 Expedice	100,000

Pořízení zvl.příjmů materiálu: Nové položky

Druh pohybu: 561 Převzetí stavu zásob

Položky	Pol.	Materiál	Množství	MZT	Skł.	Šarže	NV	Záv.
1	RG250	120	KAŽ	1040		1000		
2	RG251	120	KAŽ	1040		1000		
3				1040		1000		
4				1040		1000		
5				1040		1000		

Source: Own processing, generated in SAP

The updated state of parts in the warehouse can be checked again by the transaction MMBE.

3.2 Outsourcing order and accounting

When all basic parts are available in our warehouse, the scope on next activity is oriented on outsourcing itself. To get the outsourced product from the external company, the request on the order and then the order itself are filled in SAP system. These steps are done using the transactions ME51N (request) and ME21N (order); for the former, the type of item „IcT“ („TpP“) has to be set to „Subcontracting“ („Práce ve mzdě“). For the latter, it is not necessary to write all input data again into the system but the prepared request can be found by searching window (marked by green in the Figure 7) and inserted into our order via shopping basket (marked by red in the Figure 7). Next, the external company supplying us with outsourced product needs to be chosen. In this window, data related to the product containing the list of material is also available.

Figure 7 Outsourcing order

Přehled dokladů

Mě nořadový na objednávku

NormálObjednávka

Dodavatel: 300000 Dodavatel tuzemsko 00

Dat.dokl.: 11.11.2020

Pol.	P	Materiál	Kr.text	Obj.mnořství	ZMJ T	Dat.dodáv.	Cena netto	Měna	na	J...	Skup.mater.	Záv.	Skład	Šarže
10	P	BBQ20	Vyrobek BBQ20	1	KAŽ	16.11.2020	250,00	CZK	1	KAŽ	Skup.mater. 1	Závod 1000		

Polořka [10] BBQ20, Vyrobek BBQ20

View [1] Cenové prvky: Tabulka

N.	DPod	Označení	Čísloka	Měna	JvC	Hodnota podm.	Měna	Status	Čepře	OMJ	JmPP	MJ	Hodnota podm.	MěnaP	Stat
1	BRKX	Průřaha brutto	250,00	CZK	1	KAŽ	250,00	CZK		1	KAŽ	1	KAŽ	0,00	
		Hodnota netto včetně	250,00	CZK	1	KAŽ	250,00	CZK		1	KAŽ	1	KAŽ	0,00	
		NAVH Neodřtat.vstup.DPH	0,00	CZK			0,00	CZK		0		0		0,00	✓
		HodnNetto vř.v.s.DPH	250,00	CZK	1	KAŽ	250,00	CZK		1	KAŽ	1	KAŽ	0,00	
			0,00	CZK			0,00	CZK		1	KAŽ	1	KAŽ	0,00	
			250,00	CZK	1	KAŽ	250,00	CZK		1	KAŽ	1	KAŽ	0,00	
		BRKO Skonto	0,00	%			0,00	CZK		1	KAŽ	1	KAŽ	0,00	✓
			0,00	CZK	1	KAŽ	0,00	CZK		1	KAŽ	1	KAŽ	0,00	

Source: Own processing, generated in SAP

Next, the parts have to be delivered to the external company. In SAP, there is the transaction ME20 that accounts for the parts leaving our plant. Starting it and filling considered parts (field „Components provided“, „Poskytnuté komponenty“), the subwindow appears showing how many basic parts are needed to manufacture required amount of outsourced product („Reqt/Receipt qty“, „Mnořství potřeby/přírůřtku“) and how many parts were sent/should be sent to the outsourcer („Available SC stock“, „Disponib. zásoba PvM“). The upper value represents the amount of parts already available at external company and lower value corresponds to the amount which is missing (red colour) or which is extra

(green colour). When clicking on plus sign under basic parts on the left side, the list of orders related to the outsource product is shown.

Figure 8 Accounting of basic parts going to external company

Materiál	Záv.	Krát.text	Šarže	Zásoba PvM
Termín	Doklad	Pol.	Datum dod.	Množ.potřeby/přírůstku
RG250	1000	Material RG250		0 KAŽ
Potřeby prostř.objednávek práce ve mzdě				5 KAŽ
RG251	1000	Material RG251		0 KAŽ
Potřeby prostř.objednávek práce ve mzdě				5 KAŽ
03.11.2020	4500000066	00010	06.11.2020	1 KAŽ
11.11.2020	4500000067	00010	16.11.2020	1 KAŽ
11.11.2020	4500000068	00010	16.11.2020	1 KAŽ
11.11.2020	4500000069	00010	16.11.2020	1 KAŽ
11.11.2020	4500000070	00010	16.11.2020	1 KAŽ

Source: Own processing, generated in SAP

Clicking on the button „Post Goods Issue“ („Zaúčtování výdeje materiálu“), the amount of parts leaving our plant is set. Completing this action, the status in the warehouse using the transaction MMBE can be checked. There, it is obvious that some pieces are, after ME2O, already in the field „Stock Provided to Vendor“ („Poskyt. mater. dodavateli“), i.e. they are waiting to be processed by the external company.

Figure 9 Changes in warehouse for basic products RG250, RG251

Klient / účetní okruh / závod / sklad / šarže / zvláštní zásoba	Vol.použité
Celkem	337,000
1000 Účetní okruh 1000	337,000
1000 Závod 1000	337,000
Poskyt.mater.dodavatel	4,000
1040 Expedice	337,000

Klient / účetní okruh / závod / sklad / šarže / zvláštní zásoba	Vol.použité
Celkem	328,000
1000 Účetní okruh 1000	328,000
1000 Závod 1000	328,000
Poskyt.mater.dodavatel	13,000
1040 Expedice	328,000

Source: Own processing, generated in SAP

Last transaction of the process is represented by the delivery of the product completed from basic parts to the plant. To accomplish it, transaction MIGO serves for the acceptance to the internal warehouse. The upper left part of the window has to be set to „Goods receipt“ and „Purchase order“ („Příjem materiálu“ and „Objednávka“) and an appropriate order created by ME21N is chosen from the list of orders. Confirming that products were delivered without any damages from outside and that they can be inserted into warehouse, selection „OK“ („OK“) is checked nearby individual components.

Figure 10 Delivery of outsourced product to plant

Source: Own processing, generated in SAP

Next, the transaction can be validated by the button „Check“ („Kontrola“). If all fields are filled appropriately, the light status nearby the components gets green and the process to be finished by push of the button „Post“ („Účtování“). The amount of product accepted from outside is visible via already used transaction MMBE. There, new products are situated in the warehouse where they were accepted in MIGO transaction. Hence, the process of subcontracting is completed, all necessary data are stored in the system and they can be anytime queried and reported.

4 Conclusions

The process of subcontracting in SAP system corresponds to the one of transaction scheme which covers the activities from multiple plant departments – manufacturing and logistics. While manufacturing was represented here just by the insertion of the basic parts and final product into the system, main focus of the text was oriented on the logistics covered by more detailed actions. During them, many settings were adjusted to complete the process successfully. In real plant, they can look slightly different as SAP is customized for every customer according to his requirement. But logic as well as the structure of the process and transactions keep the same consisting in the create of purchase requisition, purchase order, deliver of basic parts to the external company and import of final product back to the plant.

The presented transaction scheme could be developed further creating some challenges. One of them is represented by the generation of the documents supporting the subcontracting during delivery and receipt of the parts. Using the code VL01N for publishing of Outbound delivery is an example which can be followed by the physical delivery of the parts (VL02N) and by printing of the items in the delivery (VL71) according to the document template.

The other challenge consists in the connection to the financial department to create the invoices and other documents needed for financial processing of the subcontracting. It is clear that plant has to pay to the external company for the manufacture of the outsourced product. Using the financial module of SAP, the payments related to this process as well as other movements on plant bank account could be executed and monitored creating data useful for reporting and further analysis. This is how SAP power can be fully utilized.

References

- Anaya, L. A. (2013). Realizing the Benefits from Enterprise Information Systems: A Sociomaterial Perspective. *Procedia Technology*, 9, 476-479
- Boell, S. & Cecez-Kecmanovic, D. (2015). What is an Information System?. *Proceedings of 48th Hawaiian International Conference on System Sciences (HICSS)*, 4959-4968. DOI 10.1109/HICSS/2015.587
- Hasan, F. F. (2018). A Review Study on Information Systems. *International Journal of Computer Applications*, 179(18), 15-18.
- Markus, M. L (2000) Learning from adopters' experiences with ERP: problems encountered and success achieved. *Journal of Information Technology*, 15, 245–265.
- Pushmann, T. & Alt, R. (2001). Enterprise Application Integration – The case of the Robert Bosch Group. *Proceedings of 34th Hawaiian International Conference on System Sciences (HICSS)*, 10, DOI: 10.1109/HICSS.2001.927242.
- Romero, D. & Vernadat, F. Enterprise Information Systems State of the Art: Past, Present and Future Trends. *Computers in Industry*, 79.
- Overview of ERP systems [online]. 2022. *SystemOnline*.

How accurate are macroeconomic forecasts of Slovakian commercial banks?

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Abstract: In this paper, we examine the accuracy of the forecast models of the selected commercial banks in Slovakia. We focus on GDP and inflation forecasts in three different forecast horizons. The data is taken from an ongoing survey administered and regularly updated by the National Bank of Slovakia. The sample consists of nine of the largest commercial banks in Slovakia. Firstly, we see how well the banks compare to each other based on RMSE. Secondly, we estimate different baseline models, namely random walk and ARIMA models, for each horizon and compare each bank's accuracy to the accuracy of these baseline models. Data is taken from the OECD revisions database, Eurostat and the database of the National Bank of Slovakia. Thirdly, we take different types of averages of the individual banks' forecasts, as forecast averaging should increase accuracy based on contemporary forecasting scientific literature. We find that the models of these commercial banks are generally more accurate than our baseline models, except for one bank, which systematically provides less accurate forecasts in the survey. What is more, we find that individual models are capable of being more accurate than the averages for each and every horizon.

Keywords: forecast comparison, arima, random walk, commercial banks

JEL Classification: G32, G33, C35

1 Introduction

The aim of this paper is to find out whether there is such a macroeconomic model in some of the Slovak commercial banks, which can systematically predict the development of macroeconomic indicators, specifically GDP and inflation, at different time horizons more accurately than our benchmark models, models of other banks and averages of individual forecasts.

The paper is structured as follows. Firstly, we describe the sources of our data. Secondly, we characterize the survey conducted by the National Bank of Slovakia among commercial banks. Thirdly, we describe the horizons at which we compare the forecasting ability of the models. We also provide an overview of the data preparation and characterize the benchmark models, as well as the theory behind our research. In section 4 we present our results and the final section concludes.

2 Methods

2.1 Data description

To begin with, we collected data from three different sources. First, the source for obtaining forecasts of commercial banks was a survey. The survey is carried out monthly by the National Bank of Slovakia (hereinafter NBS). The data has been collected approximately in the last working week of the given month since 2007. In the survey, commercial banks report their forecasts of key macroeconomic indicators, such as the exchange rate, interest rates, balance of payments, inflation and GDP at constant or current prices. The set of included indicators has changed over time. In this commentary, we focus on inflation measured by HICP and GDP at constant prices. At the beginning, nine commercial banks sent their forecasts, the list of which is presented in Table 1. Later, one bank ceased operations and two banks stopped their participation in the survey. For this reason, we had at our disposal data from six banks for the whole period, but not all of these banks sent their forecasts every month. In case the monthly forecast was missing, we assumed that its value did not change compared to the previous month. In this way, we could consider the survey a reliable source of information, which we then compared to the actual values of GDP and inflation.

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Table 1 List of participating banks

List of participating banks		
Bank	First contribution	Last contribution
Poštová Banka (PABK)	2007M10	2020M06
ČSOB Banka (CSOB)	2007M01	2020M06
Komerčná Banka	2007M04	2008M06
ING Banka	2007M01	2012M09
Istrobanka	2007M01	2009M04
Slovenská Sporiteľňa (SLSP)	2007M01	2020M06
Tatrabanka (TATR)	2007M01	2020M06
Unicredit Banka (UNIB)	2007M01	2020M06
VÚB Banka (VUB)	2007M01	2020M06

Source: Own processing

Our second source of information were the NBS and OECD databases. We obtained the seasonally and calendar adjusted GDP time series and the inflation data from these. In the case of GDP, we used revised data so that we could compare the forecasts with the actual GDP values available at the time the banks sent us their forecasts.

The only issue with the data was presented by the different frequencies. As mentioned above, banks send their forecasts on a monthly basis, but the available GDP data is quarterly. Therefore, we interpolated the available GDP data points in such a way that we considered the same quarterly value as the real GDP value in each month of the given quarter.

We considered three different time horizons for the forecast exercises. In the first horizon we compared actual GDP growth data to the same quarter of the previous year. In the second forecast horizon, we analyzed the year-on-year GDP growth in the current year. In the third and final forecast horizon we forecast the year-on-year GDP growth for next year.

With regards to inflation, we obtained the time series from the Eurostat database. We measured inflation as the annual rate of change in the HICP. Monthly inflation data is readily available on Eurostat, so we did not have to interpolate the values as in the previous case with GDP. We also took into account three forecast time horizons. The first was the forecast of year-on-year price growth. The second was forecasting inflation at the end of the actual calendar year. The third and final forecast horizon represented the inflation forecast at the end of next year.

2.2 Benchmark models

In this chapter, we describe our model selection. To begin with, in addition to the banks' point estimates we obtained from the survey, we estimated two benchmark models of our own. Our first benchmark model is a simple random walk model, as suggested by Bjornland et al (2012). In this case, the forecast value from the previous period was equal to the last known value of the time series. This represents the simplest way to model a stochastic time series. We write the model as

$$Y_t = Y_{t-1} + u_t \quad (1)$$

where the u_t are zero mean $E(u_t | Y_{t-1}, Y_{t-2}, \dots) = 0$ i.i.d. errors. Given that

$$\begin{aligned} E(Y_t | Y_{t-1}, Y_{t-2}, \dots) &= E(Y_{t-1} | Y_{t-1}, Y_{t-2}, \dots) + E(u_t | Y_{t-1}, Y_{t-2}, \dots) \\ &= Y_{t-1} \end{aligned}$$

it is clear that we consider yesterday's observation Y_{t-1} to be the most accurate forecast for Y_t . This entails that we cannot predict the difference between Y_t and Y_{t-1} , and Y_t follows a path given by random steps u_t .

Our second type of benchmark models are ARIMA models, again suggested by Bjornland et al (2012). These models forecast the future path of the time series based on its historical variations. We write

$$y_t = \alpha + \sum_{j=1}^p \phi_j y_{t-j} + \sum_{j=0}^q \theta_j \varepsilon_{t-j}, \quad (2)$$

where y_t gives us the target variable, while p and q represent the lag order of the autoregressive (AR) and moving average (MA) terms, respectively. We estimated these models in EViews, included a maximum of five AR and MA elements in (2) and used I(1) ARIMA models when necessary.

To continue with, Aiolfi et al. (2011) states that the combination of individual forecasting models can substantially improve forecast accuracy. Burgi (2015), **for example, argues that it is hard to achieve more accurate estimates than by combining the individual models using equal weights.** Because of this, we first combined the models by taking the arithmetic mean of the individual forecasts of commercial banks. In addition, Armstrong (2001) argues that a trimmed mean may also improve forecast accuracy. To calculate the trimmed mean, we excluded the lowest and highest forecast values for each single observation, thereby varying the model space over time. We then calculated the arithmetic mean of the remaining forecasts.

To sum up, we compared the forecast accuracy of the aforementioned benchmark models, individual models of commercial banks and the combination of these individual models. We measure forecast accuracy by the root mean squared error (hereinafter RMSE). RMSE is the square root of the mean of the square of all of the error. The lower the RMSE is, the more accurate is the forecast. The RMSE is formulated as

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (S_i - O_i)^2}$$

where S_i gives us the forecasted values of the variable, O_j represents the observations, and n stands for the number of observations available for analysis.

3 Results

In this chapter we describe our findings. In Table 2 we see the RMSE for each model in each period. The smallest RMSE in each column is highlighted in bold. Several interesting results stand out. Regarding averages in general, it appears that the arithmetic mean of all bank models could forecast GDP more accurately than the trimmed mean, regardless of the prediction horizon. The reason may be that we included only six banks in the analysis, as sufficient data was not available for the others. In our case, when we calculated the trimmed arithmetic mean, the highest and lowest observations for each time period were discarded. With this however, the Makridakis and Winkler (1983) rule might be violated, according to which it would be better to average at least 5 models. For the shortest horizon, the benchmark RMSEs are 1.71 for RW and 3.04 for ARIMA. Table 2 shows that all banks outperformed the ARIMA benchmark model, while RW forecasted the development of GDP better than the CSOB model. The VUB model most accurately forecasted the development of GDP. Apart from VUB, not even one of the banks was able to forecast GDP more accurately than the average of all six banks, which we expected based on the literature. Furthermore, it is also written in the literature that the model that is the best on one horizon lags behind the others on other horizons in its performance.

Table 2 GDP forecast

GDP forecast			
Model	Q-o-Q	Actual year	Next year
Arithmetic mean	0.9	0.76	3.14
Trimmed mean	0.98	0.79	3.19
ARIMA	3.04	3.19	3.53
RW (random walk	1.71	2.01	4.13
PABK	0.92	0.80	3.30
CSOB	2.11	2.20	3.19
SLSP	1.10	0.86	3.00
TATR	1.00	1.16	3.40
UNIB	0.97	0.72	3.04
VUB	0.81	0.77	3.01

Source: Own processing

The above stated assumption was true in our case, since on a yearly horizon, it was no longer the model from VUB, but the model from UNIB that had the most accurate prognostic ability. Although it was closely followed by VUB, which was in second place among the banks, but the RMSE of 0.77 was not enough in this case to overcome the arithmetic average of all six banks. Apart from UNIB, not a single bank could surpass this average. The result on the annual horizon was, therefore, similar to the result on the shortest horizon, since there were banks that could beat the arithmetic average, which finished in second place. Furthermore, each bank built a model that is more accurate than the benchmark ARIMA, but the model from CSOB cannot outperform the RW benchmark. This model has an RMSE of 2.20 compared to the RMSE of the RW model of 2.01. As for the longest horizon, RW with its RMSE of 4.53 was significantly behind even the ARIMA model, and these benchmark models have a larger RMSE than the models of individual banks. SLPS analysts were the most accurate in forecasting the development of GDP in this period. The model from TATR, which with its RMSE of 3.40, was the least accurate in this horizon. It is interesting that while only one bank had a smaller RMSE than the arithmetic mean at shorter horizons, at the longest horizon this applies to three banks. From this we can draw the conclusion that in our case the GDP predictions of these individual banks became more accurate relative to the average with an increasing length of forecast horizons. The question is whether the same banks had the same results in the case of inflation.

We see these results in Table 3. Here, too, we highlight the smallest RMSE in each column in bold. As for the means, the trimmed arithmetic mean was better only on the annual horizon, where it had an RMSE of 0.99 compared to the arithmetic mean with an RMSE of 1.00. As for the shortest horizon, the model from CSOB has the worst predictive ability with an RMSE of 1.36. Apart from this model, the model from VUB did not even surpass the ARIMA benchmark model. Among the benchmark models RW was again better than ARIMA, but both were outperformed by the UNIB, SLSP and TATR bank models, while the PABK model has the exact same RMSE. Another interesting fact is that on this horizon, none of the banks with their models exceeded the accuracy of the arithmetic mean, whose RMSE is 0.19.

Table 3 Inflation forecast

Inflation forecast			
Model	Q-o-Q	Actual year	Next year
Arithmetic mean	0.19	1.00	1.80
Trimmed mean	0.24	0.99	1.83
ARIMA	0.35	1.25	2.31
RW (random walk	0.32	0.92	2.24
PABK	0.32	1.07	1.89
CSOB	1.36	1.59	1.96
SLSP	0.22	1.05	1.84
TATR	0.23	1.02	1.73
UNIB	0.20	0.98	1.89
VUB	0.42	1.08	1.91

Source: Own processing

As for the annual horizon, the predictive power of the models generally deteriorated as expected. In this case, our benchmark RW model had the smallest RMSE, namely 0.92, which was not surpassed by any of the averages or any bank. Our next benchmark ARIMA model had an RMSE of 1.25. There was only one model whose prediction ability was worse than this, and that is the model from CSOB. The RMSE of this model was 1.59. We conclude the interpretation of the results by evaluating the last column, which represents the RMSE for the next year. On this horizon, the least accurate forecasts were produced by the benchmark RW and ARIMA models, whose RMSEs are 2.24 and 2.31, respectively. The model from TATR, whose RMSE was 1.73, had the best prognostic ability. CSOB once again had the largest RMSE among all banks, although this time it surpassed the benchmark, but its models were the least accurate at every horizon. This also applies to GDP forecasts. The reason for this systematic inaccuracy is unknown.

4 Conclusions

The aim of this paper was to find out whether there is such a macroeconomic model in some of the Slovak commercial banks which can systematically predict the development of macroeconomic indicators, specifically GDP and inflation, at different horizons more accurately than benchmark models, models of other banks and averages of individual forecasts. According to our results, we can draw the following conclusions. In Slovakia, there is no macroeconomic model in any of the commercial banks that could systematically outperform the arithmetic average of individual forecasts with its predictive ability. Nevertheless, some banks succeeded, but not consistently. On the other hand, CSOB models are many times less accurate than models of other banks, or even benchmark models. However, it is important to note that almost every bank can formulate better prognostic models than our benchmark models. We consider this to be important especially for lay people, who often read the forecasts of individual banks in the media, and those forecasts can influence their financial behavior. In the future, we plan to extend these results by calculating the weighted averages of individual forecasts using artificial intelligence methods.

References

- Armstrong, J. S. (2001). Combining Forecasts. University of Pennsylvania Scholarly Commons, Marketing Papers 34, 1-21.
- Aiolfi et al. (2012). Forecast Combinations. The Oxford Handbook of Economic Forecasting, 1-60, DOI: 10.1093/oxfordhb/9780195398649.013.0013
- Bjornland, H. C. et al. (2012). Does Forecast Combination Improve Norges Bank Inflation Forecasts? Oxford Bulletin of Economics and Statistics, 74(2), 1-18, DOI: 10.1111/j.1468-0084.2011.00639.x
- Bürgi, C. (2015). Can a subset of forecasters beat the simple average in the SPF? *RPF Working Paper*, 2015-001.
- Makridakis, S., Winkler, R. (1983). Average of forecasts: some empirical results. *Management Science*, 29, 987-996.

Short sequence iterated prisoner's dilemma in simulations and applications

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Abstract: We focus on the model of iterated prisoner's dilemma, by this we mean the game of two players deciding in prisoner's dilemma repeatedly and deciding based on the knowledge of previous decisions of their co-player. In the classical one-round model, it is suggested that players should and will tend not to cooperate. But when the game is repeated, players may build trust by collaborating and profit out of this cooperation in the game with many rounds. Several models suggest that building up trust is the winning strategy and that players using it would profit. However, as the strategy for one round and the model for many rounds do not coincide, we focus on the breaking point where the choice of strategy is not clear.

Keywords: Prisoner's dilemma, non-zero-sum game, coopetition, iterated prisoner's dilemma, game theory, evolution of cooperation

JEL Classification: C71, C72, C73, D90

1 Introduction

Prisoner dilemma (in following shortly as PD) is probably the most well-known two-player non-zero-sum game of the game theory, studied almost from the very beginning of this field (Morgenstern & Neumann, 1947). The prisoner's dilemma was designed by Melvin Dresher and Merrill Flood, two scientists at the RAND Corporation in 1950, but received its name by Albert W. Tucker. Famous Nash equilibrium (Nash, 1951) is usually demonstrated in the case, where two players decide not to trust each other as if one chooses to trust and change the strategy, it will decrease his payoff. The existence of the Nash equilibrium, whose proof was awarded by Nobel prize in 1994, is clear in this game as is used as one of the most well-known examples, the game is also used to introduce the term coopetition, the competition with cooperative elements. The applications of the game are numberless (Aumann & Hart, 1992); we should bring up the oligopoly, in which two or few businesses control the whole market. They can set a product's price high so that they all have high profits and fair shares of the market, but if one of them lowers the price, it gains dominance, and the others lose money because they lose a significant portion of the market. According to economics theory, the oligopolistic high prices would not hold eventually, as the companies would not trust each other, and risking the loss is not worth keeping the deal (Corts, 1998). However, there are cases of successfully increased prices by a small number of companies. For example, mobile phone companies in the Czech Republic are licensed by the state and keep their prices much higher than in other countries with more open competition.

The problem with expecting the behaviour of the economic subjects, both persons and companies, is the non-mathematical aspects of the game. Most people prefer not to let down their co-player, typically partners in some sense, even in the case of total strangers or anonymous contact (Kahneman, 2012) (Thaler, 2016). Additionally, we frequently gain from establishing a relationship with a new partner, so disappointing him would mean missing out on this chance for long-term gain. We may consider online marketplaces as a good model case. Mostly, the buyer would pay the price and the seller would send the goods even in the case of trading only once. Some customer-to-customer sites, such as aukro.cz or ebay.com, provide the rating of the trade by both sides to build trust in particular traders, but others, where the sellers and buyers are less regular users, simply rely on basic morality.

The iterated prisoner's dilemma is a complex problem because our actions may and probably would influence the behaviour of our partner. Should we build trust by cooperating repeatedly, our partner would expect us to cooperate. Then he or she may either cooperate and profit out of trust or may attempt to exploit our naive strategy. Should we not cooperate, our partner would probably not cooperate either. But what if the strategy is mixed and, in some turns, we cooperate, and

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in others, we do not? In some cases, the players decide after the first non-cooperative action to play safe and avoid any future cooperation. In other cases, there may be an attempt to rebuild the trust by forgiving one or a small number of actions. There are no infallible solutions or supreme strategies because these questions lie at the intersection of numerous disciplines, especially as you consider mutual trust and perception of the opponent.

The paper is organized as follows. In Iterated prisoner's dilemma, we provide the sources that study iterated prisoner's dilemma and introduced classical strategies, in Short-sequence simulations, we introduce our simulations providing the recommendations and contradicting some well-known studies and finally, in Conclusion, we ask some questions that motivate further research.

2 Iterated prisoner's dilemma

First, let us introduce basic common strategies suggested for iterated PD:

- All cheat (or Hawk) - a player playing always noncooperative
- All cooperate (or Naive or Dove) - a player playing always cooperative
- Grudger - a player, who plays cooperative, but after first non-cooperation from his opponent, he will always play noncooperative
- Copycat (or Tit for tat) - a player will first cooperate, then subsequently replicate an opponent's previous action
- Random (or Ass) - plays randomly with a probability of 0.5 to cooperate

We can observe, that for a longer sequence the strategies ignoring the behaviour of their partner are not using all the information and should be inferior. From these strategies, Hawk is the only one with a hope of some success, as he does not risk being exploited, but he cannot build trust. This strategy coincides with the one-turn PD suggested in the introduction. Dove seems much weaker, as it may work with partners that are generally cooperative but can be terribly exploited. Because of this, the strategy can be called naive (assuming the world is always a friendly place). For sure the worst strategy is Random, which is probably why we call him Ass, as it both destroys any trust and does not exploit the mistakes of the partner.

Strategies build on reaction are much smarter, as the recognition and correct prediction is a key to maximizing winnings. As Grudger plays the "safe" strategy in the way of not letting a possible noncooperative partner get better of him, the Copycat uses short memory to give his partner a chance to correct himself. Because a special situation, where two copycats meet and one of them for some reason non cooperate one turn, they would be switching cooperation/non-cooperation for the rest of the sequence, which is clearly less than ideal.

It brings us to the important question, is non-cooperation always a betrayal of trust? Probably not, as we may come to many reasons and examples, where our favourite company or business partner let us down for acceptable reasons without any intention. For example, a subcontractor may fail to provide materials for our partner on schedule, so he cannot deliver the service or the goods. In small companies or family businesses, the health or personal problems of one of the workers may impact performance greatly. Other cases may be misunderstandings or objective reasons such as a strike, traffic collapses, or a recent case pandemic and restrictions used to fight it. Based on this, in a long-term partnership, we may implement to our strategy some procedure allowing starting cooperation after some small number of non-cooperation.

Webpage "Evolution of trust"(Case, n.d.) promotes one special version of Copycat, which does cooperate if his partner cooperated in any of the previous two rounds. In other words, one missed round does not influence this so-called Copy kitten or Tit of two tats, but two rounds in a row do. In general, this is a better version to cope with random events, such as unintended non-cooperation. Another special strategy is the so-called Simpleton (or Pavlov). Simpleton starts with cooperating. If the other player cooperates with him, Simpleton keeps doing whatever it was doing in the previous round. If the other player will not cooperate, Simpleton changes what he does. In other words, he waits for the non-cooperation of his opponent and when it comes, Simpleton changes his behaviour. If his strategy gets changed by unintended non-cooperation (for example noise), he still considers it his strategy, and by successful earn by non-cooperation, he starts being noncooperative if not punished by his partner. This is surprisingly highly effective against Copy kitten and Dove (Kraines & Kranes, 1989).

However, if we look at the previous list of strategies, the first ones (Hawk, Dove, Ass) use no information about the previous, basically playing blindly. More advanced ones react on a single impulse given either in one previous turn (Copycat, Simpleton) or in all turns (Grudger), but Copy kitten uses two previous turns. Clearly, the more information about our partner we collect and process, the better and more adaptable strategy we may produce. And if we intend to model

and either advise or predict human decision making, for sure we should consider the whole history of collaboration, not one or two turns, probably with bigger weight on last turns and smaller on historical ones.

As we declare in the very beginning, the models suggest forgiving and trying to build trust are the best strategy and advice people to do so. Webpage “Evolution of trust” (Case, n.d.) summarizes this as their conclusion. The author quotes the article Trust (Ortiz-Ospina & Roser, 2016) and the book The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change (Covey, 1989), where the author promotes searching for win-win relations as the only option for a long-term partnership, the main inspiration for the website is the book Evolution of cooperation (Axelrod, 1980). But as the author of the website is also an activist and influencer, the result is more a positive message than the proven best strategy, as the author uses Reductio ad Hitlerum and other association fallacies. Another very strong argument for the same conclusion of building trust by forgiving is many tournaments of AI simulating (Fogel, 1993) (Yao & Darwen, 1994). Their winners are always strategies that try to cooperate in the long run. In general, the conclusion for sequences long enough is clear, if it is possible to create trust between players, it is highly profitable, if one of the players tries to exploit, the other should not naively cooperate but after some experience stop collaborating (with the possibility to rebuild the trust if exploiting stops). However, the loss of trust causes both players to lose in long run. Axelrod sums up success in an evolutionary game with the following 4 characteristics: being nice (never being first to not cooperate), being provable (acting like Copycat), not being envious (focusing on maximizing own score), and not being tricky (Axelrod, 1990). Even though these results are mostly based on AI, they are recommended by authors as a good human behaviour model too.

3 Short-sequence simulations

3.1 Payoff and interactions

In our simulations, we intend to keep the well-known setting of the evolution of trust webpage. Let our payoff matrix be as follows:

Table 1 Payoff matrix

The payoff of A\Payoff of B	B cooperates	B does not cooperate
A cooperates	2\2	-1\3
A does not cooperate	-1\3	0\0

Source: Own processing

Let us assume the strategies presented in previous sections interact. As we focus on short-term interactions, we do not consider noise or random mistakes and therefore we may exclude Copy kitten strategy, as it can be shown, that Copycat is superior to it in all deterministic matches. We end with 6 strategies that can interact with each other. We process a table showing the results. Note that in the case of random strategy we may consider only the mean value.

Table 2 Match process

Strategy A\strategy B	Hawk	Dove	Grudger	Copycat	Random	Simpleton
Hawk	I	II	III	IV	V	VI
Dove		VII	VIII	IX	X	XI
Grudger			XII	XIII	XIV	XV
Copycat				XVI	XVII	XVIII
Random					XIX	XX
Simpleton						XXI

Source: Own processing

- I. Both Hawks are never cooperative
- II. Hawk is non-cooperative, and Dove is cooperative every round
- III. In the first round, Hawk does not cooperate and Grudger cooperates, then both never cooperate
- IV. In the first round, Hawk does not cooperate and Copycat cooperates, then both never cooperate
- V. Hawk keeps being noncooperative, Random is random
- VI. Hawk does not cooperate, Simpleton is cooperative in odd rounds and non-cooperative in the even ones
- VII. Doves are cooperative every round
- VIII. Both cooperate every round

- IX. Both cooperate every round
- X. Dove is cooperative, random is Random
- XI. Both cooperate every round
- XII. Both cooperate every round
- XIII. Both cooperate every round
- XIV. Until Random plays noncooperative, Grudger cooperates, then he is noncooperative every turn
- XV. Both cooperate every round
- XVI. Both cooperate every round
- XVII. Random is random and copycat copies previous Random strategy
- XVIII. Both cooperate every round
- XIX. Randoms are random
- XX. Random is random and in noncooperative turns changes Simpleton strategy
- XXI. Both cooperate every round

Now, we are ready to see who benefits in what number of turns. We are interested in two to five rounds of iterated PD.

Table 3 Payoffs of 2,3,4,5 rounds PD pt.1

Strategy A\strategy B	Hawk				Dove				Grudger			
Iteration	2	3	4	5	2	3	4	5	2	3	4	5
Hawk	0\0	0\0	0\0	0\0	6\2	9\3	12\4	15\5	3\1	3\1	3\1	3\1
Dove					4\4	6\6	8\8	10\10	4\4	6\6	8\8	10\10
Grudger									4\4	6\6	8\8	10\10

Source: Own processing

Table 4 Payoffs of 2,3,4,5 rounds PD pt.2

Strategy A\strategy B	Copycat				Random				Simpleton			
Iteration	2	3	4	5	2	3	4	5	2	3	4	5
Hawk	3\1	3\1	3\1	3\1	1.5\0.5	3\1	4.5\1.5	6\2	3\1	6\2	6\2	9\3
Dove	4\4	6\6	8\8	10\10	1\5	1.5\7.5	2\10	2.5\12.5	4\4	6\6	8\8	10\10
Grudger	4\4	6\6	8\8	10\10	2.25\3.25	2.75\3.75	4.125\3.625	5.5625\3.3125	4\4	6\6	8\8	10\10
Copycat	4\4	6\6	8\8	10\10	1.5\3.5	2.5\4.5	3.5\5.5	4.5\6.5	4\4	6\6	8\8	10\10
Random					2\2	3\3	4\4	5\5	1.5\3.5	2.5\4.5	3.5\5.5	4.5\6.5
Simpleton									4\4	6\6	8\8	10\10

Source: Own processing

It is time to understand why Hawk is at disadvantage as the number of iterations increases. The only strategies it profits from interacting with are the Dove and the Random. If we know the strategy of our opponent, for interaction with every single other co-player (basically any strategy that reacts), we can find a better strategy than being a Hawk. Even though he profits a bit from interacting with another strategy, the cost of opportunity of cooperation is great.

On the other hand, strategies attempting to cooperate have benefited from meeting anybody except Hawk or Random. If we include a noise, we can see that Copycat is the best to cope with it (if the noise is high), or Dove is good at ignoring it (if the noise is low). But Grudger and Simpleton change their strategy from this point and decrease their possible results.

3.2 Simulation of interactions and survivability in population

But how to test what strategy is the best if we do not know, who we are dealing with? One of the popular models is the “evolution algorithm”, or rather a semi-evolution algorithm, which means we create a generation of agents with given strategies and let them play each other (or one random another). Then cut off some percentage with the worst payoffs and copy the successful ones to replace them to create a new generation of the same size and repeat the process. This is not proper evolution, as there is no mutation and parenting with the creation of a new generation, just copies. To compare our findings to the “Evolution of trust” model, we use their evolution model.

We consider 25 agents with various strategies. Every possible pair plays a given number of iterations and gets a payoff, every agent form 24 interactions with all others. The five agents with the lowest scores are eliminated, and the five with

the highest score are copied, so in the next generation, there are more of them. In case of a tie, pick the best/worst to be eliminated/copied randomly from the best/worst group.

To simplify the study, we do not involve noise, it means random deviation from the intended strategy, even though it is a very interesting topic well introduced on the website. For given populations the results are the following:

First, we study the suggested 5-iteration sequence. If all six AI are represented equally, the result is the elimination of all Hawks, then there is a tie as all are cooperative, the same result we get for 5 AI represented equally. If we start with four AI equally, Hawks will be eliminated if not playing only with a trine Doves+Randoms+Simpleton. If we place three AI equally, one of them is Hawks, Hawks will dominate only in cases against Doves+Simpletons, Doves+Randoms, and Simplenos+Randoms. If either Grudgers or Copycats are involved, Hawks will be eliminated, in some cases even before other AI. If the first generation involves only two AI equally, Hawks will be eliminated by Copycats or Grudgers.

It seems that the Hawks are an inferior strategy in comparison to Grudgers and Copycats, but can't his/her odd be overcome by numbers? In some cases, yes. If we include Hawks and Grudgers/Copycats in ratio advantaging Hawks, for example, five to one, an interesting result is revealed. If there are 4 times more Hawks, they win eventually, but only if there are other agents they can exploit, such as Randoms, Doves, or Simpletons. In these cases, they may overpower Copycats. But in the case of only Hawks against Copycats/Grudgers, the ratio of 4 to 1 is not enough and they will be overpowered and eliminated in several generations. The outcome so far coincides with the idea promoted before, but if we consider the strategy of the Hawk exploiting their partners, this strategy is typically meant for short-term or once-only interactions in business and economy. So, we lower the number of iterations and revisit previous results.

For a 3-iteration sequence, the result changes as follows. If all AI are represented equally, we still observe the elimination of all Hawks, then there is a tie as all are cooperative as before. For 5 AI, there is a change, if both Copycats and Grudgers are involved, Hawks disappear, if only one of them is present in the starting generation, Hawks dominate and eliminate the rest. If we start with four AI equally, Hawks will dominate unless both Grudgers and Copycats are involved. If three strategies are in the game, only the combination of Grudgers and Copycats can eliminate Hawks, otherwise, Hawks win. And in the case of two AI only, Copycats and Grudgers still beat Hawks, all the others lose against Hawks.

Finally, for a 2-iteration sequence, Hawks dominate and overpower unless they play only against Grudgers/Copycats and are outnumbered at least 3 to 2. In equal numbers, they outperform and eliminate every other strategy.

Before finishing and passing to the conclusion, let us emphasize 5 important observations about our simulations. First, we use a shortcut that Hawks win, but people using this strategy prefer to be in the minority, as the interaction between two Hawks is not beneficial. Hawks prefer to interact with somebody naive or rather used to a cooperative attitude, so the “win” basically means, that loss of trust in the entire population will hurt everybody, including the ones that destroy it by misbehaving. Second, Random is the worst choice in any situation and will be eliminated by either people that can rely on each other and profit more, or by people exploiting him/her. The only chance it can get is in one-to-one interaction against some strategies, but in the evolution model, they get no chance. Third, if we would include noise, our results are no longer deterministic, but probabilistic. The models with a very low noise would still provide similar results, except that some strategies cope with noise better (Dove, Hawk, Simpleton), some averagely (Copycat, Random), and Grudger will be much less successful. Then, we should involve Copy kitten, which would mostly ignore the noise, but is kind of weak against Random, which is typically not a big problem, as Randoms tend to disappear after a couple of generations. Fourth, the number of rounds may influence the choice of the best strategy, if we know this number. It would improve every strategy to be non-cooperative in the last round. It would be interesting to randomize the number of interactions to avoid this problem, but once again, the results would be probabilistic. And finally, fifth, the results are determined by the original **Table 1** Payoff matrix. If we change the cardinality of the numbers (we still should keep their ordering), the results may change, but the general direction that Hawks benefit from a smaller number of interactions and the big percentage of “naive” agents in populations would be still valid.

4 Conclusions

We cannot overstate the importance of both the long sequence and short sequence versions of PD. There is a business strategy where a salesman knows that his goods are not worth the price, but he/she continues to sell them, as he/she believes that the customer would only buy once, and it is reasonable to profit as much as possible. This may be seen among a group of so-called “scammers”, who try to use psychological pressure and tricks to persuade older people to pay for something they do not need and know (Dymáková, 2013). Some laws have been enacted in the Czech Republic to

prohibit these practices; for example, if the buyer does not sign the contract in the shop, but at the exhibition, he may cancel it later. Some tourist shops have a similar effect, where they do not expect a guest to visit more than once per year, although the methods are not that dishonest. In opposition to that, we may observe that companies are promoting themselves by declaring the lifespan of their business in their advertising and hiring, as long-term success implies customers returning to this company for repeating their business. One of the ways to increase credibility is lowering immediate profit out of sales, so the customer would keep some percentage of the possible higher prize but may return in the future to spend more money. Probably the biggest recent change in direct application of the PD model are the rating systems for example at firmy.cz or google maps, etc. By rating, the customer shares his experience with others, thus even the once-only customer can influence future transactions and base his decision on prior experiences of other customers. Even if there are ways to artificially enhance or reduce the rating, models that illustrate the change in consumer behaviour as a function of rating would be of interest.

One of the points of this paper is to demonstrate that there are additional factors to consider when applying this problem to the real world. As the choosing process encompasses much more than maximizing return, we may see a comeback of ethics and philosophy in modern literature. There are several papers concerning this topic, the one we would like to highlight examines sustainable corporate responsibility (Kučera & Müllerová, 2017). This brings us to ecology or social responsibility. It is another application of PD, in which one may either maximize the profit while harming others or act properly while worsening the finances in the hope of helping the population and the future. It is ideal if everyone acts responsibly. On the other hand, if one goes the opposite way, one gets wealthy and is extremely likely to draw some or all of the others along with them.

As both society and technology evolve at a rapid pace, there are new possibilities and questions concerning our topic, some of which we intend to study in the future. For example, how many non-cooperative actions do people allow to happen, before complete loss of trust? How many successful collaborations do we need to forget/forgive one exceptional non-cooperation to fully trust our partner?

The two questions we intend to study in the near future are the following. First, how would a person decide with a known history of 1-4 previous PD iterations played? And second, how much is the decision influenced by factors such as education, age, gender, etc.? During the preparation of the article, we are preparing a webpage to collect data and invite kind readers to visit creatinofthetrust.ef.jcu.cz to help us with the study.

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References

- Aumann, R. ..., & Hart, S. (1992). *Handbook of Game Theory with Economic Applications*. North-Holland.
- Axelrod, R. (1980). Effective Choice in the Prisoner's Dilemma. *Journal of Conflict Resolution*, 24(1), 3-25.
DOI:10.1177/002200278002400101
- Axelrod, R. (1990). *The Evolution of Co-operation*. Penguin Books Ltd.
- Case, N. (n.d.). *The Evolution of trust*. Retrieved from <https://ncase.me/>
- Corts, K. S. (1998). Third-Degree Price Discrimination in Oligopoly: All-Out Competition and Strategic Commitment. *The RAND Journal of Economics*, 29(2), 306-323.
- Covey, S. R. (1989). *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change*. Free Press.
- Dymáková, S. (Director). (2013). *Šmejdi* [Motion Picture].
- Fogel, D. B. (1993). Evolving Behaviors in the Iterated Prisoner's Dilemma. *Evolutionary Computation*, 77-97.
- Kahneman, D. (2012). *Thinking, Fast and Slow*. Farrar, Straus and Giroux.
- Kraines, D., & Kranes, V. (1989). Pavlov and the prisoner's dilemma. *Theory and Decision*, 26(1), 47-79.
- Kučera, D., & Müllerová, J. (2017). The Value Orientation of the Czech Companies in the Frame of Sustainable Corporate Responsibility. In *Innovation Management, Entrepreneurship and Sustainability (IMES 2017)* (496-504). Vysoká škola ekonomická v Praze.
- Morgenstern, O., & Neumann, J. v. (1947). *The Theory of Games and Economic Behavior*. Princeton: Princeton University Press.
- Nash, J. (1951). Non-Cooperative Games. *The Annals of Mathematics*, 54(2), 286-295.
- Ortiz-Ospina, E., & Roser, M. (2016). Trust. *Our World in Data*. Retrieved from <https://ourworldindata.org/trust>
- Thaler, R. H. (2016). *Misbehaving: The Making of Behavioral Economics*. Norton.
- Yao, X., & Darwen, P. J. (1994). An experimental study of N-Person Iterated Prisoner's Dilemma games. *Progress in Evolutionary Computation*, 90-108.

Functional cluster regression for commodities and the representatives of stock indexes

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Abstract: While using external variables as potential predictors, one might be challenged by numerous possible variables, which while used once-on-time might devalue the predictive ability of individual ones. Thus, the pre-selection of relevant possible predictors should be used. For purpose of risk prediction of exchange rate changes, many external variables (time series) are available, thus most commonly traded ones were selected in the final number of 32 variables. Only a fraction of those should be in fact used while proceeding with the computation. Thus, out of many possible methods of selection of finding the relevant variables, the functional cluster analysis would be used. In this paper, we describe a case study of the functional cluster analysis application on time series as one of the possible methods of explanatory variable selection for the exchange rates.

Keywords: predictors, commodities, functional cluster analysis, stock indexes exchange rate

JEL Classification: F31, F32, F37, F47, F39

1 Introduction

For the needs of regression methods based on the use of external variables - potential predictors, their choice is a crucial moment that can be responsible for the success or failure of the calculated model. The authors use various economic and commodity variables for their prediction models of exchange rates. For example, Lee-Leea Hui-Boon examined the influence of the money supply, real GDP, short-term and long-term interest rates, CPI, and current account balance on the volatility of the exchange rate in the short and long term for the currencies of Southeast Asian countries through the GARCH model, VAR, and VECM models. (Lee-Leea Hui-Boon, 2007) The same models, i.e. VAR and VECM, were used by Englam et al. (2010) to detect the effect of oil price, foreign exchange reserves, and interest rate on exchange rate volatility in the short and long run. Using the multivariate GARCH model in Latin American economies, Grydaki and Fontas described the effect of money supply inflation, and the openness of the economy when taking into account the exchange rate regime (Grydaki and Fontas, 2011). Stančík focused on the volatility of the exchange rate, as an indicator of the stability of the economy (necessary for the adoption of the EURO), primarily on the influence of the openness of the economy, the exchange rate regime, and the "news" factor, while he used the TARCH model to model this influence. (Stančík, 2007) Pearson's correlation analysis was used by Mirchandani to investigate the effect of CPI, interest rate, GDP, foreign direct investment, and current account balance on the volatility of the Indian Rupee. (Mirchandani 2013) Hasaan et al. (2017) using ARCH, ARDL, and Granger causality models demonstrated a significant effect of interest rates and net foreign assets on exchange rate volatility, while the effect of economic openness, oil price, and fiscal policy has no significant effect on exchange rate volatility in Nigeria. The scope of the research of these works indicates a strong diversity of the usability of external variables when there is no established approach to their use. Although the monitored indicators have a significant meaning, only in a certain region or a certain period, others can provide additional information of a global nature. The identification of such variables is an important prerequisite for the success of the model.

For the selection of currency exchange rate predictors, the development of which we follow in a broader context, we have at our disposal a really wide set of potential variables, from commodity markets, and their aggregate index values, to the values of stocks and stock indexes, the use of crypto-assets, macroeconomic statistical data, etc. Only a fraction of these variables (whose time series we use), however, is realistically usable in the following methods, although a number of variables will bear the same or very similar characteristics of historical development, trend, volatility, or correlation.

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For the pre-selection of variables, we can use various methods such as stepwise backward regression, optimal AIC or BIC criterium, or the mentioned cluster analysis that is intended to identify homogeneous subgroups among observations.

In this contribution, we want to describe the usage of the last-named one and the assessment of its suitability for variable selection. The selection of these variables will subsequently enter as a selection of predictors for predicting changes in exchange rates using Value at Risk methods, extended by quantile regression methods.

2 Methods

Description of the Data

There are 32 pre-selected variables available for our experiment. Those variables (time series of length from December 2008 till February 2022) are provided by Trading Economics. The data are on daily basis, we declare to use daily opening value for each variable. Representatives of both, commodities and stock indexes were chosen for purposes of the functional cluster modelling. Fourteen commodities, two commodity indexes, fourteen stock indexes, and two energetics indexes were particularly chosen. Thus, our goal is to obtain groups of variables that behave similarly with respect to time evolution. Functional clustering analysis enables us to combine functional sources of different kinds. However, it is not in the scope of this paper to describe the method of clustering analysis precisely. A more in-depth functional clustering method is given by Dai et al. (2021) however, we choose this method primarily because it allows the combining of several different views of a function so that these views are equally represented in the distance construct. It, therefore, allows combining several different distances (e.g. volatility, trend, etc.) into one composite distance in which all components are represented equally.

Description of the Method and evaluation

While selecting external variables for the needs of regression models, we chose functional cluster analysis. Alternative methods could also be used for a similar selection, for example, factor analysis and PCA methods, but these create latent variables that are poorly interpreted, so for our needs, it is more appropriate to use individual variables, therefore we will use cluster analysis.

Providing the functional clustering method, the Myllymäki & Mrkvička's (2017, 2020) GET package (Global Envelops) of R studio is used. The *fclustering* function of the GET package is used together with the smoothed curve, the number of clusters given in chapter 3.1, and the "St" type parameter, which specifies the functional measure used to compute the functional distances.

According to the variety of uses of the cluster method, it is necessary to set suitable parameters and an evaluation metric for the suitability of various combinations of these parameters. Such a metric will become the Average Silhouette Width (ASW). (Batool & Hennig, 2021)

The average Silhouette Width of clustering ϕ is

$$\bar{S}(\phi, d) = \frac{1}{n} \sum_{i=1}^n S_i(\phi, d) \quad (1)$$

where the S_i is the silhouette value of datapoint (i)

$$S_i = \frac{b(i) - a(i)}{\max(a(i), b(i))} \quad (2)$$

where $a(i)$ is the average distance of x_i to points in the cluster to which it was assigned,

and $b(i)$ is the average distance of x_i to the points in the nearest cluster to which it was not assigned.

S_i takes on the values $[-1; 1]$. If the data are appropriately clustered, the S_i value is close to 1, otherwise, the Silhouette value close to -1 indicates that data would be preferable if clustered in a neighboring cluster. Variables on the boundary of two natural clusters are represented with S_i close to zero.

Since clusters are intended to be homogeneous and well-separated, thus larger values indicate better clustering quality. Therefore, the optimal clustering (if different values are compared) is considered to be the one where the ASW values are maximized.

The variety of parameter settings in our case will mainly be in the setting of the "smoothing" parameter and the expected number of clusters. The first one represents the number of days taking into account the trend of the model. Due to the reflection of the exchange rates on the mentioned variables and the observed goal of the medium-term behavior of the explained and explanatory variables, we move to the limit of 2-4 weeks, i.e. the tested values move to the range of 2, 3 and 4 working weeks). The second variable parameter is the expected number of determined clusters. Due to the

number of tested variables (32 variables) and the ideal number of variables entering the regression model (10 variables), we set the number of clusters to be tested at 6-10.

3 Research results

In the results chapter, the first part offers the results of the selection of the "smoothing" parameter for the length of the chosen trend period and the number of selected and monitored clusters. The second part is focused on the clusters themselves and their separate performance.

3.1 Setting parameters of cluster analysis - smoothing and number of clusters

The performance results of the cluster analysis for various combinations of these parameters are offered in the following Table 1. It is noticeable that a higher number of clusters and at the same time a longer period of the monitored trend also offer a higher ASW value and thus also the accuracy of the cluster analysis. At the border of the 9th and 10th clusters, the accuracy value breaks down, and we, therefore, evaluate the number of 9 clusters and the length of the trend of the monitored period as an ideal combination of four working weeks.

Table 1: ASW results for combinations of smoothing parameter and number of clusters

Smoothing par./ number of clusters	6	7	8	9	10
2 weeks	0,1541796	0,1589222	0,1870644	0,2083123	0,2040698
3 weeks	0,1568741	0,167891	0,1876303	0,2089254	0,2039036
4 weeks	0,1586368	0,1691971	0,1882855	0,2089787	0,2038783

3.2 Results of functional cluster analysis

Using the set parameters to determine the observed trend and the defined number of clusters, the performance of the cluster analysis itself offers us the following results.

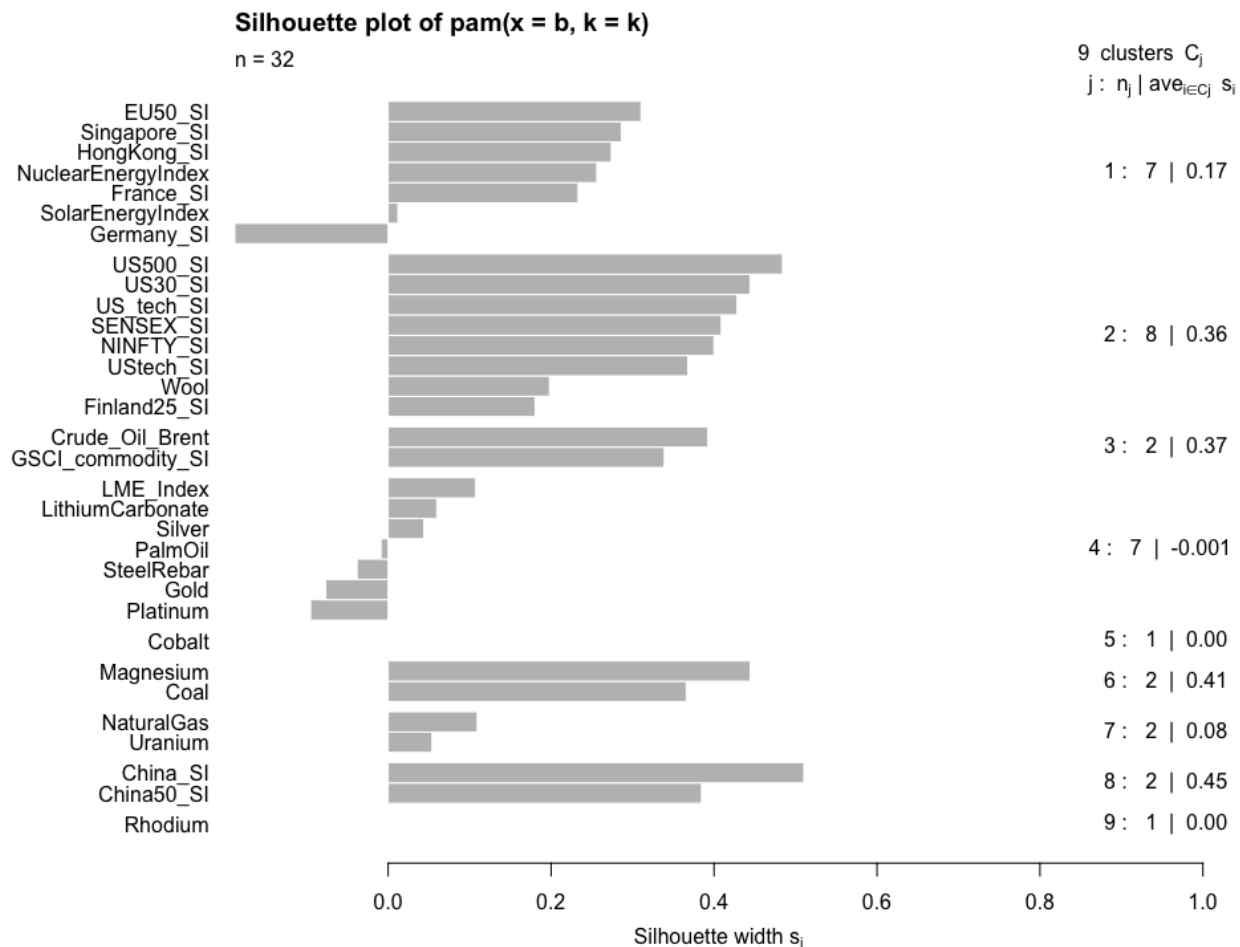
The monitored 32 variables are divided into 9 clusters. This distribution can be seen in the following Table 2. In Figure 1 we also see a detailed distribution and ASW value for each of the observed variables as the same as the closest neighbor of the variable.

Table 2: Distribution of variables through clusters

Cluster	Name variable	Neighbor	Cluster	Name variable	Neighbor
1	EU 50_SI	2	4	LME_Index	1
	Singapore_SI	2		LithiumCarbonate	6
	HongKong_SI	2		Silver	3
	NuclearEnergyIndex	2		PalmOil	1
	France_SI	2		SteelRebar	6
	SolarEnergyIndex	2		Gold	1
	Germany_SI	2		Platinum	3
2	US500_SI	1	5	Cobalt	2
	US30_SI	1	6	Magnesium	4
	US_tech_SI	1		Coal	4
	SENSEX_SI	1	7	NaturalGas	6
	NINGTY_SI	1		Uranium	4
	UStech_SI	1	8	China_SI	1
	Wool	1		China50_SI	1
	Finland25_SI	1	9	Rhodium	2
3	Crude_Oil_Brent	4			
	GSCI_commodity_SI	1			

Source: Own processing

Figure 1: Silhouette plot of the clusters



Source: Own processing

As mentioned in the previous chapter S_i takes on values $[-1;1]$. The higher the values, the greater the "encapsulation" of the function inside the cluster. Otherwise, the lower (negative) value of S_i , the less it belongs to the given cluster and the greater its probability of leaving the cluster.

The first cluster represents variables with a gradual but noticeable increasing trend combined with specifically three noticeable contortions in the trend curves. Its representatives are EURO STOXX 50³, Singapore and Hong Kong Stock Indexes, France and German Stock indexes, and both Nuclear and Solar energetical indexes.

The second cluster is represented by an even stronger increase in trend lines, as its members are US stock indexes (US 500, US 30, and both US tech indexes), both Indian stock indexes (SENSEX and NIFTY), and surprisingly the prices of Wool commodity and Finland stock index (HEX 25). However, as seen in Figure 12 and in Table 2 both last named are not the strongest members of the second cluster.

The third cluster, however, contains two variables that perform strongly similarly. The prices of Crude oil (traded in the BRENT system) and the GSCI commodity index⁴. Both variables declare strong dependence and correlation, as the prices of crude oil might be a significant part of the GSCI commodity index itself.

The fourth group might be called the commodity group, as it contains the LME Index⁵, Lithium Carbonate, Silver, Steel Rebar, Gold, and Platinum are the metal representatives supplemented with the Palm Oil variable. The cluster itself

³ It includes the 50 most important companies of the Eurozone. Those are so-called blue-chip companies considered leaders in their respective sectors.

⁴ Goldman Sachs Commodity Index actually contains twenty-four different commodities over various sectors (energy, industrial commodities, precious metals, agriculture, or livestock products).

⁵ London Metal index (six different metals aluminum, copper, lead, nickel, tin, and zinc).

is represented by a very strong rise at the beginning of the period (2008), followed by a downward trend and gaining strength exceeding historical values at the end of the observed period.

The fifth cluster is defined by just one variable, which is Cobalt. The cluster is characterized by a strong peak followed by a long period of gradual decline. Towards the end of the observed period, there is again a significantly increasing behavior of the trend curve.

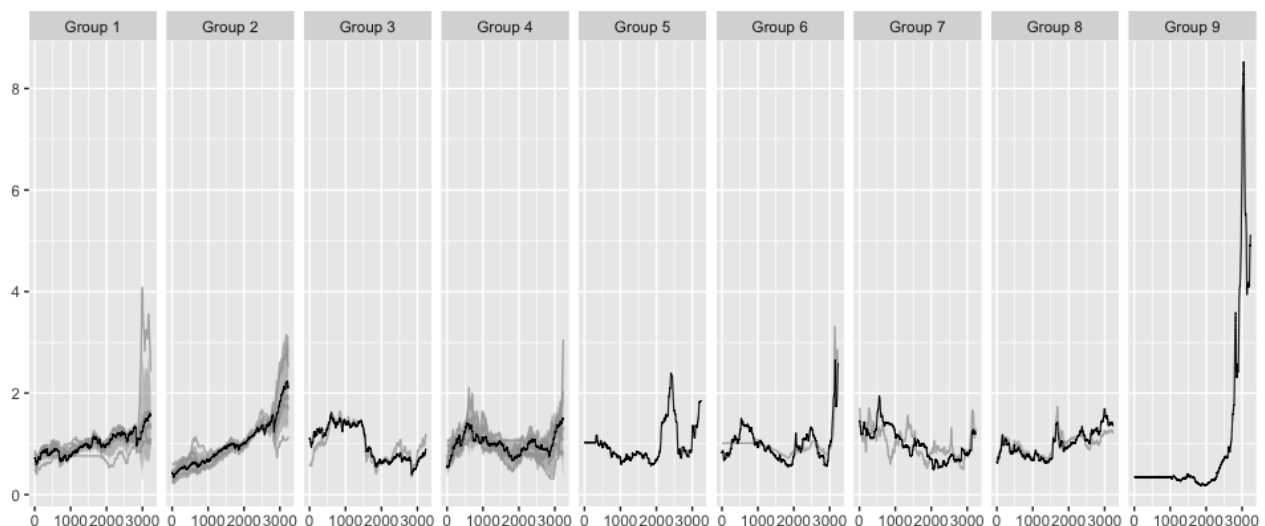
The sixth cluster is defined by both the prices of Magnesium and Coal. Thus, the cluster is specific with major peaks and an exceptionally high increase towards the end of the period, in the order of multiples of past values.

Both members of the seventh cluster are major commodities of the energetical sector – Uranium and Natural Gas. As is seen in both Table 2 and Figure 2, the trend is a long-term decline, hitting its bottom towards the end of the trend period, followed by a rapid rise.

The Eight group is represented by the two Chinese stock indexes (SHANGHAI 50 and China Shanghai Composite Stock Market Index). Both variables perform exactly the same and slightly follow another Chinese representative in the first cluster, as this one is the closest neighbor (as seen in Table 2).

Finally, the ninth cluster is again represented by a single variable – the Rhodium. Its extraordinary raising trend is out of measurements of another cluster. The value of the variable follows usability in industrial use.

Figure 2: Trend development of clusters and ranked variables



Source: Own processing

Clusters defined in this way, or their representatives cover the portfolio of monitored variables and as individual attributes can enter further analyses, for example, the aforementioned quantile regression, which is the next phase of the author's research. For the purpose of further use, the strongest representative from each cluster would be used, i.e. the variable with the highest Silhouette value, i.e. the so-called medoid.

4 Conclusions

The search for significant links between exchange rates and external variables - potential predictions - is part of the fundamental analysis of exchange rates. However, unlike other predictable quantities, the number of variables potentially acting as predictors in the case of exchange rates is considerable, and their mutual correlation or substitutability is hypothetically quite fundamental. The cluster analysis method is one of the possible approaches to the selection of mutually replaceable variables and the final selection of the most relevant groups, which can then enter the final prediction models.

The above-described application of the functional cluster analysis aimed to identify separate clusters from a group of 32 randomly selected representatives of commodities and stock markets groups and then identify their most typical representatives. Cluster analyses are then run on the basis of the trend behavior of sub-variables.

As described in chapter 3. Research results, the ideal distribution represents 9 separate clusters whose representatives show very similar trend behavior. In other words, the representatives of these clusters will perform more or less ambivalently, so they are mutually replaceable. It is certainly promising information that the offered clusters also connect variables cooperating on a "technical level", e.g. different stock market indices listed by the same stock exchanges listed in the same cluster, or the cluster of significantly linked precious metal commodities and commodity indexes, etc. This fact then confirms the credibility of cluster analysis even for supporters of technical analysis. Out of these clusters, it is possible to identify the so-called medoids, i.e. the strongest representatives of the given cluster, and use these representatives for the needs of further analysis.

The logical next steps would be the application of cluster analysis to a larger portfolio of variables and a test of the quality and benefit of the predictive ability when applied directly to currency rate prediction models.

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References

- Batool, F., & Hennig, C. (2021). Clustering with the Average Silhouette Width. *Computational Statistics & Data Analysis*, 158. DOI: 10.1016/j.csda.2021.107190
- Dai, W., Athanasiadis, S., & Mrkvička, T. (2022). A New Functional Clustering Method with Combined Dissimilarity Sources and Graphical Interpretation. In R. López-Ruiz (Ed.), *Computational Statistics and Applications*. IntechOpen. DOI: 10.5772/intechopen.100124
- Englama, A., Duke, O. O., Ogundipe, T. S., & Ismail, F. U. (2010). Oil price and Exchange Rate Volatility in Nigeria: An Empirical Investigation. *CBN Economic and Financial Review*, 48(3), 31-48.
- Grydaki, M., & Fontas, S. (2011). What Explains Nominal Exchange Rate Volatility? Evidence from the Latin American Countries. *Discussion Paper*, 2010(10).
- Hassan, A., Abubakar, M. 'ilu, & Dantama, Y. U. (2017). Determinants of Exchange Rate Volatility: New Estimates from Nigeria. *Eastern Journal Of Economics And Finance*, 3(1), 1-12. DOI: 10.20448/809.3.1.1.12
- Lee-Lee, C., & Hui-Boon, T. (2007). Macroeconomic factors of exchange rate volatility [Online]. *Studies In Economics And Finance*, 24(4), 266-285. DOI: 10.1108/10867370710831828
- Myllymäki, M., & Mrkvička, T. (2020). GET: Global envelopes in R. *arXiv:1911.06583 [stat.ME]*.
- Myllymäki, M., Mrkvička, T., Grabarnik, P., Seijo, H., & Hahn, U. (2017). Global envelope tests for spatial processes [Online]. *Journal Of The Royal Statistical Society: Series B (Statistical Methodology)*, 79(2), 381-404. DOI: 10.1111/rssb.12172
- Mirchandani, A. (2013). Analysis of Macroeconomic Determinants of Exchange Rate Volatility in India. *International Journal Of Economics And Financial Issues*, 3(1), 172-179.
- Stančík, J. (2007). Determinants of Exchange-Rate Volatility: The Case of the New EU Members. *Czech Journal Of Economics And Finance (Finance A Uver)*, (57), 414-432.
- Trading Economics. (2022). Retrieved September 22, 2022, from <https://tradingeconomics.com/>

Expansion of cloud computing in V4 countries

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Abstract: Currently, the trend of information technology transformation towards cloud computing is becoming increasingly apparent. This trend brings with it a number of advantages, but also concerns and limitations for end customers. The question therefore arises as to how Czech small and medium-sized enterprises react to this trend and whether they embark on the implementation of applications based on cloud computing. If they are already starting to implement it, then what types? Are only basic applications that do not require complex implementation of interest to businesses, or are they also starting to implement more complex applications? This article looks at the dynamics of cloud computing development in Czech small and medium-sized enterprises and compares them with developments at the level of the European Union and the Visegrad Four countries.

Keywords: Cloud computing, SME, cloud adoption, cloud application usage

JEL Classification: A30, C40, O33

1 Introduction

Over the past decade, advances in computing have made it possible to build cost-effective and computationally efficient large data centres for public cloud service providers. Due to the benefits of this IT delivery concept, the concept has been positively received by service providers. The cloud computing (CC) model transforms information technology into the form of public service provision – a commodity concept of service. (Alkhalil, Sahandi, & David, 2017)

Thanks to the possibility of commoditizing company information technologies, the transformation from software operated on-premise (on the company's own resources) to a cloud computing (CC) environment is a current issue in a number of Czech companies. This trend is nothing new, it was already manifested in Western countries in the last decade. (Ramchand, Chhetri, & Kowalczyk, 2021) (Senarathna, Wilkin, Warren, Yeoh, & Salzman, 2018) However, thanks to the long-life cycle of IT projects and the slight delay, it is currently becoming more and more evident in the environment of small and medium-sized enterprises in the territory of the Czech Republic.

Especially for small and medium-sized enterprises, cloud computing could be an ideal solution for the change of information technology, taking into account the presented advantages. It is necessary to add that among the available cloud infrastructures, the solution that is referred to as the public cloud is thought of. (Gutierrez, Boukrami, & Lumsden, 2015) The most important and commonly known public cloud providers (CSP) include Microsoft, Amazon, Google, and Red Hat. It is the public cloud that represents the infrastructure operated by the cloud service provider, which enables access to the infrastructure, platform, and system through a defined interface. Such a solution has a number of advantages such as overall reduction of capital expenditure, ease of implementation, high availability and others. (Alouffi, and others, 2021)

Through the public cloud, it is possible to purchase services divided into three models. The difference between the individual models is mainly in the ratio of parts of the system that are managed by the CSP and the customer. The first model is infrastructure as a service (IaaS). It is typical for this model that CSP only takes care of the operation of the hardware itself and the virtualization of individual components. The rest is up to the customer. In this model, the customer manages everything from the middleware to the application. The most common charging model is the "pay as you go" model. The second model is Platform as a Service (PaaS). For the PaaS model, the CSP additionally manages the middleware and run-time environment. The customer has control over the application and data. As an example, we can mention frequently used web servers. Again, very often charged with a "pay as you go" model. The third model is software as a service (SaaS). When using the SaaS model, the CSP manages everything, including the data and the application.

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Thus, CSP provides a ready-made application, running on cloud infrastructure, which is accessible to users through a web browser, desktop or mobile application. In this case, CSP also provides updates of the entire solution and at the same time ensures data backup. A typical charging model is payment per user and / or application. This also ensures complete licensing of the solution for the end customer. (Nguyen & Liaw, 2022) (Abdel-Basset, Mohamed, & Chang, 2018)

In addition to the mentioned advantages, individual solutions also have perceived disadvantages. In expert article, there is often a company's concern about the possibility of their data being misused. Alternatively, the company's concern about losing control over the entire solution and completely handing over its applications to CSP management. With this, CSPs can work through public opinion and prevent such a scenario with their own processes. (Christiansen, Haddara, & Langseth, 2022) (Habib, Hauke, Ries, & Mühlhäuser, 2012)

In this article, we want to focus on Czech small and medium-sized enterprises that have already implemented and operate cloud computing. In this contribution, we want to provide information on the rate at which implementations are increasing within this spectrum of businesses and compare this rate with the surrounding Visegrad 4 states and the European Union (representation of 27 countries as of 2020). Furthermore, we want to offer a view of the representation of basic groups of applications provided through cloud computing.

2 Methods

As part of the methodology, we focus only on small and medium-sized enterprises that purchase services based on cloud computing via the Internet. It is the public cloud that seems to be the ideal solution for small and medium-sized businesses. The first research question we want to answer is the evaluation of the dynamics of the development of cloud implementations. For this evaluation, we will use indices and compare the dynamics of development with the V4 countries and the EU as a whole. The second research question is whether enterprises use all cloud-provided applications equally. For the evaluation, we will perform a conversion to the percentage representation of individual applications from the total share of companies using cloud computing.

The input data was obtained from the freely accessible Eurostat database, where an own dataset was created based on data from the category Science, technology, digital society / Digital economy and society / ICT usage in enterprises / E-business. Table 1 shows the percentage representation of companies using cloud computing for individual geopolitical areas, divided by size into small and medium-sized enterprises for the given period. Table 2 shows the percentage representation of companies from the sector of small and medium-sized companies using a given type of application for individual geopolitical regions and periods.

Table 1 – Percentage of enterprises buying CC services used over the internet

Time		2016	2017	2018	2020	2021
GEO	Enterprise size					
EU (from 2020)	Small	17	N/A	21	34	38
	Medium	26	N/A	34	46	53
Czechia	Small	17	20	24	26	42
	Medium	22	27	34	37	47
Hungary	Small	11	15	15	22	23
	Medium	19	23	29	37	41
Poland	Small	6	8	9	21	24
	Medium	13	17	19	38	43
Slovakia	Small	17	21	19	23	33
	Medium	21	27	26	33	47

Source: Own processing based on Eurostat (Eurostat, 2022)

Table 2 – Percentage of enterprises buying specific CC services used over the internet (SE – Small enterprises, ME – Medium enterprises)

Time		2016		2017		2018		2020		2021	
GEO	CC service \ Enterprise size	SE	ME	SE	ME	SE	ME	SE	ME	SE	ME
EU (from 2020)	e-mail	11	16	N/A	N/A	14	23	25	34	30	41
	office software	7	10	N/A	N/A	10	17	19	28	23	35
	hosting enterprise's database	8	11	N/A	N/A	10	16	15	23	17	24
	storage of files	10	16	N/A	N/A	14	22	22	32	25	36
	finance or accounting software	6	7	N/A	N/A	8	11	16	18	19	22
	CRM software	4	7	N/A	N/A	6	10	8	14	9	16
	CC power to run own software	3	6	N/A	N/A	4	8	7	13	8	14
Czechia	e-mail	13	15	16	20	19	25	20	29	34	39
	office software	7	8	9	14	13	20	16	24	36	41
	hosting enterprise's database	5	7	8	12	8	12	10	15	11	21
	storage of files	8	11	12	16	15	23	17	25	25	33
	finance or accounting software	5	6	8	9	9	10	11	13	23	21
	CRM software	3	6	4	7	5	8	7	9	6	11
	CC power to run own software	3	6	3	7	4	7	8	14	4	5
Hungary	e-mail	7	13	10	16	11	21	16	29	16	31
	office software	5	10	7	12	9	16	13	24	13	28
	hosting enterprise's database	4	7	5	8	6	10	11	17	10	18
	storage of files	6	10	8	14	9	17	15	25	13	27
	finance or accounting software	4	6	5	8	5	10	8	13	9	17
	CRM software	3	5	3	7	4	8	5	9	4	11
	CC power to run own software	2	4	4	7	5	8	7	13	7	14
Poland	e-mail	4	10	5	12	6	13	15	30	19	34
	office software	2	5	3	7	4	10	13	24	15	28
	hosting enterprise's database	3	6	3	8	3	6	7	13	6	12
	storage of files	3	8	5	11	4	10	10	22	9	20
	finance or accounting software	2	3	2	4	3	4	8	11	8	10
	CRM software	2	2	2	4	2	4	4	8	4	8
	CC power to run own software	1	2	2	3	1	3	3	6	2	5
Slovakia	e-mail	14	16	18	20	16	21	19	30	29	39
	office software	9	9	11	15	12	14	14	23	21	31

	hosting enterprise's database	5	8	7	10	7	10	9	15	13	15
	storage of files	8	11	10	15	11	15	13	23	19	31
	finance or accounting software	8	8	10	10	9	10	11	15	18	21
	CRM software	3	4	5	7	5	8	6	10	10	11
	CC power to run own software	4	6	5	7	4	8	6	11	8	11

Source: Own processing based on Eurostat (Eurostat, 2022)

3 Research results

As part of the data evaluation, we only encountered the unavailability of some data. For the year 2017, data on the percentage of cloud usage in an aggregated form for the entire EU is not available. Other unavailable data is for 2019, which is not available at all.

3.1 Adoption of cloud computing

When evaluating the overall representation of companies using cloud computing, it is positive for Czech companies that neither at the beginning nor at the end of the monitored period do we find a significant difference compared to the European Union as a whole. We see similar results in Slovakia, which is comparable to the Czech Republic in terms of deviation from the EU as a whole. In this respect, Poland and Hungary show greater differences compared to the EU. In the case of Hungary, the gap with the EU increased at the end of the monitored period compared to the beginning of the monitored period.

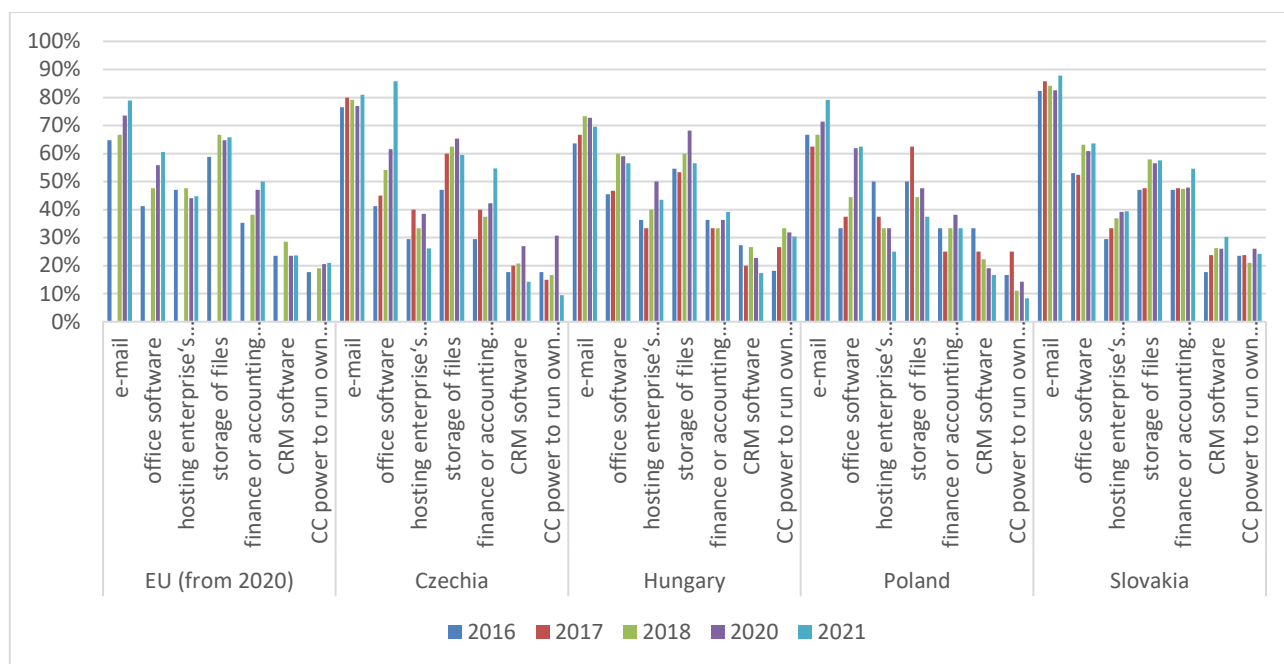
Evaluating the dynamics of development is difficult, as year-on-year comparisons are complicated by missing data. We made the comparison against the starting year 2017. Based on this comparison, we have identified the most significant growth for the EU, Hungary and Poland in the period 2020. Here it is possible that a wave of sharp increase appeared already in 2019, this cannot be confirmed or excluded. Conversely, in the Czech Republic and Slovakia, the greatest growth did not occur until 2021. For small Czech businesses, this means a 61.5% year-on-year increase in companies using cloud computing, and a 27% increase for Czech medium-sized businesses.

We attribute the increase that occurred in some countries in 2020 or 2021 to changes caused by the corona virus pandemic, together with various forms of support in individual states.

3.2 Type of services

In the relative comparison of small companies for each observed period, there are common features for all countries. Small companies primarily focus on services, that have low technological complexity, and have rapid implementation. These are email services and office software. Within small businesses in the Czech Republic, office software experienced significant growth, from a share of 62% to 86%. Email services based on cloud computing for the entire monitored period copy the development of the use of the cloud as a whole. In the case of the purchase of storage for files, this is again a more than half representation of these services, and with the exception of Poland, we can observe a growth trend. The lowest use of cloud services in the Czech Republic for small businesses is seen in the purchase of computing power to run their own software, where Czech small businesses experienced the most significant drop from 31% to 10% in 2021. While, the European-wide share is 21% in 2021, and other countries are following this trend. In the overall overview of purchased services, this is the least purchased commodity. All this is shown in detail in Figure 1.

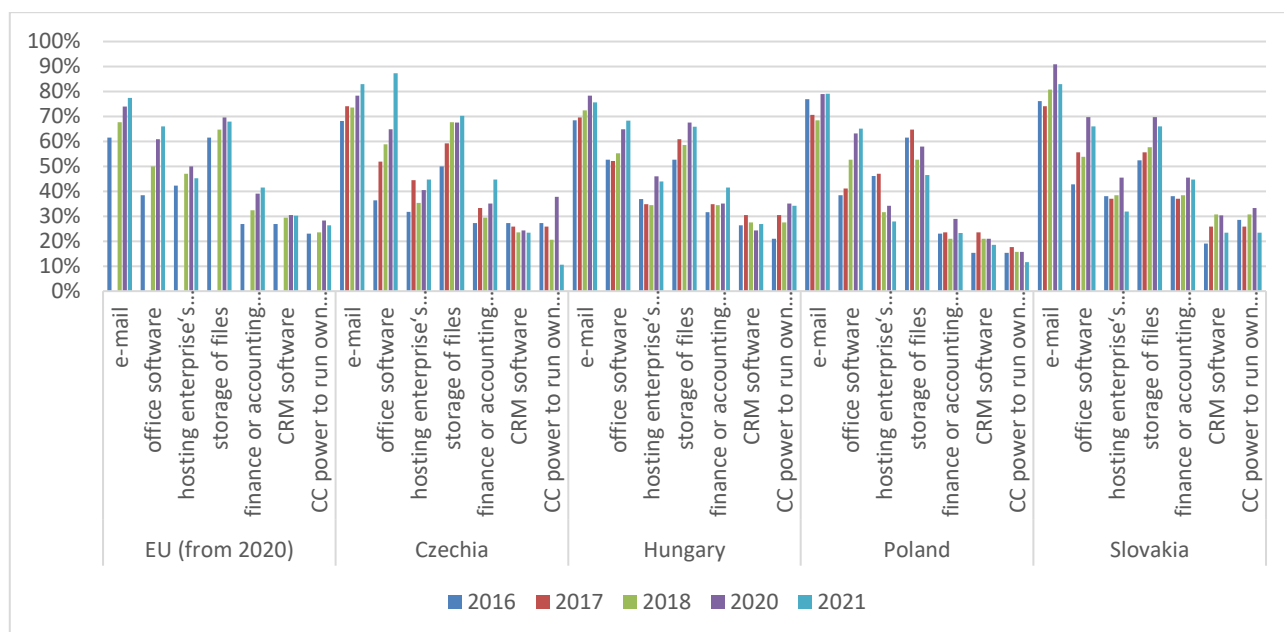
Figure 1 – Relative percentage usage of cloud services in small enterprises



Source: Own processing

In a relative comparison of medium-sized companies for individual monitoring periods, common features are again identifiable. Like small companies, medium-sized companies focus more on services that are not too technologically complicated and can be implemented quickly. Again, this is mainly about services for email and office software. It is interesting that for Czech medium-sized enterprises we can once again identify significant growth in office software between 2020 and 2021. Specifically, it is a growth from 65% to 87%. We have not seen similar growth in any other geographic area. If we look at another significant change, we can again identify a significant decrease for Czech medium-sized enterprises in the purchase of computing power to run their own applications between 2020 and 2021. In percentage terms, this is a decrease from 38% to 11%. The European-wide average for this commodity is around 26%, and other countries, with the exception of Poland, follow this trend. All this is shown in detail in Figure 2.

Figure 2 – Relative percentage usage of cloud services in medium enterprises



Source: Own processing

If we compare the distribution for individual geographical areas and periods in relation to the size of the company, we will find that there are no significant differences between small and medium-sized companies in terms of the choice of services provided by the form of cloud computing.

The three most represented services are email services, office software and file storage. It is these services that are often offered in the form of SaaS, thanks to which companies can easily determine the costs of their solutions in advance with great accuracy. At the same time, the services offered are generally simple and easily acceptable. In doing so, we can support the findings from articles focusing on the factors affecting the adoption of cloud computing as a whole, which claim that service complexity has a negative effect on cloud adoption.

The least represented service is the purchase of computing power. We expected this mainly because of the complexity of the given solution. Businesses may mistakenly believe that by purchasing computing power (typically IaaS) they will easily transfer their entire infrastructure to the cloud. However, the problem arises during operation. Migrated applications are not optimized for operation in a cloud environment, and in particular inappropriate use of resources can make services based on the "pay as you go" charging model significantly more expensive.

4 Conclusions

The evaluation of the dynamics of the development of Czech small and medium-sized enterprises compared to the average of the European Union is ambiguous due to the missing year 2019. Based on this, it cannot be said that the delay of Czech companies compared to the EU as a whole is one or two years. However, there is some delay. It is interesting that at the beginning of the monitored period the average of the EU and the Czech Republic and Poland was very similar, and 5 years later the percentage representation of companies using cloud computing in these countries is again very similar. However, the year-to-year changes are very different. In the case of small businesses from Slovakia and Hungary, we identify a slight lag compared to Czech small businesses and the EU average. Slovak medium-sized enterprises caught up with Czech medium-sized enterprises only in the last year of the monitored period and reached the same percentage representation. In the monitored period, Hungarian medium-sized enterprises have the smallest representation of companies using cloud computing of all monitored geographical areas.

From the point of view of cloud computing-based services used, it has been confirmed to us that companies are increasingly implementing services that are technologically simple, easier to grasp and quick to implement. We explain this state precisely by the simplicity and friendliness of these services. At the same time, we think that the simple determination of the total costs incurred for the operation and licenses of the given solution also contributes to this. The three most frequently represented services have in common that they are most commonly provided in the SaaS mode. Furthermore, it is interesting that we do not identify significant differences between small and medium-sized enterprises in terms of the use of services based on cloud computing. Here again, a simple determination of the total costs incurred for operation probably plays a role. In our future research, we will focus on the representation of individual cloud computing services in Czech small and medium-sized enterprises and try to clarify why and how individual services are chosen.

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References

- Abdel-Basset, M., Mohamed, M., & Chang, V. (2018). NMCDA: A framework for evaluating cloud computing services. *Future Generation Computer Systems*, 12-29.
- Alkhalil, A., Sahandi, R., & David, J. (2017). An exploration of the determinants for decision to migrate existing resources to cloud computing using an integrated TOE-DOI model. *Journal of Cloud Computing*, 1-20.
- Alouffi, B., Hasnain, M., Alharbi, A., Alosaimi, W., Alyami, H., & Ayaz, M. (2021). A systematic literature review on cloud computing security: Threats and mitigation strategies. *IEEE Access*, 57792-57807.
- Eurostat. (01. 09 2022). *Data Browser*. Načteno z Eurostat:
https://ec.europa.eu/eurostat/databrowser/view/ISOC_CICCE_USE/default/table?lang=en&category=isoc.isoc_e.iso_c_eb
- Gutierrez, A., Boukrami, E., & Lumsden, R. (2015). Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK. *Journal of enterprise information management*.
- Habib, S. M., Hauke, S., Ries, S., & Mühlhäuser, M. (2012). Trust as a facilitator in cloud computing: a survey. *Journal of Cloud Computing: Advances, Systems and Applications*, 1-18.

- Christiansen, V., Haddara, M., & Langseth, M. (2022). Factors affecting cloud ERP adoption decisions in organizations. *Procedia Computer Science*, 255-262.
- Nguyen, G. T., & Liaw, S.-Y. (2022). Understanding the Factors Affecting the Small and Medium Enterprises Adoption of Cloud computing: A Literature Review. *International Journal of Business, Management and Economics*, 149-162.
- Ramchand, K., Chhetri, M. B., & Kowalczyk, R. (2021). Enterprise adoption of cloud computing with application portfolio profiling and application portfolio assessment. *Journal of Cloud Computing*, 1-18.
- Senarathna, I., Wilkin, C., Warren, M., Yeoh, W., & Salzman, S. (2018). Factors That Influence Adoption of Cloud Computing: An Empirical Study of Australian SMEs. *Australasian Journal of Information Systems*, 1-31.

Consumer prices forecasting based on ARIMA models

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Abstract: High consumer prices and high inflation afflicted many countries in the world recently. The cause is the Covid epidemic and Russian aggression in Ukraine, which primarily led to an increase in energy prices. In the Czech Republic, the inflation reached 17.5% in June 2022. The rapid increase of consumer prices has consequences. The number of poor people that depend on social benefits is growing. Government prepares measures and subsidies and for low income households. For policymaking and planning, a projection of the consumer prices development in the future is needed. Therefore, the aim of the paper is to project the prices of basic food: bread, butter, milk, poultry, potatoes, sugar, and eggs. The data were taken from Czech Statistical Office with monthly frequency for the period of 2010–2022 in order to have long time series. We applied Box-Jenkinson methodology – SARIMA and ARIMA models and modelled the development of the time series and forecast to the future 12 months. For bread prices forecast, an ARIMA model is preferred. In case of butter, both models forecast slight decrease of price. and we cannot clearly conclude which model is better. In case of milk projection, SARIMA is in contrast with ARIMA, but both models could be realistic as the price of milk is very volatile throughout the whole period. For price of chicken and potatoes, both forecasts are in contrary, but ARIMA is more probable. SARIMA model projects more realistic development of sugar price. In case of eggs price, both models project stabilization, so it cannot be concluded which model is preferred. However, econometric correctness and the best fit of the model is not a guarantee that projected values would meet the expectations based on the theory and practical experiences.

Keywords: ARIMA models, consumer prices, forecasting, inflation

JEL Classification: C53, E31

1 Introduction

Increase of consumer prices and high rate of inflation afflicted many countries in the world recently. The rate of inflation is expressed by the increase in the Consumer Price Index (CPI) in comparison to the base year, previous year or previous month. CPI consists of the consumer basket of products and services that are consumed by the households. The consumer basket is developing in time and currently contains around 850 items in the Czech Republic (CR). Also, the weight representation of individual items in the basket changes, but the share of food and non-alcoholic drinks is still dominant (it was 17.8% in 2022 in the CR). The rapid rise in consumer prices has negative societal consequences. The number of poor people that depend on social benefits is growing and the government must take effective measures. After years of relative stability of inflation in the CR, its development in year 2022 is not favourable. The CPI compared to the same month of the previous year reached two-digit values already in January. After years of low inflation below 3%, the inflation started to grow in 2021 due to Covid-19 pandemic. Later, the war at Ukraine and increasing prices of energies caused even more rapid price increase. The Czech Central Bank took the measures to lower the inflation (rise of interest rates) as it is targeting the inflation. However, “high impact of food prices on CPI, accompanied by food price volatility seriously hampers conduct of inflation targeting of the central bank.” (Šoškić, 2015). According to Czech Statistical Office ((ČZSO), 2022), the inflation in the Czech Republic started to increase since July 2021.

Inflationary pressures can come from either the demand side or the supply side. “Food inflation may be coming from the demand side if the increase in income of households is fuelling the demand and pushes the food prices up.” (Šoškić, 2015) On the other hand, shortage of certain commodities can raise their prices and cause supply driven inflation. Inflation in the Czech Republic is among the highest in the EU, after the Baltic states. Food prices are an important component of the consumer price index, which pushes inflation up. On average, they grow at the sixth fastest rate in Europe, while some goods, such as fish or soft drinks, remain more or less at pre-crisis prices. It is discussed to what extent the price increase

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is due to the price policy of supermarkets, which increase the price of food (e.g. bread, butter, milk, flour and sugar) more than the commodity prices are increasing. There is not lack of the commodities, so other factors are the cause.

1.1 Literature review

Projections of the inflation rates are done by central banks and many scholars. Besides, “reliable price forecasts can aid cash flow management and improve farm production decision planning: what and how much feed to grow, what time of year to produce.” (Hansen, 2020) There are many various models which has been continually developed and enhance as inflation rate is one of the basic economic indicators. For example, Hassani and Silva (2018) exploited auxiliary information contained within United Kingdom inflation forecasts and modelled the inflation by Multivariate Singular Spectrum Analysis. First, they applied a variety of parametric and nonparametric models to generate univariate forecasts of inflation and chose the best univariate forecast. This is then included into the multivariate analysis together with data as an auxiliary information. They recommend this method because it is multivariate and brings the most accurate results. Bradley, Jansen and Sinclair (2015) examined whether excluding food and energy prices from the Consumer Price Index (CPI) produce a measure that better captures permanent price changes. They found out that “the permanent component of the core CPI is much more volatile than the actual core series and that the core excludes volatile permanent shocks to the overall price level”. Besides, the core CPI series is not correctly characterized as having only permanent movements, and the food and energy time series are not correctly characterized as having just temporary movements.

Some researchers focused on the consumer food prices that takes significant share of CPI. García-Germán, Bardají and Garrido (2015) used error correction models to evaluate the extent at which world agricultural commodity price movements affect consumer food prices in the EU. There was found a long-run relationship between world agricultural commodity and consumer food prices in over half of the member states. Li and Zhao (2015) examined the CPI for food in China. They found that fluctuation of CPS for food is clustered, explosive, periodic, has decreasing amplitude and its fluctuation is asymmetric. “The impact of positive information was significantly larger than the equivalent negative impact, so the government's main task is controlling rising inflation of the food commodity prices.” (Li and Zhao, 2015). The asymmetric fluctuation of CPI for food is explained by inflation inertia and the public's expectation effect. El-Ghini and El-Karimi (2020) examined the transformation of world food commodity prices to food inflation in Morocco in years 2004–2018, by using Structural Vector Autoregression (SVAR) model on monthly data.

Our paper focuses on the modelling and forecasting of the consumer prices. Particularly we focus on bread, butter, milk, poultry, potatoes, sugar, and eggs. For modelling of time series of agricultural prices Autoregressive Integrated Moving Average (ARIMA) models are often used. For example, Jadhav, Reddy and Gaddi (2017) forecasted the prices of cereals and Maize in Karnataka based on the data from period 2002–2016. Sangsefidi et al. (2015) used besides ARIMA also Autoregressive Conditional Heteroskedasticity model to predict the prices of potatoes, onion, tomato, and veal. They found out that the ARIMA models had lower relative error. Šimpach and Šimpachová Pechrová (2018) also used two models and compared their results. Besides ARIMA model applied on the time series from 02/2006 to 06/2016 of Czech producers' prices of milk, they also utilized Vector Autoregressive (VAR) model. They found out that ARIMA model showed better prediction capabilities as VAR model was probably missing some variables. Šimpach and Šimpachová Pechrová (2018) modelled prices of beef, poultry and pork meat in the CR. They found out that all timeseries were non-stationary and non-seasonal, and that depend mainly on the price one month ago. For modelling of consumer prices of sugar in period of 09/2016 to 08/2017 in the CR was the optimal model ARIMA (1, 1, 1) as found out by Pechrová and Šimpach (2017a). Pechrová and Šimpach (2017b) examined the development of consumer prices of eggs and projected them into the future. The best model was ARIMA(1, 0, 0) with constant and impulses in crisis months (03, 05, 07/2012).

2 Methodology

We focused on modelling the consumer prices of caraway bread (1 kg), fresh butter (250 g), semi-skimmed milk pasteurized (1 l), whole chicken without offal (1 kg), consumable potatoes (1 kg), sugar crystal (1 kg), and fresh chicken eggs (10 pieces). The data were taken from CZSO with monthly frequency for the period of 2010–2022 in order to have long time series that is needed for chosen methodology (at least 50 and preferably 1000 observations or more should be used (Wang and Zhao, 2009). “The input series for ARIMA needs to be stationary, i.e. it should have a constant mean, variance, and autocorrelation through time.” (Novković et al., 2019)

First, Fisher F-test and Kruskal-Wallis for seasonality testing were applied on each time series. If there is significant seasonality, it has to be modelled. Then we can consider two types of models (see below). Consequently, the stationarity of the time series was tested by augmented Dickey-Fuller test (ADF test).

There are three types of ADF test for stationarity: with constant and trend, with constant only, and without constant and trend. The largest model – ADF with constant and trend – is calculated according the equation (1).

$$\Delta Y_t = c + \gamma t + \beta Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_{t-i} + \varepsilon_t, \quad (1)$$

where ΔY_t is the first difference of the explained variable, Y_{t-1} is lags of explained variable and α and β are their parameters, c represents the constant, t is trend variable and γ is its parameter, m is the maximum length of the lagged dependent variable, and ε_t is pure white noise error term. All three types of models are compared, and the best is chosen based on the statistical significance of the parameters and of the model or based on information criteria (e.g. Akaike information criterion). The null hypothesis is non-stationarity (parameter is equal to zero). Alternative hypothesis states that the parameter is less than 0 (stationarity).

Each time series was modelled by Box and Jenkins (1970) methodology that works with autoregressive (AR) and moving average (MA) processes. When only autoregressive and moving average part is present, then we talk about ARMA model that can be used only when the time series is stationary. If the time series is not stationary, its difference of d^{th} order must be done. Then the model is ARIMA(p, d, q), where p is the order of AR term, d is the number of non-seasonal differences and q is the order of MA term.

Diagnostic of the type of the model was done by Autocorrelation function (ACF) and Partial Autocorrelation function (PACF) that were plotted in order to determine the order p of AR process and order q of MA process. Correlograms of ACF and PACF are simply the plots of ACF and PACF against the lag length (Wang and Zhao, 2009). ARIMA(p, d, q) model is then written as (2).

$$Y_t = c + \sum_{i=1}^p \phi_i Y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j}, \quad (2)$$

where ϕ and θ are parameters. When there is a seasonal component, a model is in a form of SARIMA(p, d, q)(P, D, Q)_s, where P is the order of SAR model, D is order of seasonally differencing, Q is the order of SMA model, and S means the periodicity. Model is then written as (3).

$$Y_t = c + \sum_{i=1}^p \phi_i Y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \sum_{i=1}^P \Phi_i Y_{t-S} + \sum_{j=1}^Q \Theta_j \varepsilon_{t-S} \quad (3)$$

Currently, consumer food prices are difficult to predict because they are subject to many economic shocks. But statistical software nowadays allows to choose an appropriate model. There are algorithms that can calculate all shapes / types of ARIMA and SARIMA models in a relatively short time. It can also perform their diagnostics and evaluation statistics. Based on the selected information criteria, it can then recommend a suitable model. In our paper, we chose Akaike's information criterion. The resulting model was tested whether there was autocorrelation (Breusch-Godfrey serial autocorrelation LM test), homoscedasticity (Autoregressive Conditional heteroscedasticity (ARCH) test) and normality (Jarque-Bera test) of the residues. It is desirable that null hypothesis H_0 (no serial autocorrelation, no heteroscedasticity, normality) are not rejected.

The seasonality of each time series was indicated and examined by Census X12-ARIMA algorithm. If there is a seasonality present, an algorithm tries to seasonally adjust the time series. All our time series contained certain type of seasonality, so we elaborated both models – SARIMA and ARIMA. They were applied on original time series of chicken, potatoes, and eggs and then on non-seasonally differenced time series in case of bread, butter, milk and sugar. The predictions were done for next 12 months. We used software Eviews 10 for the calculations.

3 Results and Discussion

Consumer prices of agricultural commodities usually depends on the industrial producers' prices and agricultural producers' prices. Our chosen method takes into account only previous prices of particular food (commodity) and hence, the projection of the final price for consumer is difficult and the results must be taken with caution. Each type of time series had different ideal model. Results of the timeseries diagnostic are given in Table 1. In case of high data volatility, it is recommended to use their logarithmic transformation. We had to do it in almost all cases with exception of SARIMA and ARIMA models for milk, and ARIMA models for potatoes and eggs.

All analysed time series show some form of seasonality. Fisher or Kruskal-Wallis tests confirmed it in majority of time series. Only the chicken price was clearly non-seasonal time series. Similarly moving seasonality was identified in all prices' development with exception of potatoes.

Seasonality is greater for commodities that have a statistically significant order of P or Q (order of SAR or SMA model). The prices in particular month of bread, milk, and sugar depend on their own prices in the same month last year and the

year before (order of SAR is 2). The prices of butter, chicken, potatoes and eggs depend on the prices in the same month only from last year (order of SAR is 1). The price of bread depends on the price of bread in the previous month according to the SARIMA model. ARIMA model assumes that it depends on the price in the previous 3 months because seasonality is removed in this model. The price of eggs depends on the price of the previous two months according to SARIMA model, while ARIMA states that it is 3 months back. The price of butter, chicken, potatoes and sugar has a longer "memory", it depends on the price in the previous 3 periods according to SARIMA model. ARIMA model states that in case of butter and sugar, the price is dependent only on prices 2 months ago. Chicken price is dependent according to ARIMA on the previous 4-month prices and potatoes price on last 3 prices. The price of milk is dependent even 4 periods back by both models.

Table 1 Optimal models for consumer prices

	Seasonality		Moving seasonality	Optimal model	
	Fisher test	Kruskal-Wallis test		Seasonal	After seasonal adjustment
caraway bread	Yes	Yes	Yes	SARIMA(1,1,1)(2,0,0) ₁₂ in logs	ARIMA(3,1,3) in logs
fresh butter	Yes	Yes	Yes	SARIMA(3,1,2)(1,0,1) ₁₂ in logs	ARIMA(2,1,2) in logs
semi-skimmed milk	No	Yes	Yes	SARIMA(4,1,3)(2,0,0) ₁₂ no logs	ARIMA(4,1,4) no logs
whole chicken	No	No	Yes	SARIMA(3,0,2)(1,0,0) ₁₂ in logs	ARIMA(4,0,1) in logs
potatoes	Yes	Yes	No	SARIMA(3,0,1)(1,0,2) ₁₂ in logs	ARIMA(3,0,4) no logs
sugar crystal	No	Yes	Yes	SARIMA(3,1,0)(2,0,1) ₁₂ in logs	ARIMA(2,1,3) in logs
fresh chicken eggs	Yes	Yes	Yes	SARIMA(2,0,1)(1,0,0) ₁₂ in logs	ARIMA(3,0,2) no logs

Source: own processing

The econometric software performed many models and selected the optimal ones in terms of the Akaike information criteria. In case of bread, it can be seen that SARIMA model has optimal one of the lowest projections. Unlike in ARIMA model where the highest price should reach 45 CZK in 2023 and stabilize, in SARIMA, the price should not overcome 42 CZK/kg. Due to increasing prices of wheat and energies (gas and electricity), the ARIMA scenario seems more realistic. Bread price increased significantly in 2021 and the forecast takes into account this trend. The models just differ in the magnitude of the price increase. The trend of increasing agricultural producers' prices is assumed by the Ministry of Agriculture (MoA, 2021a). "For the marketing year 2021/2022, it is assumed that despite higher cereal production, but with average quality parameters, there will be a significant increase in prices on the cereal market for most commodities, both with regard to European and world cereal production, but above all to the uncertain political situation in Ukraine and Russia and also with regard to the increase of all costs (fuel, electricity, fertilizers, spare parts, etc.)." MoA expects that the monthly average producers' prices of food wheat will reach 6200–7200 CZK which will be reflected in the consumer prices of bread and pastry. For case of Serbia, Novković et al. (2019) found that optimal model for wheat prices projections was ARIMA(1,1,1).

Increase of butter prices is projected by both models, but in case of ARIMA, it is only up to September 2022, while SARIMA shows the peak in November 2022. Nevertheless, SARIMA projection is milder – the prices of butter shall not overcome the threshold of 230 CZK per 1 kg. Surprisingly, ARIMA predicts slight decrease in December 2022. MoA (2021b) proclaimed that "butter prices will continue to decline slightly in real terms in line with most other agricultural commodities over the projection period". However, this is an old projection. As can be seen from Fig 1, the prices increased rapidly in 2021 and first half of 2022, so maybe stagnation is more realistic than such sudden decrease. Hansen (2020) suggested that world-prices of butter are fitted the best by autoregressive process. For their projection AR yielded the best forecast with a reasonable MAPE up to 8–9 months ahead. After 9 months, the SETAR (self-exciting threshold

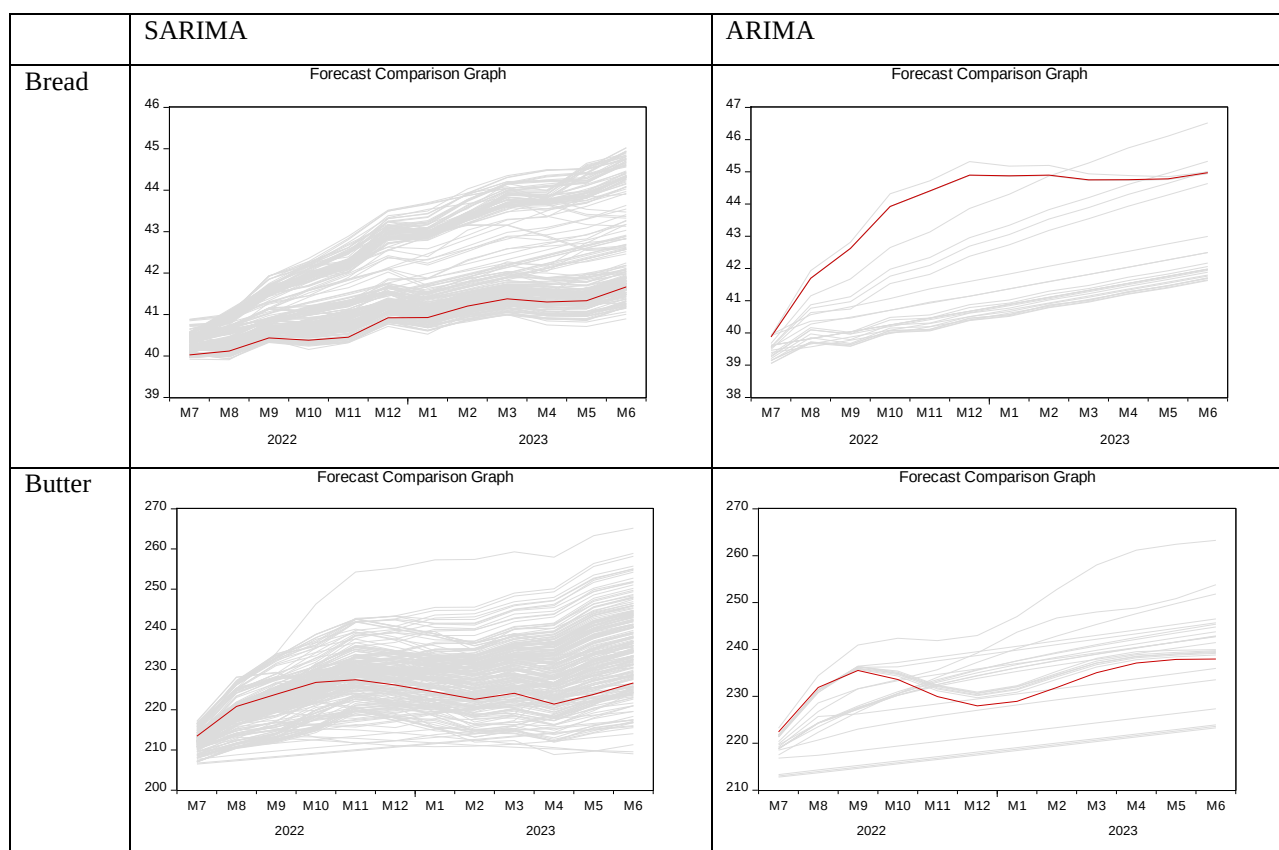
autoregressive model) and the LSTAR (logistic smooth transition autoregressive model) produce equally good forecasts. (Hansen, 2020)

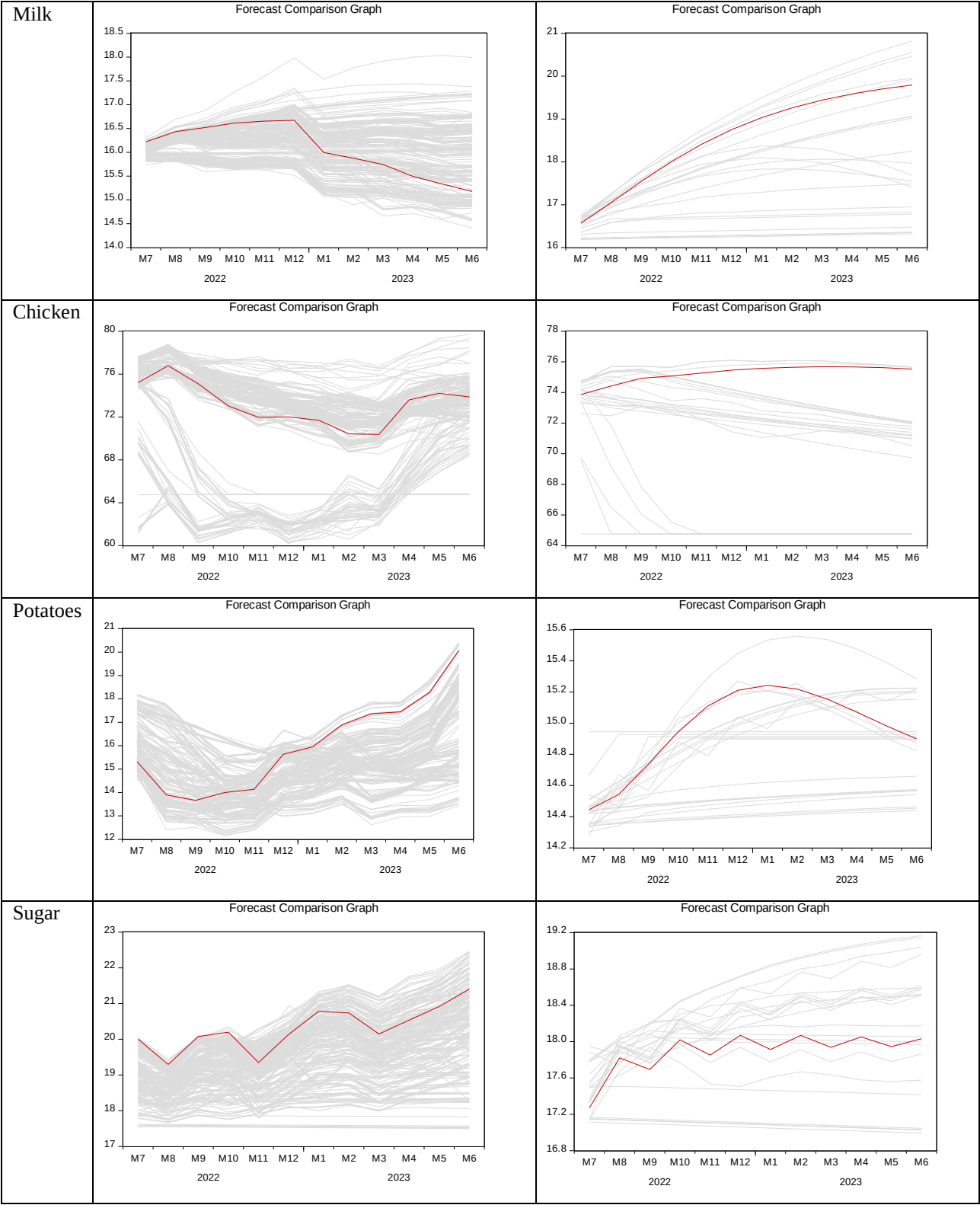
In case of milk, the algorithm chose SARIMA model that predicts decrease of the price in 2023. It might be realistic, because the price was very volatile during the observed period, regardless that the price started to increase rapidly in 2021 (it was the lowest then) and keeps the trend since that. Also, agricultural producers' price has been increasing since 2016. ARIMA model showed high increase of milk price – up to 20 CZK/l in 2023, so the results of both models are in contrast. MoA (2020) expected stabilization of price of skimmed milk powder on the international markets, that would imply that also consumer price could stabilize. Šimpach and Šimpachová Pechrová (2018) projected very low producers' prices in 2018. "ARIMA model suggests prices of milk from 5.97 to 7.06 CZK/l that is more realistic prediction than in case of VAR model that predicts lower prices (5.86–6.38 CZK/l)." (Šimpach and Šimpachová Pechrová, 2018). According to Hansen (2020), for the world price of for skimmed milk powder, whole milk powder, and whey powder the nonlinear methods are the most accurate.

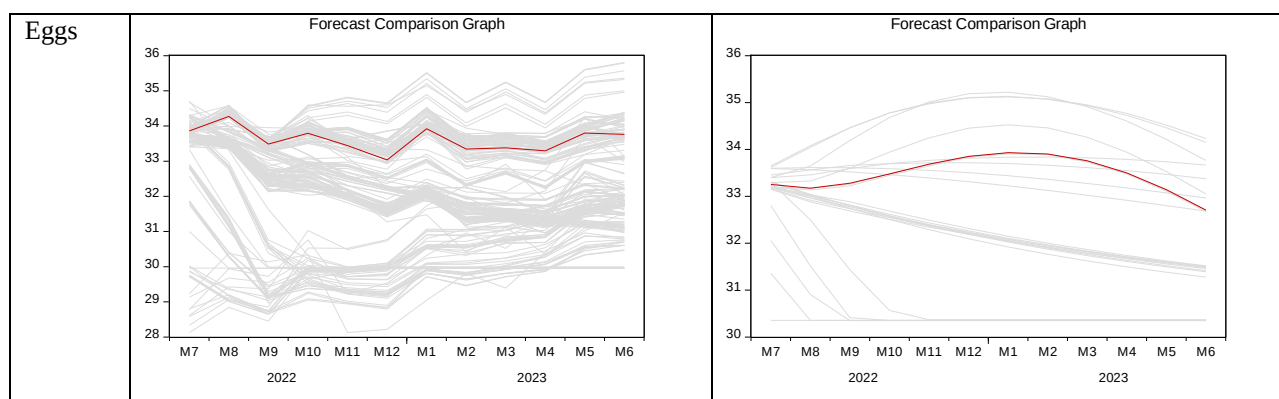
Consumer prices of chicken could move between 70 to 77 CZK/kg according to optimal SARIMA model while optimal ARIMA model expects mild increase up to 76 CZK/kg and stabilization. The stabilization can be probable scenario as the situation was already stabilized in 2020. "Overall, the situation on the poultry meat market in 2020 can be assessed as stabilized, despite the impact of the COVID-19 pandemic and the related restrictions on foreign trade." (MoA, 2021c) The economic shock came in April 2022 when the price suddenly increased from 62 CZK/kg to 75 CZK/kg. It keeps increasing, but in slower pace. Šimpach and Šimpachová Pechrová (2018) modelled the prices of poultry and found out that they depended only on the lag of price one month ago. They found out that ARIMA(1,1,0) with unit impulse in 06/2008 was optimal. In our case it was ARIMA(4,0,1), because we have different commodity – whole chicken.

Consumer price of potatoes has always been very volatile. "The development of the average consumer price of early potatoes is mainly influenced by the state of stocks of other consumer potatoes from the last harvest, the development of their price, the supply and import values of new and early potatoes, but also the development of the weather and the date of the start of the harvest." (MoA, 2021d) Therefore, similarly as in case of milk, also here the projections of SARIMA and ARIMA models differ significantly. Both predict price increase, but SARIMA expect unrealistic decrease since 07/2022 to third quarter of 2023 (see Fig. 1). ARIMA model envisioned increase of the price up to 15,2 CZK/kg in January 2023 followed by decrease. In the context of the whole time series we may expect the stabilization of the consumer price in the near time period.

Figure 1 Comparison of forecasts (07/2022 – 06/2023) of consumer prices of commodities (CZK)







Source: own processing

For sugar price, the algorithm chose models that project changes almost every month. The pattern is somehow similar to the development of real price, nevertheless, the ARIMA model is less realistic – the volatility probably will not have that regular pattern. SARIMA on the other hand, corresponds to the reality that the price of sugar has been increasing since the third quarter of 2021 (see Fig. 1). It should increase up to 22 CZK/kg. ARIMA model expect lower price (18 CZK/kg). Pechrová and Šimpach (2017) projected the consumer prices of sugar by ARIMA(1,1,1) model. Their forecast in medium variant forecast predicted prices of sugar crystal from 18.4 CZK/kg to 19.1 CZK / kg. Our current forecast is more similar to their upper variant (23.0 CZK / kg). The consumer price of sugar does not traditionally copy the development of prices of industrial producers. Agricultural producers' prices are dependent on prices of agricultural inputs – seeds, plant protection products and fertilizers. “These prices are not created in the Czech Republic, but are due to the development of the EU market, which is directly dependent on the development of commodity prices on world markets.” (MoA, 2021e) Therefore, the projection of consumer prices is difficult.

Also, the prices of eggs increased significantly during 2021, but SARIMA and ARIMA predict stabilization on the higher level in 2022–2023. However, SARIMA model expects low volatility between 33 to 35 CZK/10 pieces, ARIMA model predicts slight increase up to 34 CZK/10 pieces in February 2023 and then mild decrease below 33 CZK/10 pieces.

Our results can be compared to those of Šimpachová Pechrová and Šimpach (2017). They used ARIMA(1,0,0) with constant and impulses in crisis months (03, 05, 07/2012) to model the consumer prices of eggs. They expected price from 2.56 CZK/pc to 2.61 CZK/pc in next 12 months since 09/2016. Currently, the prices are much higher. Significant role on price formation will have import (mainly from Poland and Germany) as “the number of laying hens in domestic farms is gradually decreasing” (MoA, 2021c). In 2020 in comparison with 2019, the agricultural producers prices increased, but consumer prices decreased, so there is no clear positive relationship between those prices. (see MoA, 2021c).

4 Conclusion

The rapid increase of consumer prices could have societal consequences, so the government can take measures to support low income households. For policymaking and planning, a projection of the consumer prices development in the future is needed. Therefore, the aim of the paper was to project the prices of basic food: bread, butter, milk, poultry, potatoes, sugar, and eggs.

The correct model was chosen by algorithm implemented in the econometric software automatically based on Akaike criterion. For bread prices forecast, an ARIMA model is preferred. In case of butter, both models forecast slight decrease of price. But in comparison with previous period of sharp increase, this looks like stagnation. We cannot clearly conclude which model is better as the development pattern is similar. In case of milk projection, SARIMA is in contrast with ARIMA, but both models could be real as the price of milk is very volatile and is increasing and decreasing throughout the whole period. For price of chicken, both forecasts are in contrary. SARIMA model projects decrease while ARIMA slight increase up to asymptote 76 CZK/kg. This is probable development as the price of chicken was low in 2020 in comparison with previous period, so the increase probably will continue. Similar situation is for potatoes where ARIMA model projects certain stabilization after reaching a peak price at the end of the year 2022. SARIMA model projects more realistic development of sugar price. In case of eggs price, both models project stabilization, so it cannot be concluded which model is more preferred.

However, econometric correctness and the best fit of the model was not a guarantee that the model would have the best projection powers, or that the projected values would meet the expectations based on the economic theory and practical experiences. There are other determinants that influence the price of the agricultural commodities that only the price in previous period. So, the autoregressive process and moving average are not sufficient to explain the development of consumer prices of food. Those depend on prices of inputs (agriculture producers' prices, energies), industrial producers'

prices, and the agrarian-food trade relations. Each commodity and hence also food product have specific situation and the relation between price of input and output has different magnitude. Therefore, the projection of the final price for consumer is difficult and the results must be taken with caution. Special regression models, VAR models or neural network models can be also used for price projections. For example, Hansen (2020) recommends that combination of linear and nonlinear models is useful in forecasting commodity prices shall be used.

Acknowledgement

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References

- Box, G. & Jenkins, G. (1970). *Time Series Analysis: Forecasting and Control*. San Francisco: Holden-Day.
- Bradley, M. D., Jansen D. W. & Sinclair, T. M. (2015). How Well Does "Core" Inflation Capture Permanent Price Changes? *Macroeconomic Dynamics*, 19(4), 791–815. DOI: 10.1017/S1365100513000618
- CZSO (2022). Indexy spotřebitelských cen. CZSO. Available from https://vdb.czso.cz/vdbvo2/faces/cs/index.jsf?page=vystup-objekt&z=G&f=GRAFICKY_OBJEKT&pvo=CEN08B3&skupId=2218&katalog=31779&evo=v1877_%21_CEN-SPO-MEZIR-EM_1&str=v589 [Cit. 2022-08-10]
- El Ghini, A., & El-Karimi, M. (2020). Global Food Commodity Prices and Domestic Food Inflation: Some Insights from Morocco. *New Medit*, 19(3), 57–76. DOI: 10.30682/nm2003d
- García-Germán, S., Bardají, I. & Garrido, A. (2015). Evaluating price transmission between global agricultural markets and consumer food price indices in the European Union. *Agricultural Economics Volume*, 47(1), 59-70.
- Hassani, H., Silva & E.S. (2018). Forecasting UK consumer price inflation using inflation forecasts. *Research in Economics*, 72(3), 367–378. DOI: 10.1016/j.rie.2018.07.001
- Jadhav, V., Reddy, B.V.C. & Gaddi, G.M. (2017). Application of ARIMA Model for Forecasting Agricultural Prices. *Journal of Agricultural Science and Technology*, 19(5), 981–992.
- Li, J.W. & Zhao, B. (2015). Research on Asymmetric Fluctuation of Consumer Price Index for Food in China. *Proceeding of the 4th International Conference on Social Sciences and Society*, 134–138.
- MoA (Ministry of Agriculture) (2021a) Situační a výhledová zpráva: Obiloviny. Odbor zemědělských komodit MZe. ISBN 978-80-7434-651-4. Available from https://eagri.cz/public/web/file/702121/SVZ_Obiloviny_12_2021.pdf [cit. 2022-08-23]
- MoA (2021b.) Situační a výhledová zpráva: Mléko. Odbor zemědělských komodit MZe. Available from https://eagri.cz/public/web/file/670746/Mleko_2020_WEB.pdf [cit. 2022-08-23]
- MoA (2021c). Situační a výhledová zpráva: Drůběž – drůběží maso a vejce. Odbor zemědělských komodit MZe. Available from https://eagri.cz/public/web/file/682901/Drubez_2021_web.pdf [cit. 2022-08-23]
- MoA (2021d). Situační a výhledová zpráva: Brambory. Odbor zemědělských komodit MZe. Available from https://eagri.cz/public/web/file/706553/SVZ_Brambory_11_2021.pdf [cit. 2022-08-23]
- MoA (2021e). Situační a výhledová zpráva: Cukr-cukrová řepa. Odbor zemědělských komodit MZe. Available from https://eagri.cz/public/web/file/697813/CUKR_12_2020.pdf [cit. 2022-08-23]
- Novković, N. Mutavdžić, B., Ivanišević, D., Drinić, L. & Vukelić, N. (2019). Models for Forecasting the Price of Wheat and Maize in Serbia. *Journal on Processing and Energy in Agriculture*, 23(3), 128–141.
- Pechrová, M. & Šimpach, O. (2017). Modelling the Development of the Consumer Price of Sugar. *Proceedings of the 35th International Scientific Conference Mathematical Methods in Economics*, September 13-15, 2017, 527–531.
- Pechrová, M. & Šimpach, O. (2017). Modelling the Development of Eggs Prices in the CR. *Proceedings of the International Conference Hradec Economic Days 2017*, 682–688.
- Sangsefidi, S. J., Moghadas, R., Yazdani, S. & Nejad, A.M. (2015). Forecasting the prices of agricultural products in Iran with ARIMA and ARCH models. *International Journal of Advanced and Applied Sciences*, 2(11), 54–57.
- Šimpach, O. & Šimpachová Pechrová, M. (2018). Development of Milk Prices in the Czech Republic. *Proceedings of the International Conference Hradec Economic Days 2018*, 378-388. DOI: 10.36689/uhk/hed/2018-02-037
- Šimpach, O. & Šimpachová Pechrová, M. (2018). Food availability and the development of the consumer prices of meat. *Proceedings of the 27th International Scientific Conference Agrarian Perspectives XXVII*. September 19-20, 2018, 401–407.
- Šoškić, D. (2015). Inflation Impact of Food Prices: Case of Serbia. *Ekonomika Poljoprivreda-Economics of Agriculture*, 62(1), 41–51.
- Wang, H. J. & Zhao, W. G. (2009). ARIMA Model Estimated by Particle Swarm Optimization Algorithm for Consumer Price Index Forecasting. *Artificial Intelligence and Computational Intelligence*, 5855, 48–58.

Energy-efficient application programming for green cloud computing

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Abstract: Green Cloud Computing is a very interesting area that deals with different ways to reduce the energy consumption of clouds and data centres. Software solutions (native applications or those running inside containers) whose optimization (especially at the binary code level) can achieve a significant increase in computational performance or a reduction in computational time and thus directly reduce power consumption have a significant impact on the power consumption in these environments. In our study, we focused on the optimization of programming code in the C++ programming language, both in terms of the syntactic constructs of the programming language and the code generator itself. Our findings show that the difference in the efficiency of the resulting binary form of the program can be as much as tens of percent lower in terms of energy consumption.

Keywords: Cloud computing, code, optimization, energy, efficiency, green computing

JEL Classification: C69, C80, P18, Q55

1 Introduction and motivation

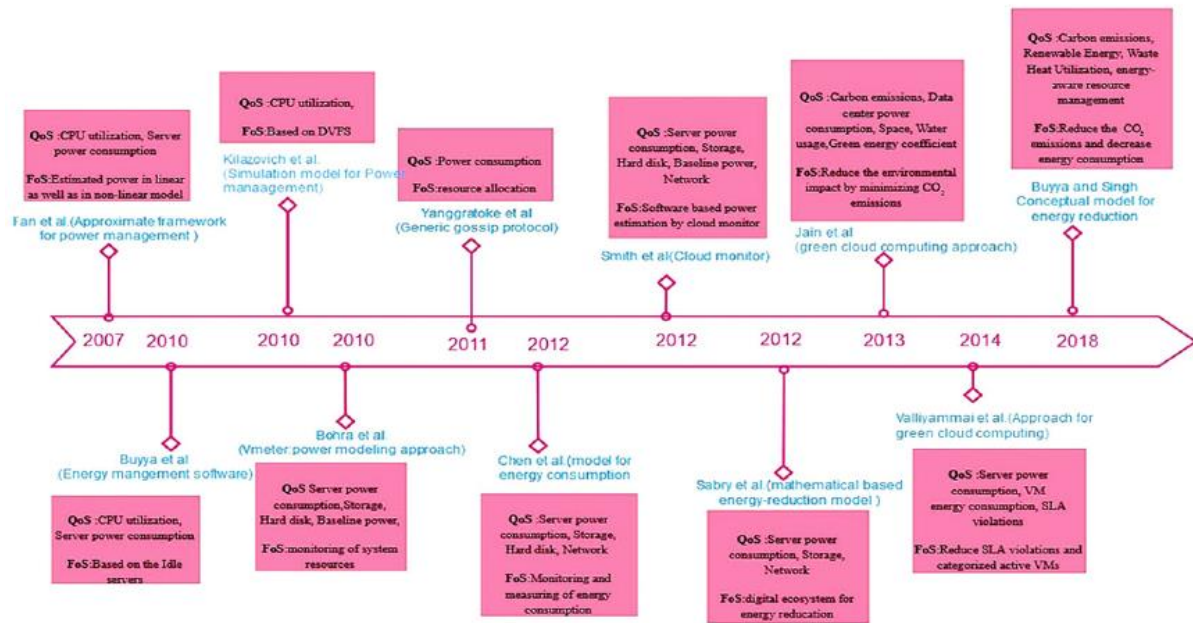
Since cloud infrastructures consume a huge amount of power, finding ways to reduce this power consumption has been a very hot research topic in recent years (Lefevre, Orgerie, 2010), (Nordman and Berkeley, 2009). Several concepts have been proposed (Younge et al., 2010) that independently are able to reduce power consumption in a dramatic way. Concepts that allow energy reduction are generally divided into hardware (tangible) and software (intangible) (Bharany et al., 2022). Hardware concepts include e.g., solar energy systems, buildings with continuous heat circulation, server rooms with alternative cooling (direct air intake), etc. and software concepts include e.g. orchestration systems for the management or development of energy efficient applications (DEEA). All mentioned concepts, with the exception of DEEA, depend on a specific infrastructure for which they have to be specifically optimized. The evolution of solutions across time (Esmailzadeh et al., 2011) can be seen in Figure 1, with hardware-oriented (Khanna et al., 2011), (Mashayekhy et al., 2015) solutions appearing first, and later software-oriented solutions (Ketankumar et al., 2015) and (Singh et al., 2015). A popular solution is the use of methods from the field of artificial intelligence (Chen et al., 2016), or even tracking user activity (Kim et al., 2011), (Lin, 2012).

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Figure 1 Evaluation of promising techniques used in Green Computing within the years 2007-2018, source (Bharany et al., 2022)

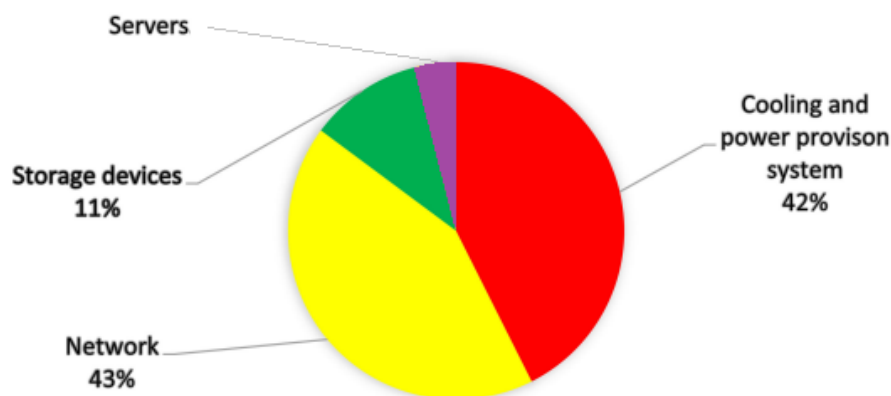


The development of energy-efficient applications is a trend that has been addressed with varying intensity for many decades and the current global energy crisis makes this trend very important again. For the development and optimization of energy-efficient programs, native compilable programming languages such as C, C++, Go or Rust are particularly suitable. This is because compilers of these programming languages generate direct executable binary forms of programs that are natively executed by concrete processors. The programmer can therefore influence the efficiency of the resulting binary program form by both the design of the application and the use of appropriate program constructs.

2 Current State-of-the-Art

According to (Bharany et al., 2022) the typical total consumption of a data center is shown in Figure 2. A relatively small fraction of energy is left for server operation and reducing consumption through efficient application implementation is particularly important in this area.

Figure 2 Energy consumption graph based on US Datacenters in 2014.



A comprehensive comparison of implementations and efficiency measurements was meant (Pereira et al., 2021). Table 1 contains the specific data regarding the code efficiency measurements. The measurements were oriented on consumed energy [Joule], on the total application execution time [ms], and on the size of used memory [Mb].

Table 1 The energy efficiency comparison of currently most used programming languages

Total					
	Energy (J)		Time (ms)		Mb
(c) C	1.00	(c) C	1.00	(c) Pascal	1.00
(c) Rust	1.03	(c) Rust	1.04	(c) Go	1.05
(c) C++	1.34	(c) C++	1.56	(c) C	1.17
(c) Ada	1.70	(c) Ada	1.85	(c) Fortran	1.24
(v) Java	1.98	(v) Java	1.89	(c) C++	1.34
(c) Pascal	2.14	(c) Chapel	2.14	(c) Ada	1.47
(c) Chapel	2.18	(c) Go	2.83	(c) Rust	1.54
(v) Lisp	2.27	(c) Pascal	3.02	(v) Lisp	1.92
(c) Ocaml	2.40	(c) Ocaml	3.09	(c) Haskell	2.45
(c) Fortran	2.52	(v) C#	3.14	(i) PHP	2.57
(c) Swift	2.79	(v) Lisp	3.40	(c) Swift	2.71
(c) Haskell	3.10	(c) Haskell	3.55	(i) Python	2.80
(v) C#	3.14	(c) Swift	4.20	(c) Ocaml	2.82
(c) Go	3.23	(c) Fortran	4.20	(v) C#	2.85
(i) Dart	3.83	(v) F#	6.30	(i) Hack	3.34
(v) F#	4.13	(i) JavaScript	6.52	(v) Racket	3.52
(i) JavaScript	4.45	(i) Dart	6.67	(i) Ruby	3.97
(v) Racket	7.91	(v) Racket	11.27	(c) Chapel	4.00
(i) TypeScript	21.50	(i) Hack	26.99	(v) F#	4.25
(i) Hack	24.02	(i) PHP	27.64	(i) JavaScript	4.59
(i) PHP	29.30	(v) Erlang	36.71	(i) TypeScript	4.69
(v) Erlang	42.23	(i) Jruby	43.44	(v) Java	6.01
(i) Lua	45.98	(i) TypeScript	46.20	(i) Perl	6.62
(i) Jruby	46.54	(i) Ruby	59.34	(i) Lua	6.72
(i) Ruby	69.91	(i) Perl	65.79	(v) Erlang	7.20
(i) Python	75.88	(i) Python	71.90	(i) Dart	8.64
(i) Perl	79.58	(i) Lua	82.91	(i) Jruby	19.84

Source: (Pereira et al., 2021)

The measurements confirmed the idea that the programming languages which are not interpreted are able to achieve substantially better energy efficiency.

3 Contribution

In our paper, we focused on the optimization of programs written in the C++ programming language of its latest variants and tried the use of advanced programming constructs and experimentally compared the efficiency of the resulting binary code with or without their use. A sample of some optimizations is shown below.

About new tested features

Selected C++20 features (Calandra, 2022) have been analysed and tested, those in themselves have the character that inherently improves performance in specific ways. While conducting the performance tests we measured units for execution time, compile-time, memory usage during translation and size in bytes of the whole translation unit. Those units were always specifically chosen and measured according to character that the given feature in the new standard provides.

Techniques used in the measurement

Created was a custom benchmark for execution efficiency using Chrono library (Microsoft documents, 2022). For our purpose the mentioned library provides very accurate CPU time and it's also very popular among testers. Testing was performed on three different computing setups with those unique operating systems: Windows 10, Ubuntu and macOS. The measurements were also carried out using those three most used compilers: g++, clang++ and MSVC.

Testing each time took place in an isolated, prepared environment to obtain accurate and also unaffected results. Used algorithms were developed and optimized purely for our testing purposes. That means we strive for higher time complexity within a given algorithm. This allows the program to run or compile for several minutes for relatively low input parameters. In this way, we achieve precise measurable results that can be further statistically analysed.

Selected language features

Attributes `[[likely]]` and `[[unlikely]]`

Conditions and if statements are generally one of the most frequently used constructs across all programs. New attributes improve performance in evaluating given conditions. Because conditions are so frequently used, influencing evaluation output then makes a significant difference in overall performance.

Consteval and Virtual Constexpr - Compile time evaluation

Compile time evaluation is improved and extended with each edition of the standard. Latest C++ standard brings new two keywords with a useful rich application. Main idea of the whole usage is that the appropriate calculations will be evaluated during the translation time, which will subsequently speed up the runtime of a program.

Modules - a new compile units

Most of C++ projects are using multiple translation units (cppreference.com. Modules, 2022). You can easily separate the interface from its implementation. Up to now, it has only been possible to use header files, but they suffered from a number of inconveniences. Main reason for our deeper exploration is that for many large projects, translation times are often very disproportionate, and order of imported units suffer from unexpected bugs. New modern way called modules eliminates these problems. It basically delivers an improved and much faster solution (Lischner, 2020).

Description of features and measurement principle

Tested attributes `[[likely]]` and `[[unlikely]]` allow the compiler, or rather the optimization performed, to modify the generated form so that it executes significantly faster when evaluating conditionals in if-else branching (Stroustrup, 2020). The whole idea behind usage is that conditional branching in very frequent cases is not distributed with uniform probability. In fact, a specific condition is usually evaluated with a certain superiority than others. Described situation does occur frequently, not only in large projects, and the use of this new functionality can result in significant execution time savings. Attributes affect only the speed of the algorithm during program execution, but not its translation time.

Syntax

```
if (condition) [[likely]] {  
  
    // code  
  
} else (condition) [[unlikely]] {  
  
    // code  
  
}
```

The principle consists in comparing execution time of algorithms for standards C++17 (fundamentally without attributes) and C++20, both using optimization parameter `-O3`. An important remark, all algorithms do not dispose of third-party libraries that further affect any aspect of performance. The evaluated results of algorithms are stored in a variable of type `volatile` to avoid unwanted side effects. In this case, our previously mentioned custom benchmark was used.

The benchmark takes a total of 10 samples per one run and averages them, while ignoring the best and worst results. Testing was carried out for three different input parameters each time, with each parameter being tested thirty times. This means a total collection of 900 possible results. Efficiency is thus assessed based on the measured execution time of both versions.

Consteval and Virtual Constexpr

Since the C++11 standard, which introduced the keyword `constexpr`, there is a possibility to evaluate functions or variables directly at compile time. The declared `constexpr` function, however, does not directly guarantee this property to the user with certainty. It is only able to be used in this way under certain conditions and with constant parameters (Fertig, 2021). The ISO C++ committee decided to clearly define this sometimes-unclear notion, and so the keyword `constexpr` was newly introduced, which directly guarantees that the function will necessarily be evaluated at compile time. If this case could not be feasible for certain reasons, the program will not be able to be compiled afterwards. This option again gives us more control over the code. What's also new is that virtual functions can now be evaluated during compilation. (Stroustrup, Sutter, 2022).

Since the C++20 and C++17 standards do not differ in terms of the compile time speed of the created algorithms, we will take advantage of the new extended capabilities of the latter standard to transfer the computations to the compile time and compare them non-competitively with the runtime by using custom benchmark of a C++17 program.

However, these units are not directly comparable to each other, which is not the stated purpose of the measurement. The stated goal is to use a completely new way of speeding up the application which has not been possible yet.

The results are then evaluated in such a way that the calculation of the algorithm in C++20 will always run at a constant speed, so we will measure the compile time using the parameters of the respective compilers. On the other hand, for C++17 we see by what time difference the application in C++20 would be faster in the runtime of the program. Thus, the main idea is to convey motivation by showing how certain calculations transferred to the compile time will effectively speed up an application and as well as to achieve better results. Indeed, in general, for any non-trivial program, there is bound to be a space where such functionality could be deployed at any time.

Modules

The latest standard now comes with a long-awaited and completely new modern and redesigned solution for libraries and other compilation units. Modules thus generally provide a completely new way to work with multiple linked translation units. They also eliminate recurring problems that still have common header files. Modules can be now imported in any order without having concern for macro redefinitions. (Microsoft documents, 2022).

Adding a module starts with the keyword: `import module`. For the part of the module that is to be exported, for example, a function, namespace, or class we add the keyword `export`. A module can also easily be divided into several logical partitions, where we then separate the interface from the implementation (Stroustrup, 2018).

The most significant benefit is that once the module is compiled, it is preserved in binary form. Such a module is much faster to process than a header file since the compiler just reuses it at each place it occurs (ModernesCpp.com, 2020).

The comparison in terms of performance differences occurs for programs that use complete compilation either using modules (C++20) or on the other side of header files (C++17). We primarily test compile time, but we also focus on the size in bytes of the compiles themselves and occasionally the size of the memory consumed during compilation. The results of these tests are obtained based on built-in parameters used by compilers and operating systems.

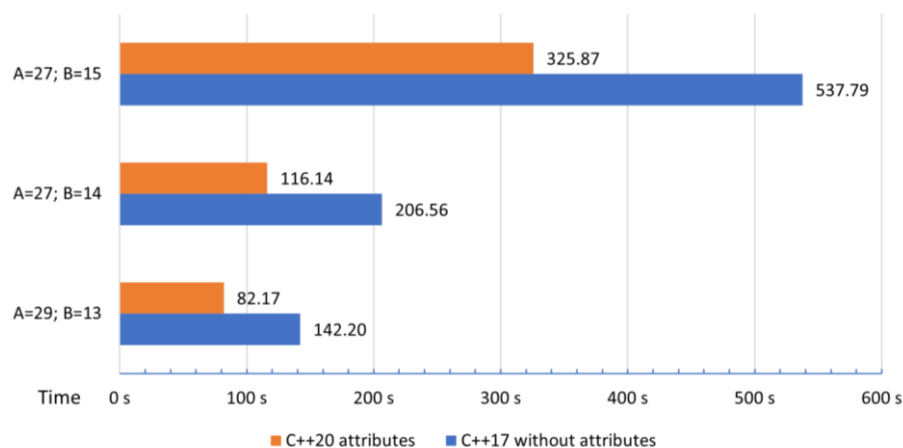
4 Results and Discussion

A total of 8 different programs were created to test the new optimization attributes. Each of them has its own compiled version that belongs to the corresponding C++ standard. The greatest performance increase was observed for the testing algorithm based on the longest common sequence of characters of two strings.

On the other hand, an algorithm based on finding an element in a given range of numbers has a performance increase in lower percentages units, but it is still a certain improvement.

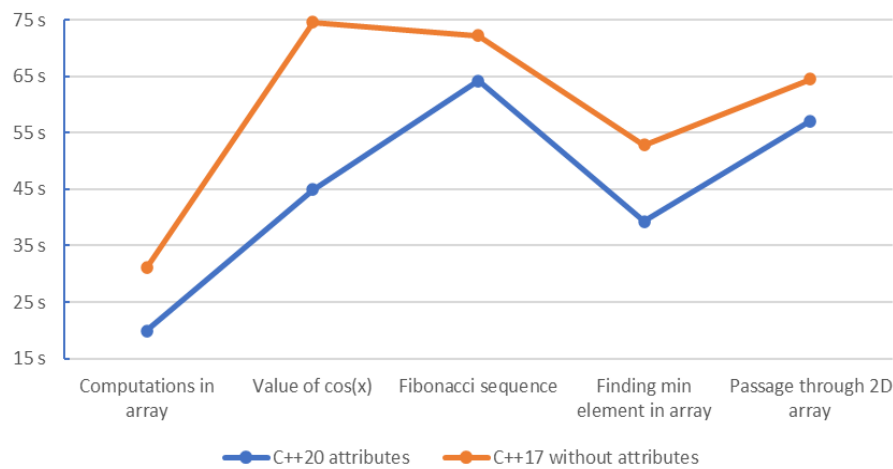
In case of the LCS algorithm, the performance increase reached up to 43.77 % in the best result. In the following graph in Figure 3 we can see the comparison of algorithm speed depending on different input parameters on the left side. Measured execution time in seconds then represents the statistical average of obtained samples.

Figure 3 Results of the LCS algorithm



Now follows the processed and analysed data from five different test algorithms, which have been scored and added to the chart. The bottom part shows names of tested algorithms, and the left part displays the average evaluation time of algorithms across different input parameters.

Figure 4 Comparison of efficiency for created algorithms



Obtained results indicate that there has indeed been a significant performance increase in execution time. A minor remark is that attributes must be properly thought out for a given algorithm, otherwise, we would decrease the performance on the contrary.

We also explored the corresponding assembler outputs to determine the cause of these improvements. Instructions are now modified so that the entire block run is now tailored to the set attributes during evaluation. Thus, the subsequent instruction jump for the evaluation first runs to the location in the conditional instruction register, according to the set attributes. This also rearranges the blocks differently and consequently generates faster code depending on our custom settings.

Advantage of Compile-time computation

In the following content, we discuss the improvement of the program runtime by evaluating the given computations at compile time. For this purpose, the tested programs use new consteval keyword and the others evaluate virtual functions at compile time using also another new virtual constexpr keyword.

The most remarkable result was found on the recursive algorithm based on the well-known Fibonacci sequence. The following Table 2 shows a summary of some selected algorithms. The last two algorithms in the table newly use a possibility of evaluating virtual functions at compile time. The data thus shows required compilation time for a certain input parameter. Run time then displays possible execution time savings of our program.

Table 2 Tested algorithms with compile-time evaluation

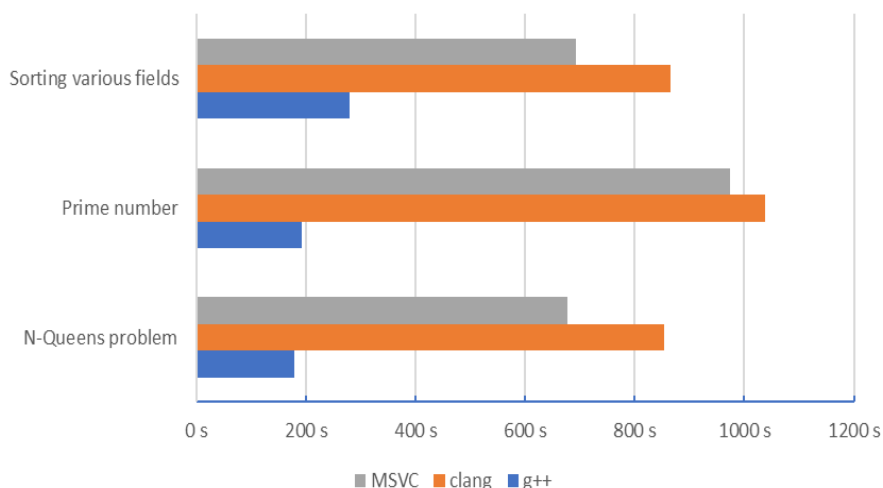
Compiler		g++	
Name of algorithm	Parameter	Compile time [min]	Run time [s]
Fibonacci Sequence	N = 46	8.12	12.27
N-Queens problem	DIM = 12	7.47	0.71
Prime numbers	N = 35 K	5.96	1.43
Binomial numbers	N = 31	4.93	0.44

Source: Own processing

From the end user's perspective, this means that an application did not have to evaluate this relatively high computation repeatedly after the build was completed. Imagine all these results on a global scale. On suitably transferred computations, they can speed up the final application without having to make major changes.

The g++ compiler also presented the fastest translation times (tested on a particular setup with OS Windows), often four times faster than clang. Importantly, translations were not affected by optimization parameters that would significantly affect all obtained values.

Figure 5 Compiling speed analysis on Windows PC



Advantage of using these new options is their ease of deployment into a project. After proper testing of an application, these features can be easily and cost-effectively added at any time. Constexpr functions can therefore be transformed effortlessly, and their evaluation is flexible as needed.

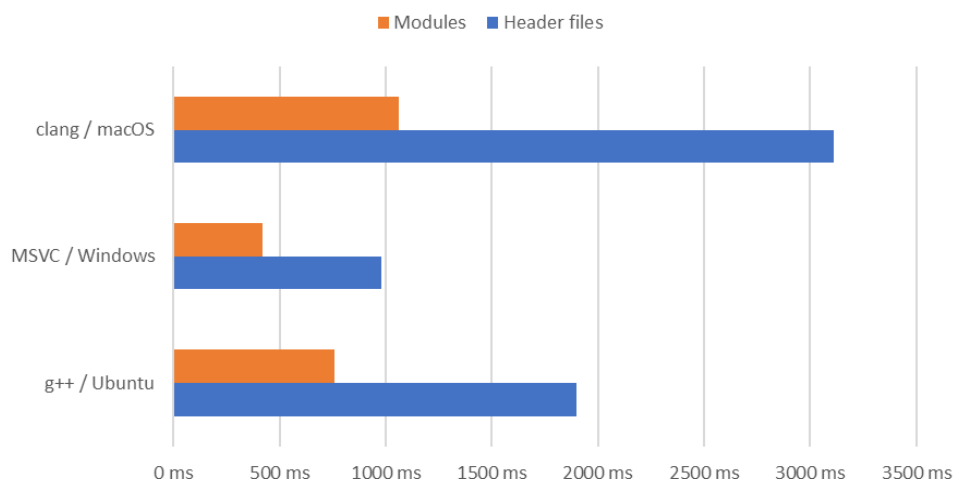
Modules or header files

Now let's take a look at the results from tested modules compared to header files. In case of using clang on macOS or g++ (Ubuntu), the compile size of whole programs for modules was in lower kilobytes, meanwhile the header files were in the lower units of megabytes.

The memory savings when compiling with g++ in a computing setup with Ubuntu was several percent. Huge difference was when using bits/stdc++ library, where the iostream was sufficient for modules. This resulted in up to six times of memory savings for the modules.

The chart in Figure 6 compares programs using only modules or header files as a translation unit.

Figure 6 Comparison of compilation speed



Compilation time in this case is probably one of the most remarkable things. Obtained values were statistically evaluated and added to the graph, using different configurations and operating systems. All the used compilers achieved excellent results, although each of them approaches modules slightly differently and the current library support is not the same for all of them.

5 Conclusion

In our work, we concentrated on the different techniques that are suitable for green cloud computing data centres. One of the easily affectable areas is the development of energy-efficient applications. The application efficiency depends on the used compiler and the used constructions within the source code. Our measurements experimentally confirmed that the energy requirements can be decreased by about tens of percent. The efficient application development seems to be a very promising building stone for green cloud computing data centers.

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References

- Bharany, S., Sharma, Osamah, I., S., Khalaf, O. I., Abdulsahib, G. M., Al Humaimeedy, A. S., Aldhyani, T. H. H., Maashi, M., Alkahtani, H. (2022). A Systematic Survey on Energy-Efficient Techniques in Sustainable Cloud Computing. *Sustainability*, 14(10), DOI: 10.3390/su14106256.
- Lefevre, L., Orgerie, A. (2010). Designing and evaluating an energy efficient Cloud. *J Supercomput* 51, 352–373. DOI: 10.1007/s11227010-0414.
- Nordman, B. and Berkeley, L. (2009). *Greener PCs for the Enterprise* no. August, 2009, DOI: 10.1109/MITP.2009.71.
- Younge, J., von Laszewski, G., Wang, L., Lopez-Alarcon, S., Carthers, W. (2010). Efficient resource management for Cloud computing environments. *International Conference on Green Computing*, Chicago, IL, 357-364, DOI: 10.1109/GREENCOMP.2010.5598294.
- Kim, J. M., Kim, M., Kong, J., Jang, H. B., Chung, S. W. (2011). Display Power Management That Detects User Intent. *Computer*. 44(10), 60–66. DOI: 10.1109/MC.2011.312
- Lin, C. (2012). A Novel Green Cloud Computing Framework for Improving System Efficiency. *Physics Procedia* 24, 2326–2333. DOI: 10.1016/j.phpro.2012.02.345,
- Ketankumar, D. C., Verma, G., Chandrasekaran, K. (2015). A Green Mechanism Design Approach to Automate Resource Procurement in Cloud. *Procedia Computer Science*, 54, 108–117. DOI: 10.1016/j.procs.2015.06.013.
- Khanna, R., Zuhayri, F., Nachimuthu, M., Le, C, Kumar, M. J. (2011) Unified extensible firmware interface: An innovative approach to DRAM power control. *2011 International Conference on Energy Aware Computing (ICEAC)*. IEEE. 1–6. DOI: 10.1109/ICEAC.2011.6136703.
- Esmailzadeh, H., Cao, T., Xi, Y., Blackburn, S. M., McKinley, K. S. (2011). Looking back on the language and hardware revolutions: measured power, performance, and scaling. *ACM SIGARCH Computer Architecture News*. vol. 39. ACM. 319–332. DOI: 10.1145/1961295.1950402.
- Chen, Y., Chen, T., Xu, Z., Sun, N., Temam, O. (2016). DianNao family: energy-efficient hardware accelerators for machine-learning. *Communications of the ACM*. 59(11), 105-112. DOI: 10.1145/2996864.
- Mashayekhy, L., Nejad, M. M., Grosu, D. (2015). Physical Machine Resource Management in Clouds: A Mechanism Design Approach. *IEEE Transactions on Cloud Computing*, 3(3), 247–260. DOI: 10.1109/tcc.2014.2369419.
- Singh, K., Ku, M.-L. (2015). Toward Green Power Allocation in Relay-Assisted Multiuser Networks: A Pricing-Based Approach. *IEEE Transactions on Wireless Communications*. 14(5), 2470–2486. DOI: 10.1109/twc.2014.2387165.
- Pereira, R., Couto, M., Ribeiro, F., Rua, R., Cunha, J., Fernandes, J. P., Saraiva, J. (2021). Ranking programming languages by energy efficiency. *Science of Computer Programming*. 205, 102609. DOI: 10.1016/j.scico.2021.102609.
- Calandra, A. (2022). *Modern C++ features*. <https://github.com/AnthonyCalandra/modern-cpp-features> Microsoft documents. C++ Standard Library header files, <https://learn.microsoft.com/en-us/cpp/standard-library/chrono?view=msvc-170> cppreference.com. Modules (2022), <https://en.cppreference.com/w/cpp/language/modules>
- Lischner, R. (2020) *Exploring C++20: The Programmer's Introduction to C++*. 3rd ed. Berkeley: Apress,
- Stroustrup, B. (2020). *Thriving in a Crowded and Changing World: C++ 2006–2020*. <https://www.stroustrup.com/hopl20main-p5-p-bfc9cd4--final.pdf>
- Fertig, A. (2021). *C++20: A neat trick with consteval*. <https://andreasfertig.blog/2021/07/cpp20-a-neat-trick-with-constexpr/>
- Stroustrup, B., Sutter, H. (2022) *C++ Core Guidelines*. <https://isocpp.github.io/CppCoreGuidelines/CppCoreGuidelines>

Microsoft documents (2022). Overview of modules in C++, <https://learn.microsoft.com/en-us/cpp/cpp/modules-cpp?view=msvc-170>

Stroustrup, B. (2018). *A tour of C++*. Second edition. Boston: Addison-Wesley. C++ In-Depth series.

ModernesCpp.com (2020). *C++20: The Advantages of Modules*. <https://www.modernescpp.com/index.php/cpp20-modules>.

Impacts of Changes and Policies in the Fields of Finance, Accounting and Taxation

Public accounting in France

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Abstract: The article deals with the public accounting in France. Therefore, the article pays the attention to the explanation of this concept, its legal regulation, crucial principles, functioning in practice and presentation of basic subjects of this concept. However, the contribution also contains a critical evaluation of this model, as well as its historical genesis. The author is based on French publications mainly by Professor Michel Bouvier and the FONDAFIP association created by him. The author also draws on other professional publications devoted to French public accounting.

Keywords: Accounting, Public Accounting, France, Public Administration

JEL Classification: M40, M41, M48

1 Introduction

At first glance, the public accounting (i.e. *la comptabilité public* in French) could be compared to the area regulating budgetary law of finance (in the broader sense of the word) in the public sphere. However, this inaccuracy does not avoid the French society, which is still not always completely clear on the term in question. In fact, the term “public accounting” is a generic term that is used to denote a set of provisions relating to the financial and accounting structure of public entities.

Regarding the systematic inclusion of public accounting in the French law of public finance (or rather public financial law), it is necessary to state that public accounting is a legal sub-branch of the French law of public finance and therefore it is placed at the level of other sub-sectors, such as budgetary law, or tax law. (BOUVIER, 2017, s. 20)

Nevertheless, public accounting cannot be denied a significant connection with budget law, or rather budgeting, which in France since 2006 can be characterized as performance and multi-year budgeting. The French state budget is divided into three basic accounts – the general account, 2 attached accounts and 32 specific accounts. (CATTEAU, 2007, 42) At the level of the state the public accounting is most evident in the framework of the so-called general account of the state.

The public accounting is primarily financed by public mandatory benefits, which are strictly regulated. The public accounting is intended for the further management of public funds by the relevant persons. It is a system that is presented across the entire French public sector, and which naturally reflects the decentralized organization of French public administration starting at the state level, continuing through French territorial self-governing units (i.e. regions, departments, municipalities) and ending with French public institutions (including e.g. public hospitals). A specific feature of the French concept of the public accounting is the fact that it is essentially taken over from the private sphere.

2 Methods

The aim of the article is to present an integral and traditional part of the French concept of public finance law, namely the public accounting. The article therefore presents the legal framework of the mentioned sub-branch of public finance law, its core principles, the essence of its functioning and its comparison with accounting from the private sector. For this purpose, the descriptive method is used, which is further interspersed with the method of analysis and comparison.

As for specialized literature, due to the absence of any domestic literature in the given area, it is necessary to proceed from foreign specialized literature. In this context, the French literature and the work of leading French theoreticians and practitioners, represented among others by Professor Bouvier or the former Minister of Finance and later Senator Alain Lambert, are naturally offered.

3 Research results

The third chapter deals with the very essence of public accounting. In the first subsection, the legal framework of French public accounting is presented, in the second subsection, the functioning of public accounting is presented, and in the third subsection, a comparison of public accounting with private sector accounting.

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3.1 The Legal Framework of the French Public Accounting

The public accounting in France is regulated by two main acts. The first of the crucial acts, the *Loi organique relative aux lois de finances* (hereinafter referred to as "LOLF"), also referred to as the French financial constitution, reformed the original organic regulation from 1959. The LOLF has completely reserved one of its chapters (chapter V) for the management of state accounts (or public accounting), when in Article 31 it entrusts the public accountant with a monopoly on account management. According to the Article 27 of the LOLF, "*state accounts must be accurate, true and must present a true picture of the state's property and financial situation*" and further that the public accountant is "*responsible for compiling state accounts and ensures compliance with public accounting principles*." LOLF puts "*performance*" in the first place through the entire public sector (either within its management or its economic activities). Performance, as the ability to achieve expected results, is the very essence of the new French budgetary framework. Therefore, both the efficient operation of the public administration and its transparency are taken care of. The transparency became the new motivation for the modified model of French public accounting. For this reason, the French state budget in the LOLF regime is no longer presented according to the nature of the expenses (e. g. expenses for employees or for the operation of a public entity, expenses for investments, etc.), but since 2006 according to the so-called public policies (*les politiques publiques*, e.g. culture, justice, healthcare). As regards the mentioned performance, every year the French government prepares the so-called annual performance proposal (*le projet annuel de performance*), which consists of its intention of how it plans to use the funds. These annual performance proposals are attached to the draft financial law (i.e. the state budget act) in October of the previous year for which the budget is drawn up. The government then presents the so-called annual performance report (*le rapport annuel de performance*) in June of the year following the year for which the report is prepared. The annual performance report presents and clarifies the actual results regarding the government's activities during the given period. It is thus an instrument of comparing not only the forecast (performance proposal), but also the evaluation of the implementation of the budget, the assessment of performance indicators and the actual total expenditure of the state for the previous year.

The second crucial act in the renaissance of French public accounting was the constitutional act of July 23, 2008, referred to as the "modernization of the institutions of the Fifth Republic". As a result, a new principle related to financial and accounting transparency was included in the French Constitution: "*Public administration accounts are accurate and true. They give a true picture of the economic results, assets and financial situation of the public administration.*" In other words, the French Constitution was modified in such a way that it was supplemented with *de facto* the same terms with which LOLF operates.

The only decree among the legal regulations concerning the field of public accounting was the Decree of November 7, 2012, on budget management and public accounting (hereinafter referred to as the "GBCP Decree"), which replaced the Decree of December 29, 1962, on the general regulation of public accounting (hereinafter referred to as "RGCP Decree") and, thanks to its Article 53, was mainly responsible for defining the concept of public accounting, which it defined as follows:

"Public accounting is a system of organizing financial reporting that allows:

- 1) to understand, to sort, to register and to control data on budget, accounting operations, as well as on state treasury operations, in order to ensure accurate and truthful account management;*
- 2) to submit financial statements showing a true picture of assets, financial situation and economic results as of the end of the budgetary year;*
- 3) to contribute to the calculation of the expenditure of activities or services, as well as to the evaluation of their performance. Public accounting is also organized in a way that allows these operations to be processed through national accounts."*

The GBCP decree extended the provisions of the LOLF to all public entities and at the same time became the starting legal basis for adjusting the position of the two basic actors of public accounting, i.e. the originator (*l'ordonnateur*) and the public accountant (*le comptable public*).

It was the GBCP decree that provided the legal framework for providing accurate information on the property situation of public entities, on their financial obligations and, last but not least, on their solvency.

3.2 The Functioning of the French Public Accounting System

The aforementioned GBCP decree confirmed a number of provisions that had been applied only experimentally until then. That is why the decree was a fundamental shift. This also meant the culmination of a long-term effort aimed at providing more and more accurate information about the property situation of public entities, about their financial obligations, as well as about their solvency.

These information needs are directly linked to the financing of public entities and further to the growing use of financial markets or the banking system. Therefore, over the years, this new concept originating directly from the private sector has been introduced as a default model for French public entities.

As a result of bringing public accounting closer to corporate accounting, accounting standards have also been harmonized. The Public Accounts Standardization Board has established accounting rules applicable to public entities. Three collections of accounting standards have been issued in this area. The first collection of regulations concerns the accounts of the state, the second collection of accounts concerns the accounts of public institutions and the third collection from 2016 concerns the accounting standards of territorial self-governing units (André, 2016, 66).

The LOLF introduced the accrual accounting model in public administration with "rules that differ from the rules used in the private sector only by the specificity of public activity". In other words, the state's main account is established according to a new accounting concept, which is largely inspired by the practice of businesses, or other international public accounting concepts that simultaneously take into account the specificity of the state. The concept of the LOLF allows for a clear and concise reading of the state's accounts. Therefore, it can be stated that this accounting reform enriched French society and at the same time restored the comprehensibility of financial information in the public sector.

It has already been mentioned that public accounting in France affects the budgets of the entire public sector, and at the state level it mainly affects the so-called main account of the state. Since 2006, an annual financial statement containing the following financial statements has been drawn up in connection with the main state account:

- 1) balance sheet: it shows the difference between assets and liabilities. Assets represent property values of the state, liabilities represent obligations of the state towards third parties.
- 2) profit and loss statement: it is made up of three overviews that show the total costs and revenues of the accounting period.
- 3) statement of cash flows: it is a traditional overview of cash flows, which are divided into three categories - cash flows associated with the activities of the state, cash flows associated with investment operations, cash flows associated with financial operations.
- 4) annex: it provides additional information for understanding the accounts of the state. It mainly contains an explanation and calculation of off-balance sheet liabilities. In this direction, we can find here, for example, an assessment of the pension obligations of civil servants.

The aforementioned financial statements established in the so-called main accounting (i.e. the accounting of the so-called main account of the state) contribute to a better understanding of the financial and property situation of the state. In addition, the above-mentioned financial statements provide additional basis for the evaluation of so-called public policies and thus appropriately complement the government's annual performance reports, which are submitted to the French Parliament. At the same time, these financial documents are necessary for the creation of the government's proposal for a financial law (i.e. the law on the state budget). The aforementioned financial statements are also beneficial for individual ministries, as they give them a better opportunity to analyze individual expenses associated with their departments and at the same time have a better overview of the assets they manage.

Public accounting in France is based on two core principles, namely the separation of the functions of the public accountant and the principal of the operation within the financial sector, and the personal and financial responsibilities of the public accountant.

French public accounting entrusts the monopoly of operations relating to public revenue and public expenditure to two basic entities: the originator and the public accountant. Their tasks complement each other and at the same time are independent of each other. At the same time, their tasks must be organized in such a way as to enable mutual and continuous checks between these entities.

The originator is essentially the legal representative of the relevant public entity for which he performs his function. He has exclusive authority in the area related to the adoption and appropriateness of decisions that have financial implications. Therefore, he is also the only entity who can issue spending orders and sign revenue claims within the relevant public entity. Orders for expenses, or income claims represent the individual order of payment of needs, or obtaining funds that are made available to the public accountant.

The second important principle of public accounting is the personal and financial responsibility of the public accountant, which is characteristic of French public accounting. This responsibility is established in the Article 17 of the GBCP decree, which stipulates that all public accountants, after being appointed to their position, are "*personally and financially responsible for their actions and supervision, which is due to them according to Articles 18, 19 and 20*" of the

same decree. Any violation of these provisions on their part or on the part of persons under their authority is liable to result in their personal and financial liability, under the conditions set out in Article 60 of the aforementioned decree.

In the relationship between the originator and the public accountant, it is necessary to mention another important entity, namely the person of the so-called judge of accounts. In practice, the French Court of Auditors and the regional chambers of accounts are the guarantors of the correctness of operations with public revenues and public expenditures. The task of the judge of accounts is to determine, by means of a review of the relevant documentation, whether or not the public accountant made a mistake in the performance of his tasks. In the case that the public accountant erred, the judge of accounts authoritatively states the existence of the debt, thereby activating the accounting liability and the public accountant is required to use his personal funds to repair the financial damage caused.

Accounting standards of the French public accounting are set by the Public Sector Accounting Standards Council (PSASC), which was established by the annual Budget Act on 30 December 2008. The PSASC has replaced the Public Accounting Standards Committee (PASC). Whereas the PASC regulated only accounting standards of the French government, the PSASC regulates accounting standards in the French public sector.

3.3 The Accrual Accounting in the Public Administration

The French public accounting took over a lot of accounting practices from the accounting of business entities. This is demonstrated by a number of examples in which public entities demonstrate their interest in the transfer of private sector accounting practices to public sector accounting. These are, for example, the following points:

- expenditure supervision,
- payment of debts,
- knowledge of the public entity and its relations with other authorities,
- control and operating of property,
- preventing difficulties and risks (for assessing the budgetary sustainability of the public entity, as well as for potential public intervention, or for choosing the appropriate management regime).

Just like a business entity, a public entity is also able to use accounting in the performance of its functions and further fulfill the importance that a business entity attributes to financial reporting. However, the translocation of the accounting of a private entity into the public administration naturally has its limits.

Although (and not only) French public entities are more focused on budgetary issues, it is necessary to note the speed with which they adapted to the accounting of business entities and within a few years made considerable progress in documenting and in the continuous monitoring of their property situation.

However, all these favorable developments cannot completely overshadow the dubious, almost hostile reactions of a number of public entities who still do not see, especially in the context of the significant reduction of public funds to which they are increasingly exposed, how the introduction of accrual accounting could be useful for them in their daily life.

Despite appearances and a number of official statements, the adoption of business accounting by French public entities will, in practical use, be different from the accounting used in the private sphere, for reasons related to the concept of public administration and the nature of the activities it performs, as well as its financing.

The first difference between French public accounting and the accounting of business entities is dual accounting structure of French public accounting. On the one hand, we are talking about the so-called "administrative accounting", which is the exclusive domain of the person ordering the operation. This area is made up of accounting for obligations, accounting for the consumption of budget funds and accounting for usable public funds. On the other side, there is "general accounting", i.e., the area led by a public accountant, which traditionally has a profit and loss statement, a balance sheet and an appendix. However, this duality led to the fragmentation of the information system of public entities, and what is worse, this duality led to the "impermeability" of these two areas. So, while for a business entity its accounting functions as a coherent system for recording, monitoring and reporting financial information, for a French public entity the section of the person ordering the operation, or the section of the public accountant each has its own rules governing their specific tasks, which, however, prevents any synthesis of the French model of public accounting.

Another difference between accounting in the public sector is the fact that the economic model of a public body is quite different from the economic model of a business entity. Business entities incur costs to generate revenue, and their performance is assessed relatively simply by profit, which rises as turnover is maximized and declines as costs rise faster than revenue. However, the essence of most public entities lies in the completely opposite functioning, since public

entities were created to consume or distribute public funds intended to satisfy the demand for public services (*services publics*). Under these conditions, their performance gradually increases and their account balance becomes zero or even negative.

It is the same with the investment of these entities. In the case of business entities, the capital is intended to achieve additional income, or to reduce production costs. In the case of public entities, on the contrary, investing is intended to increase their potential to perform the relevant public service. Another fact related to this is that investments in public entities often lead to the creation of future cost flows and therefore future expenses that will have to be financed.

The absence of a relationship between revenues and expenses means that the profit and loss statement of most public entities appears to be insufficient to evaluate their performance. As a result, their financial statements rarely provide relevant and actionable information about the added value they create or the services they provide.

Benefits of the public accounting include better financial information about the public sector,

The negative of the French model of public accounting is a separation of the function of the public accountant and the originator. The disadvantage of this model is the excessive formalism, the cumbersome procedures of these two entities, the redundancy of tasks and controls or the unnecessary use of employees. Critics further state that this antiquated nature of the current system has long since disappeared from the private sector. According to these critics, the most negative element associated with the separation of functions of the public accountant and the originator today lies in the fact that it leads the originator and his colleagues to lose interest in accounting itself. For this reason, one can observe different delays on the part of managers in the public sector compared to their colleagues in the private sector in using the information they can draw from accounting.

4 Conclusions

The paper dealt with one of the legal sub-branches of French financial law, or more precisely, French public financial law, namely public accounting. It was pointed out the historically traditional role of public accounting in the French public finance system and its close connection, or the connection with budget law, as well as the system of inclusion of public accounting within the framework of French public financial law.

In the article dealing with the legal regulation of public accounting in France, the cardinal reform of 2006 was mentioned, which, apart from budgetary law in France, also significantly affected public accounting. This reform smoothly followed on from the general reform of the state administration ("*Révision générale des politiques publiques*"), which was successfully implemented a year earlier. In connection with the aforementioned reform of budget law, or of public accounting, valid and effective legal regulations were mentioned, which can be described as pivotal in the given area.

Furthermore, the functioning of public accounting was described, including its two core principles, on which public accounting in France has been built for a long time. Although perhaps unusual from our point of view, the principle of personal and financial responsibility of the public accountant was introduced, as well as the principle of separating the functions of the person ordering the operation and the public accountant. However, it is precisely the second of these principles that is still being criticized in France. However, taking into account, among other things, the reform of public accounting that has already taken place, I do not think that this principle, which is already firmly linked to the traditional French model of public accounting, would change fundamentally.

After the reform of 2006, or with the introduction of LOLF, the central motive of the state administration became the efficiency of its management with regard to the most efficient results of public management. In this effort, public accounting plays its irreplaceable role, where one can observe a deviation from the concept of control of the activities of the relevant public entity (resulting from the original Decree on the general adjustment of public accounting from 1962) to the concept of financial reporting, or financial transparency of a public entity in the LOLF regime. Furthermore, the role and activities of the main actors (including the control authority) who apply the legal norms governing public accounting in France were presented. Last but not least, attention was also paid to the accrual system of accounting (which is adopted from the private sector), on which the French concept of public accounting is based. It was demonstrated how this concept manifests itself at the level of the state budget, specifically within the so-called main account of the state.

Attention was also paid to the natural differences in the management of entities from the private and public sectors, as well as to the different tasks of these entities with regard to their area of management. Furthermore, the factual differences of the French concept of public accounting with regard to the accounting of entities in the business sector were analyzed. The French professional or lay public is far from united as to whether public accounting is the most effective instrument for managing public funds, or for effective management of them. To a certain extent, this may seem

paradoxical, since it was the French Financial Institute (LOLF) that first introduced, through the entire public sector, the "performance" aspect of public administration. Whether it is performance, assessed as the efficiency of handling public funds, or the efficiency of public administration in a broader sense, this performance is always subsequently evaluated on the basis of specific results. However, this system is the target of criticism, as performance and achieved results are the most important aspect for the French system. The subsequent evaluation is only interested in the achievement of results and the ways in which these results were achieved, or side effects that were, or only in the future will they be evoked by the chosen methods. This system thus gives a very wide field of action especially to economists, analysts and statisticians who evaluate and assess the mentioned results.

References

- André, M. (2016). Comptabilité Générale de l'État. In M. Bouvier, M.-Ch. Esclassan, *Revue Française de Finances Publiques*. Quels comptes pour demain? 63-68
- Bouvier, M. (2017). Finances publiques. 16. éd. Paris: LGDJ.
- Catteau, D. (2007). *La LOLF et la modernisation de la gestion publique : la performance, fondement d'un droit public financier rénové*. Paris: Daloz.
- Lambert, A. (2016). Quel bilan 10 ans après? In M. Bouvier, M.-Ch. Esclassan, *Revue Française de Finances Publiques*. Quels comptes pour demain? 19-25

Organisational work compliance and budgetary dysfunctions in an emerging economy

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Abstract: Political pressure for budgetary compliance and the lack of competitive markets characterise public sector organisations. As a result, preventing budgetary dysfunctions is a key component of budgetary performance in public organisations. One factor that sets local Government's budgeting apart from the national level is its prominence as a public institution. Subsequently, all Government divisions budget for their operations, but the local government budgeting has a unique structural arrangement. The three most significant pieces of local legislation intended to enforce reform in Ghanaian local governance are Ghana's Local Government Act 462, composite budgeting, and the Functional organisational Assessment (FOAT) system. However, compliance with high statutes seems complicated for local governments to adhere to strict laws due to internal and external constraints. The aim is to investigate and explore organisational work compliance concerning budget dysfunctions and their effect on work performance. The paper offers insight into local Government Budgetary regulations and compliance and brings to bare the shortcomings (Budgetary dysfunctions) in abiding by these regulations. This study used the general interdisciplinary research strategy as the foundation for its methodology, and the documentary analysis style was adopted. A conceptual model that describes and analyses the study's assertions are offered. Finally, Future empirical testing will be conducted by the study's offered structure.

Keywords: Budgetary dysfunctions, Organisational work compliance, Work performance, Local Government, emerging economy

1 Introduction

Disruptions in control system norms and procedures, as well as organisational and behavioural effects on managers brought on by budgeting, are referred to as dysfunctional behaviour (Paino et al., 2010; Hartmann, 2000). Political pressure for budgetary compliance and the lack of competitive markets characterise public sector organisations. As a result, preventing budgetary dysfunctions is a key component of budgetary performance in public organisations (Johansson & Siverbo, 2014)). One factor that sets local Government's budgeting apart from the national level is its prominence as a public institution. Subsequently, all Government divisions budget for their operations, but the local government budgeting has a unique structural arrangement (Gianakis & McCue, 1999; Matsoso et al., 2021). The three most significant pieces of local legislation intended to enforce reform in Ghanaian local governance are Ghana's Local Government Act 462, composite budgeting, and the Functional organisational Assessment (FOAT) system. However, compliance with high statutes seems complicated for local governments to adhere to strict laws due to internal and external constraints (Musah-Surugu et al., 2018).

Managers must comply with various internal and external regulations incorporated into the development of budgetary control. These regulations comprise operating procedures, local ordinances, and national laws and regulations (Bedford & Malmi, 2015; Almklov et al., 2018). Control is demonstrated to be effective by rigorously enforcing compliance standards, demonstrating how the importance of compliance is connected to managerial performance assessment (Merchant & Van der stede, 2017; Siverbo, 2021). In Ghana, the annual administration of FOAT is a performance-based grant program that encourages local governments to carry out governmental directions at the federal level. Effectiveness, accountability, and essential community services are all ensured during this FOAT assessment. The District Development Facility (DDF) fund is a result base aid given to local government organisations that perform well in the FOAT. The DDF is not accessible to local government institutions that do not operate satisfactorily. Prior to the start of the fiscal year,

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projects must be carefully planned and given the necessary funding under the composite budgeting and FOAT systems. Failure to adhere to these procedures will make the assembly incapable of taking on projects. The pressure mounted on these local government agencies in Ghana to comply with meeting the FOAT assessment and other budgetary compliances could be a factor that influences budgetary dysfunctions like slack. According to (Hartmann, 2000), dysfunctional behaviour is a normal reaction to compliance or control rather than being a characteristic of humans. The degree to which such compliance is thought to affect performance, evaluation, and rewards is also believed to cause stress and tension, potentially leading to dysfunctional behaviour like budgetary slack. Additionally, Internal audit was implemented as a part of modifications introduced to local government financial management; however, internal auditing appears ineffective in preventing deviations. Moreover, many governmental institutions, especially local governments, are perceived to be deceptive and occasionally mismanage resources (Aikins et al., 2022). Given the elaborations above, this study aims to investigate and explore organisational work compliance concerning budget dysfunctions and their effect on work performance

2 Literature review

Organisational work compliance

In reliance on local governments to carry out policy, central governments confront issues with compliance. The main obstacles to good governance worldwide are compliance issues resulting from centralised policies (Anderson et al., 2019). Public organisations have more socio-political pressures, political compliance, and legal bounds. Additionally, public sector employees are subject to more formal bureaucratic systems and red tape. Local council politicians' interference, central government control, and non-compliance with citizen policy are a few examples of the external environmental factors that local officials must deal with. These elements, along with organisational management and individual elements, have diverse effects on turnover intent and local government bureaucrats' output (Jeong & Han, 2021).

2.1 Pursuit for budgetary compliance and dysfunctional issues in Ghana

The annual administration of FOAT is a performance-based grant program. By applying performance metrics, the FOAT audit awards local governments with allocation to external grants from the District Development Facility (DDF). The primary goal of FOAT is to evaluate local governments in Ghana in terms of how strictly they adhere to and comply with the legal and regulatory frameworks that support their goals and operations. Along with assuring effectiveness, accountability, and the provision of essential social services, it thus subsidises local governments in carrying out national policy objectives. The movement of funds from a planned item to one not budgeted for is strenuous with the FOAT system and the current local government budgetary control system. Projects need to be meticulously planned and given the necessary funding before the fiscal year starts to comply with the requirements of the FOAT scheme and composite budgeting. The most efficient method of giving help in current development assistance is to emphasise results and the evaluation methods used to produce them by presenting these findings as proof of success. The clever strategy used by aid users and donors in response is interpreted as the "numbers game." Sabbi & Stroh (2020) explain this "numbers game." in the sense that regardless of the actual delivery of services or local population satisfaction, agencies provide results to meet assessment expectations. According to the authors, Results-based aid's (RBA) pre-assessment procedures give the context necessary to examine municipal councils' responses to financial resources.

2.2 Work Performance

According to Uddin et al. (2021), Key performance indicators are crucial because they let practitioners identify "what has to be done," which enables them to comprehend performance measurement in practice. While they may not align with the instigators' goals, these understandings are important. They argued that the distinction between what is planned and what occurs can be seen in practitioners' perceptions of what makes meaning of actions and phrases. The authors went on to discuss the "teleoaffective" structure, which is crucial to "what actually happens," as Schatzki (1996) emphasised. The implementation of new performance measurement rules may become unimportant as a result of the "teleoaffective" formations that result from actors' purposeful projects, such as "just doing the job," "manipulation," "raising one's voice, if necessary," and "symbolic/ceremonial practices". Expanding on this, they concentrated on the "organisation of practice" to better understand how organisational players behave in dynamic environments (the socio-material context).

3 Methods

This study used general interdisciplinary research as the foundation strategy by integrating the discipline of Budgeting, Work performance and organisational compliance to form the framework for the study. This style of the method is a reflection of (Syrtseva et al., 2021). Organisational Compliance: Failure to effectively monitor, identify, investigate, and remedy misbehaviour within an organisation's levels could have disastrous effects. Although organisations recognise the value of the compliance role, all organisations, whether private or public, must ensure that their members abide by legal and regulatory requirements, industry standards, and internal norms and expectations. They are responsible for monitoring

how many hundreds of laws are followed by thousands of members. Compliance failures at these complex organisations can be severe and extensive in breadth and associated damage (Martinez, 2020). However, this study is of the view that although control is demonstrated to be effective by rigorous compliance standards (results-based aid), it also tends to create budgetary dysfunctions. Organisational compliance as a variable is intended to be measured empirically in a future study by the level of rigorousness to comply with results-based aid regulations (FOAT).

Work performance: The work performance construct includes actions that employees can influence and support organisational objectives. In human resource management, work performance is referred to as the "ultimate dependent variable," which elevates the evaluation of this factor to the level of capital concern. It is equally critical to be able to describe the performance and measure it using appropriate tools (Ramos-Villagrasa et al., 2019). This variable will be empirically tested in the future by Increases in economic development infrastructures and the number of completed by the MMDAs

Budget dysfunction (slack) will be empirically tested in the future based on the scores presented in table 1.1 below. The test will also include the level of budget target deviation.

Data was collected through the documentary analysis and observation form of qualitative research focused on the local Government service of Ghana. This data was retrieved from the published reports on the Consolidated Annual Budget Performance of the MMDAs by the ministry of finance. In Ghana, the MMDAs (Metropolitan, Municipal, and District Assemblies) are the Governmental institutions that form the local Government. There are 254 MMDAs in Ghana, which are scattered across the 16 regions of the nation. Since our goal was to undertake in-depth case analyses of a few municipal governments, qualitative research was deemed appropriate. Using a qualitative rather than a structured questionnaire survey, we examined the composite budget relating to selected MMDAs of Ghana to higher statutes much more thoroughly.

4 Research Results

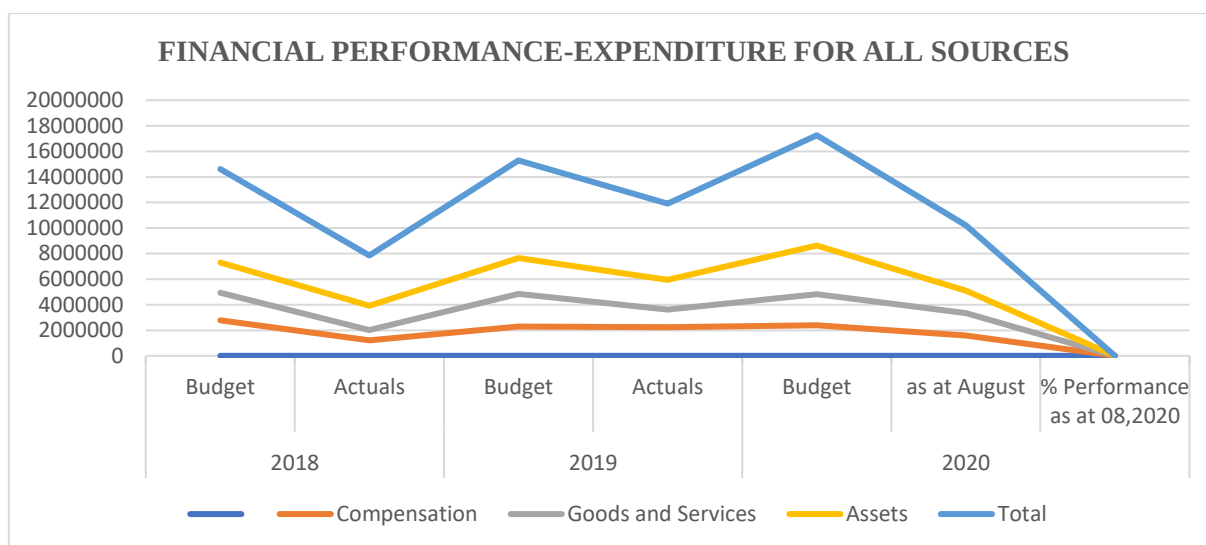
Table 1.0 Results of Budget Sub-Programme of the Asuogyaman district Assembly for 2021

Main Outputs	Output Indicator	Past years		Projections		
		2018	2019	2020	2021	2022
Projects and programs monitoring	No. of monitoring visits undertaken	2019	10	7	12	12
Improved level of Revenue Improvement Action Plan (RIAP) implementation	Percentage of RIAP Implementation	80%	85%	88%	100%	100%
Increased citizens participation in planning, budgeting and implementation	No. of public hearings undrtaken	4	3	2	6	6

Source: authors' estimation based on (Government of Ghana, 2021)

Table 1.0 above shows the sub-program results for planning, budgeting and coordinating a specific local government organisation. Creating thorough, precise, and trustworthy action plans and budgets falls under the purview of this sub-programme. IGF (internally generated funds), DACF (District Assembly Common Fund), and DDF (District Development Fund) are the sources of funding for the program. The community members, development partners, and assembly departments will profit from the efficient performance of this sub-programme (Government of Ghana, 2021). Sabbi & Stroh (2020) express concern about results-driven agendas encouraging decision-makers to set relatively easy-to-reach Budget targets. (Budget slack). This brings to bare that published reports on budget performance are not enough if the reported performance is not reflected in the development of the communities of the MMDAs.

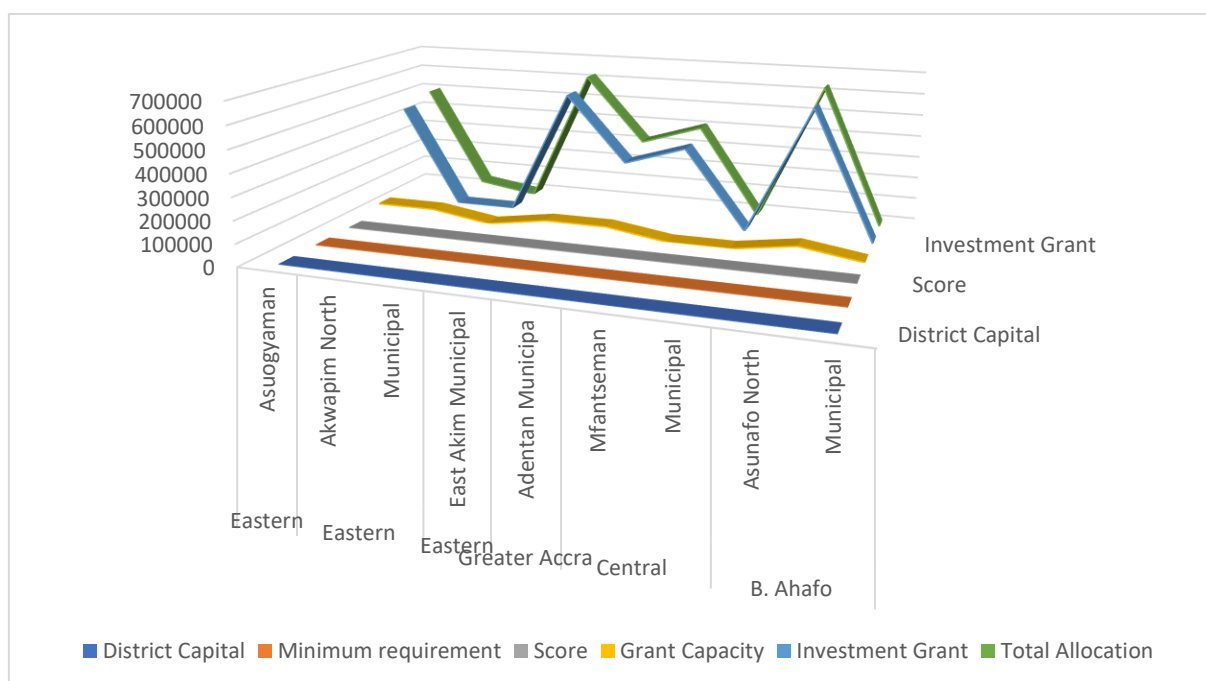
Figure 1.0 Financial Performance Expenditure for all sources



Source authors' estimation based on (Government of Ghana, 2021). Figures are stated in the Ghanaian cedi currency

Figure 1.0 above shows sources of revenue for a specific MMDA in Ghana (Asuogyaman district assembly). As shown in the table, it appears the district is on a soundtrack. The concern is to examine the possibility of slack creation by the MMDA or to identify if results-based aids influence them to create dysfunctions. Based on the report on FOAT assessment by (Local Government service, 2011), to carry out their assigned duties, MMDAs must comply with the Government's current policies, rules, regulations, and procedures.

Figure 1.1 Assessment of selected metropolitan, municipal and district assemblies for the 2011 district development facility (DDF)



Source: (Local Government service, 2011). Figures are stated in the Ghana cedi currency

The performance of MMDAs for the fifth assessment conducted by the Ministry of Local Government and Rural Development utilising the Functional Organisational Assessment Tool (FOAT) is shown in figure 1.1 above, along with the DDF and UDG allocations for selected MMDAs. In order to fulfil their assigned functions, the MMDAs are evaluated based on how well they comply with current government policies, rules, laws, and procedures. The local government service report for the 2011 FOAT assessment revealed that only MMDAs that passed the assessment was granted both the DDF and the capacity-building grants. Those MMDAs that failed the assessment were only given the DDF. In order to qualify for the UDG, only 34 MMAs had a result equal to or higher than the 82-point national average for the DDF Performance Metrics. A Capacity Support Fund (CSF) of US\$40,000 is available to each of the 34 MMAs that meet the UDG eligibility requirements.

Quantifying the size of budgetary dysfunction in Ghana's economy (The local Government of Ghana)

Gollwitzer (2011) developed a budget institution index that measures the adequacy of budget intuitions which also measured the governing procedures and rules in Forty-six African countries. The index scaled range is between 0 and 1, the resulting scores for Ghana are presented below. The scores marching the variables for the index uncovers the level or the size of budgetary dysfunctionality in the local Government of Ghana.

Table 1.1 Budgetary regulations and procedures score for Ghana

Centralisation	Rules and controls	Sustainability	Comprehensiveness	Transparency	Overall
0.792	0.542	0.569	0.719	0.250	0.574

Source: (Gollwitzer, 2011)

As shown in Table 1.1 above, Ghana scored 0.792 for centralisation and 0.719 for comprehensiveness, which is close to 1 and thus high. On the other hand, the dimensions of rules and controls and Sustainability recorded average scores of 0.542 and 0.569, respectively. The dimension of transparency uncovers a possible attribute for budget manipulations (slack) and the issue of dysfunctions like the budget deficit, among others.

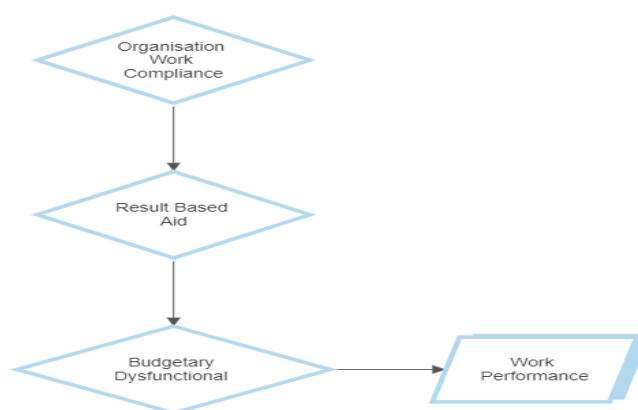
The goals of deficit reduction in the framework of regional convergence criteria are legally grounded in several African nations. The apparent drawback of stringent budgetary regulations is that they may drastically reduce the policy options available to the Government. Medium-term direction, transparency, comprehensiveness in coverage, and consistency in implementation are four aspects that make financial policies successful. Hidden budgeting and corruption are avoided by maintaining transparency throughout the entire budgeting process (Gollwitzer, 2011).

Additionally, Provisional budgetary statistics for the financial year under review reveal that budgetary activities resulted in an overall deficit of GH42,355.00 million (9.2% of GDP), compared to an amended deficit objective of GH41,273.00 million (9.4% of GDP). This is by the consolidated budget evaluation reports from 1 January to 31 December 2021 presented by the MDAs to Parliament (Ministry of Finance, 2022).

5 Research Assertions and Research Model

The study further developed assertions for future empirical testing. H0a: Organisational work compliance does not have a positive influence on result-based aids. H0b: Results-based aids do not positively influence budget dysfunction. H0c: Budget dysfunction does not have a positive influence on work performance

Figure 1.2



Source: Authors' own

6 Conclusion

We observed through our documentary analyses study that compliance in budgeting can be tight (rigid) or loose. When compliance or regulations become tight for managers, their natural response to save their reputation is to create dysfunctions. This study is, however, not of the view that compliance should not be strict. However, we are drawing attention to the fact that policymakers must be aware that result-based assessment like that of the FOAT evaluation should be conducted by putting measure in place that checks the authenticity of budgetary figures or results from the MMDAs. This is also because it is of no use if an MMDA in a particular community seems to be performing well by scoring higher marks but does not reflect in the development of the community.

7 Research limitation/Implications: The explanation of organisational work compliance and budgetary dysfunctions in a unique scenario and the paper's ability to inspire new study topics in emerging economies make it attractive to scholars. We showed that the results-based aid's high-performance ratings influenced by organisational work compliance do not accurately reflect positive work performance or community development. In order to study the micro-processes of organisational compliance and how they have the effect of causing budgetary dysfunctions that would have otherwise gone unnoticed, the paper has focused on "organisations of practice."

8 Practical implication: The paper draws the attention of policymakers, as such various forms of management decisions, to encourage compliance and evaluation procedures conducted with measures that check on avoiding budgetary dysfunctions.

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References

- Aikins, A. E., Mensah, J. V., & Kumi-Kyereme, A. (2022). Investigating the conditions under which internal auditing is carried out in selected local governments in the Central Region of Ghana. *Asian Journal of Accounting*. DOI: 10.1108/AJAR-10-2021-0186
- Almklov, P. G., Antonsen, S., Bye, R., & Øren, A. (2018). Organisational culture and societal safety : Collaborating across boundaries. *Safety Science*, 110(February 2017), 89–99. DOI: 10.1016/j.ssci.2017.12.029
- Anderson, S. E., Buntaine, M. T., Liu, M., & Zhang, B. (2019). Non-Governmental Monitoring of Local Governments Increases Compliance with Central Mandates: A National-Scale Field Experiment in China. *American Journal of Political Science*, 63(3), 626–643. DOI: 10.1111/ajps.12428
- Bedford, D. S., & Malmi, T. (2015). Configurations of control : An exploratory analysis. *Management Accounting Research*, 27, 2–26. DOI: 10.1016/j.mar.2015.04.002
- Gianakis, G., & McCue, P. C. (1999). *Local Government Budgeting: A Managerial Approach*. Greenwodd Publishing Group.
https://books.google.cz/books?hl=en&lr=&id=qPGIDZvdQ9AC&oi=fnd&pg=PR7&dq=LOCAL+GOVERNMENT+BUDGETING,++MANGERIAL+APPROACH&ots=WfezFw1DhJ&sig=0QQB_zh1cve4CJmR8ltZyCl0sfQ&redir_esc=y#v=onepage&q=LOCAL GOVERNMENT BUDGETING%2C MANGERIAL APPROACH&f=false
- Gollwitzer, S. (2011). Budget institutions and fiscal performance in Africa. *Journal of African Economies*, 20(1), 111–152. DOI: 10.1093/jae/ejq035
- Government of Ghana. (2021). *2021 Composite Budget- Eastern Region*. <https://mofep.gov.gh/publications/composite-budget-2021/er>
- Hartmann, F. G. H. (2000). The appropriateness of RAPM: Toward the further development of theory. *Accounting, Organisations and Society*, 25(4–5), 451–482. DOI: 10.1016/S0361-3682(98)00036-1
- Jeong, J. S., & Han, S. H. (2021). Turnover Intention and Productivity of Local Bureaucrats : Focusing on Influences of Local Politicians Intervention , Central Government Control , and Citizen Compliance *. *Korea Observer*, 52(2), 211–238.
- Johansson, T., & Siverbo, S. (2014). The appropriateness of tight budget control in public sector organisations facing budget turbulence. *Management Accounting Research*, 25(4), 271–283. DOI: 10.1016/j.mar.2014.04.001
- Local Government service, G. (2011). *Publication of FOAT V. (2011) Results & Allocation (DDF & UDG)*. <https://lgs.gov.gh/index.php/publication-of-foat-v-2011-results-allocation-ddf-udg/>
- Martinez, V. R. (2020). COMPLEX COMPLIANCE INVESTIGATIONS. *Columbia Law Review*, 120(2), 249–308. <https://medium.com/@arifwicaksanaa/pengertian-use-case-a7e576e1b6bf>
- Matsoso, M. L., Nyathi, M., & Nakpodia, F. A. (2021). An assessment of budgeting and budgetary controls among small and medium-sized enterprises: evidence from a developing economy. *Journal of Accounting in Emerging Economies*, 11(4), 552–577. DOI: 10.1108/JAEE-04-2020-0082
- Merchant, K., & Van der stede, W. (2017). *Management control systems: performance measurement, evaluation and incentives* (4th ed.). Pearson. <http://eprints.lse.ac.uk/id/eprint/76569>
- Ministry of Finanace, G. (2022). *The 2021 Consolidated MDAS Annual Budget Performance Report*. <https://mofep.gov.gh/reports/2022-07-20/the-2021-consolidated-MDAS-annual-budget-performance-report>
- Musah-Surugu, J. I., Owusu, K., Yankson, P. W. K., & Ayisi, E. K. (2018). Mainstreaming climate change into local governance: financing and budgetary compliance in selected local governments in Ghana. *Development in Practice*,

28(1), 65–80. DOI: 10.1080/09614524.2018.1398717

- Paino, H., Ismail, Z., & Smith, M. (2010). Dysfunctional audit behaviour: An exploratory study in Malaysia. *Asian Review of Accounting*, 18(2), 162–173. DOI: 10.1108/13217341011059417
- Ramos-Villagrasa, P., Barrada, J., Fernández-del-Río, E., & Koopmans, L. (2019). Assessing Job Performance Using Brief Self-report Scales : The Case of the Journal of Work and Organisational Psychology Assessing Job Performance Using Brief Self-report Scales : The Case of the. *Journal of Work and Organizational Psychology*, 35(3), 195–205. <https://journals.copmadrid.org/jwop/art/jwop2019a21>
- Sabbi, M., & Stroh, A. (2020). The “Numbers Game” Strategic Reactions to Results-Based.pdf. *Studies in Comparative International Development*, 1(55), 77–98.
- Schatzki, T. . (1996). *Social practices: A Wittgensteinian approach to human activity and the social*. Cambridge University Press.
- Siverbo, S. (2021). The impact of management controls on public managers ’ well-being. *Financial Accountability & Management*, 1–21. DOI: 10.1111/faam.12290
- Syrtseva, S., Burlan, S., Katkova, N., Cheban, Y., PISOCHENKO, T., & Kostyrko, A. (2021). Digital technologies in the organisation of accounting and control of calculations for tax liabilities of budgetary institutions. *Estudios de Economia Aplicada*, 39(7). DOI: 10.25115/eea.v39i7.5010
- Uddin, S., Popesko, B., Papadaki, Š., & Wagner, J. (2021). Performance measurement in a transitional economy: unfolding a case of KPIs. *Accounting, Auditing and Accountability Journal*, 34(2), 370–396. DOI: 10.1108/AAAJ-11-2019-4231

Identification of tax fraud and analysis of their impact

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Abstract: One of the ways in which entrepreneurs try to gain an unjustified advantage within economic relations is by committing tax fraud. Tax fraud is an integral part of today's economy, and as the ways of committing tax fraud evolve, so do the ways of detecting it. Entire chains of domestic and foreign companies are often involved in tax fraud. In this way, more and more pressure is exerted on the authorities that are supposed to serve to uncover these frauds. The aim of the article is to identify tax fraud as such, as well as the ways in which it is committed, and to analyze how these frauds affect business activities. In cross-border transactions, it is always much more difficult to prove that tax fraud has occurred. Authorities investigating tax fraud at the national level are limited by their national jurisdiction, and international cooperation at the bilateral and European level is therefore very essential in this area. We will probably never get rid of tax fraud completely. However, thanks to consistent cooperation, it is possible to significantly reduce their occurrence.

Keywords: fraud, tax fraud, tax crime, international transaction

JEL Classification: G32, G33, C35

1 Introduction

Fraud in the field of public finances and financial law is a hot topic that constantly affects the events around us (Kohoutkova & Zidkova, 2015; Petev, 2020; Rakovský, 2021; Sarnowski & Selera, 2020). Schneider et al. (2015) states that indirect taxes are still the driving force behind the shadow economy. In the case of fraud, it is generally a situation where someone enriches himself at the expense of someone else by misrepresenting him, taking advantage of someone else's mistake or concealing material facts that subsequently lead to damage to someone else's property. Among the most common types of fraud are tax frauds, among them tax frauds on value added tax related to the fact that within the business chain, tax evasion occurs at the expense of the public budget, and this loss is not compensated by the tax subject. However, tax fraud is not the only fraud that we can encounter. We can also identify insurance fraud, credit fraud or even subsidy fraud. Insurance fraud is a situation where someone provides false or grossly distorted information or conceals essential information in the context of concluding or changing an insurance contract, liquidating an insurance event, or when exercising the right to insurance or other similar performance. We then speak of credit fraud if someone, when negotiating a credit agreement or taking out a loan, provides false or grossly distorted information, or conceals essential information, or uses the funds obtained through a purpose-built loan for a loan other than the specified one without the creditor's consent. Subsidy fraud is associated with the fact that someone provides false or grossly distorted information or conceals essential information in an application for the provision of a subsidy, subvention or returnable financial assistance or contribution. Said frauds can be a separate type of fraud or be part of fraudulent conduct, e.g., corporate frauds. In our article, we will focus in more detail on tax fraud.

Each type of fraud has its own specific characteristics and therefore there are a number of factors that trigger fraud (Ahmad et al., 2021; Opreț et al., 2017; Vondráček & Eibl, 2018). The primary reason for tax fraud is the conflict of interests between the private and public sectors. Other risk factors are closely related to each other, influencing each other. We can mention, for example, economic factors, tax-technical factors, legislative factors, psychological factors, socio-political factors, ethical and social factors. Of course, tax frauds have fundamental effects on the functioning of both the state administration (Dimić, 2021) and the entrepreneurs themselves (Vondráček & Eibl, 2018). The implications of fraud are significant. Some can be marked and quantified simply, others are more complicated or are indirect impacts. Easier to quantify are direct financial losses, sanctions, fines, fraud corrections. But, for example, damage to the brand, reputation, loss of position on the market, employee departures are already difficult to quantify and have a long-term effect. The

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impacts are also on the assets of organizations and companies, as they are of a different nature - the costs of detecting them, the costs of solving them, the costs of preventing fraud, the costs of subsequent damages.

A significant part of tax fraud is fraud within cross-border transactions (OECD, 2021; Sato, 2014; Ševčík, 2018; Turksen & Abukari, 2020), when entities committing tax fraud rely, among other things, on cooperation between public authorities of individual member states it is not flexible enough (Petev, 2020), to be able to detect these frauds in time. Despite the fact that new measures are being introduced to fight against these frauds, their scale is still striking. International sources indicate that fraud actors are increasingly using new technological tools, and therefore effective and timely international cooperation and cooperation is essential (Sarnowski & Selera, 2020). The fact that fraud is a global economic problem is also confirmed by transnational working groups that prepare strategies to prevent economic fraud at the international level. It is necessary to examine not only existing stimuli, but also newly emerging ones. The Forum of Heads of tax crime investigation of the OECD's task force on tax crimes and other crimes regularly discusses current and emerging risks, including those arising from the COVID-19 pandemic. (OECD, 2021)

However, in relation to the international scope of fraud, the violation of law related to fraud may differ depending on the legal system of the jurisdiction. In her article, Karfíková (2018) explains and recalls the importance and clarity in the field of tax law. However, regardless of the nature of the particular culture, policy and legislative environment that reflects the nature of the legal framework, according to (Turksen & Abukari, 2020) the legal framework will be most effective if it actually seeks to not only clearly define crimes (Brychta et al., 2021; Procházka et al., 2022), but also to have clearly defined punishments according to the seriousness of the fraud, so that the perpetrators cannot take advantage of these differences.

The aim of the article is the definition of tax fraud, their identification from the point of view of criminal law, and further evaluation of the available tax fraud statistics.

2 Methods

To achieve the set goal, the methods of scientific work based on the evaluation of primary and secondary data, induction, deduction, analysis and synthesis were used. When writing the article, information from primary sources was analysed. Above all, data obtained from the activities of law enforcement authorities, i.e., the courts and the police of the Czech Republic, which try to detect crimes related to tax issues. Another source of data was subsequently statistical data obtained from the financial administration, i.e., the bodies that stand on the front line in the fight against tax evasion. If these authorities discover that a tax subject may have committed a tax crime, they are obliged to report this fact to the law enforcement authorities. After evaluating the data obtained in this way, their selection took place. Subsequent data analysis covers the period from 2010 to 2021. Detailed statistics on the commission of tax crimes, which are kept by the courts, public prosecutor's office, police and financial administration authorities, may differ depending on the stage of the investigation of tax fraud. Financial administration bodies are obliged to notify the police of any suspicious behaviour that could fulfil the elements of the facts of individual criminal offences. Then comes the turn of the police, who check whether a crime has been committed. Therefore, not every initiative of the financial administration authorities necessarily has to end with the initiation of criminal prosecution. On the other hand, other authorities, not only the financial administration authorities, can pass on the suggestions to the police. Furthermore, not every criminal prosecution ends with bringing an indictment. If the police do not have sufficient evidence, the public prosecutor postpones the case and does not bring a legal action to the court. Finally, there is one more elimination criterion, namely decision-making in court. Again, not every indictment ends with a court decision declaring that a crime has been committed. Courts can also decide that no crime was committed, and therefore no tax fraud could have occurred. For this reason, individual statistics may vary. The authors therefore chose the statistical overviews of crime by the Police of the Czech Republic to carry out the impact assessment. (Policie ČR, 2022) and statistical overviews of the Financial Administration of the Czech Republic (Finanční správa České republiky, 2022). An integral part of the examined issue was also the definition of tax frauds and their initial theoretical-legal analysis.

3 Research results

We can look at tax fraud and examine it from different points of view (Popescu, 2020), it combines a legal, social, financial and ethical problem (Nováček, 1999). It is also necessary to agree with Šimonová (2018), that the term tax fraud and tax evasion cannot be synonymous, when each of them means something slightly different. Furthermore Šimonová (2018) adds that tax fraud is a form of deliberate avoidance of tax liability, while tax evasion is the result of the overall economic behaviour of tax subjects, which is oriented towards the greatest possible reduction of tax liability on an illegal principle.

When defining tax evasion, we can also use the web portal of financial terms to help. The portal (penize.cz, 2022) states that tax evasion is understood as: *"The negative practice of not declaring taxable items, profit that exceeds the permitted reliefs for the purpose of evading the tax that is legally due."* Put simply, tax evasion means the violation of a

generally binding tax regulation in such a way that leads to a reduction of the tax liability of the tax subject, which is, however, to a greater or lesser extent provable and therefore punishable (Pickhardt & Prinz, 2012). The above also shows the fact that there is a very thin line between tax optimization and tax evasion. Tax evasion and tax fraud are also related to other concepts, which will be partially discussed below, namely tax avoidance, tax reduction or aggressive tax planning. As Sejkora (2017) states, „*tax avoidance is first and foremost a lawful legal action, but in its illegitimate form it can reach the level of illegality establishing the administrative responsibility of the tax subject.*“ According to the authors, the definition of tax fraud itself is very problematic and causes considerable difficulties. While the theory, especially the legal one, has the definition of tax fraud quite clear in this case, the opposite is true for the wider public. The concepts of tax optimization, tax fraud and tax evasion are also merging. This, combined with the dynamic development of the given area, especially towards the tightening of these definitions, leads, according to the authors, to considerable public uncertainty.

From a legal point of view, tax fraud is a typical institution of criminal law. Tax crimes are classified under economic crimes and are among the most frequently occurring and prosecuted economic crimes (Púry & Kuchta, 2013). The starting point for defining this term must therefore be found in the Criminal Code, specifically in Act No. 40/2009 Coll., Criminal Code, as amended. Section 209 generally defines the crime of fraud. According to the Criminal Code, fraud means a situation where someone enriches himself or another by misleading someone, taking advantage of someone's mistake or concealing essential facts, and thus causes not insignificant damage to someone else's property. Karfíková et al. (2018) further applies this definition to tax law, and according to her, tax fraud is therefore a situation where „*someone (most often a tax subject, but it is also possible to exclude an official person of the tax administrator) enriches himself or another by misleading someone, taking advantage of someone's mistake or concealing material facts, and as a result the public budget does not receive tax revenue.*“ The specificity of tax fraud is the existence of missing tax that should have been paid but was not paid as a result of the actions of the perpetrator of this crime. Dimić (2021) reminds that, unlike other crimes, the immediate harmful effect is not directly visible. A sign of fraud in the sense of European jurisprudence is the fact that one of the participants does not pay the tax and the other deducts it; this essentially violates tax neutrality. However, one cannot automatically consider "any" of the participants in the trade chain as "one" and "another" *stricto sensu*. It is always necessary to look for factual links and a causal connection between the non-payment of tax and claiming a deduction and proving knowledge of facts indicating possible fraudulent behaviour in order to attract a tax deduction between these entities. In the opposite way, the objective tax responsibility of any entity involved in the trade chain and the responsibility for the movement and fate of the goods would be completely inadmissible (3705/2018 Daň z přidané hodnoty: Daňový podvod, 2018). Brychta et al. (2021) states that the Court of Justice of the EU does not provide an explicit and exhaustive definition of tax fraud but establishes signs and circumstances that testify to the existence of tax fraud, e.g., failure to keep accounts, concealment of the delivery of goods, concealment of income, failure to submit a tax return, failure to pay tax due to administrative authorities.

The concept of tax fraud is closely related to tax reduction. Section 240 paragraph 1 of the Criminal Code defines the criminal offense of reducing tax, fee, and similar mandatory payment. The law specifically states that "*whoever reduces to a greater extent a tax, duty, social security premium, contribution to the state employment policy, accident insurance premium, health insurance premium, fee or other similar compulsory payment or induces an advantage to any of these compulsory payments, will be punished by imprisonment for six months to three years or a ban on activity.*" The next paragraphs of this section then define more severe punishments and qualified facts of the same crime.

The following section of the Criminal Code, i.e., section 241, defines a crime related to the above, namely failure to pay taxes, social security contributions and similar mandatory payments. Pursuant to paragraph 1 of this section, anyone who "*to a greater extent, as an employer or payer, he does not fulfil his legal obligation to pay taxes, social security contributions, contributions to the state employment policy or health insurance premiums for an employee or another person, he will be punished by imprisonment for up to three years or a ban on activity.*" Again, other paragraphs define the qualified facts.

Detailed statistics on tax crimes are carried out by law enforcement agencies, i.e., courts, public prosecutor's offices, and the police. The criminal complaint is then usually filed by the financial administration authority, as in many cases criminal proceedings follow the tax administrator conducts a tax audit, and at the same time discovers facts which, in his opinion, fulfil the factual nature of one of the criminal offences. In this situation, the tax administrator basically has no other option than to file a criminal complaint, as he is obliged to do so. A paradoxical situation may follow, when two separate proceedings concerning the same matter, e.g., the same tax and the same tax period, are conducted simultaneously. Both procedures are governed by completely different rules and principles, and as a consequence, they can end up with completely different results. In the opinion of the authors, inaccuracies already arise here, since there is no uniform classification of tax fraud, the authorities do not keep uniform statistics, and they can therefore be misleading. In addition,

misconduct detected by a financial administration authority does not automatically mean that it is tax fraud under criminal law.

Sejkora (2017) also points out that the true extent of tax evasion is difficult to ascertain, due to imperfect tools for detecting and measuring tax evasion. This is also helped by the fact that there is no unequivocal rule that would define which actions are still in accordance with the law and which are no longer. The situation is also made more difficult by the fact that the rules are also evolving at a time when the fictitious border is also shifting. Actions that in the past were accepted as legal and constituted tax optimization can now, about developments in the area, be considered actions contrary to the law.

In the next part, the authors will focus on the evaluation of the obtained statistical data regarding the clarification of selected crimes from the point of view of the clarification of crimes by the Police of the Czech Republic. Statistics obtained from the Police of the Czech Republic were deliberately chosen, as these probably best show the extent of criminal activity in the Czech Republic. At the same time, it is the police that is largely involved in the detection of tax crimes and plays a key role in it.

Table 1 Total damage of detected tax fraud between 2010 and 2021

Year	Tax evasion		Failure to pay taxes, social security premiums and similar mandatory payments		Total tax collection
	Total damage (thousand CZK)	% on the total collection	Total damage (thousand CZK)	% on the total collection	(thousand CZK)
2021	4 042 007	0,73697	170 627	0,03111	548 466 000
2020	5 250 403	0,93560	169 940	0,03028	561 183 000
2019	4 758 683	0,81545	203 498	0,03487	583 567 000
2018	3 746 824	0,61363	144 894	0,02373	610 597 000
2017	3 980 480	0,62294	156 291	0,02446	638 982 000
2016	5 686 096	0,84846	136 019	0,02030	670 167 000
2015	7 957 739	1,08683	135 021	0,01844	732 197 000
2014	8 572 074	1,07747	179 750	0,02259	795 572 000
2013	6 843 153	0,80165	132 437	0,01551	853 634 000
2012	6 278 758	0,69223	169 310	0,01867	907 039 000
2011	3 361 121	0,39509	210 396	0,02473	850 732 000
2010	4 510 534	0,52086	203 378	0,02349	865 971 000

Source: Own processing by (Finanční správa České republiky, 2022; Policie ČR, 2022)

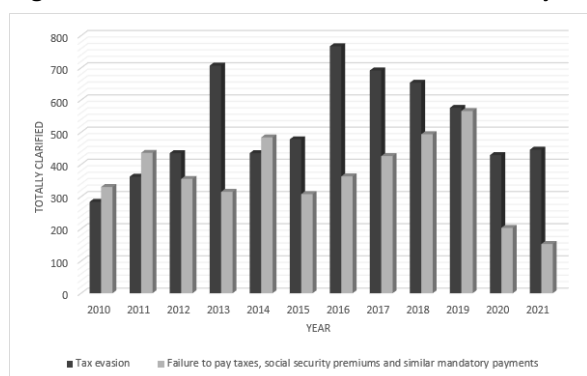
From the statistics presented in Table 1, it follows that much greater damage is caused by the crime of evasion of tax, fee, and similar compulsory payment. The amount of damage ranges from 3.4 billion CZK in 2011 to 8.6 billion in 2014. It is possible to say that over the last 10 years the amount has been constant and varies between 0.4-1.1 % of the total collection taxes in the case of the criminal offense of evasion of tax, fee, and similar mandatory payment. In the case of Failure to pay taxes, social security premiums and similar mandatory payments, the amount ranges from 0.02-0.04 % of the total tax collection. Of course, these are only statistics of detected crimes. Logically, the statistics cannot contain all tax evasions. For this amount, we can only talk about estimates, which may not be exact.

Table 2 Total number of clarified frauds and damage in individual years

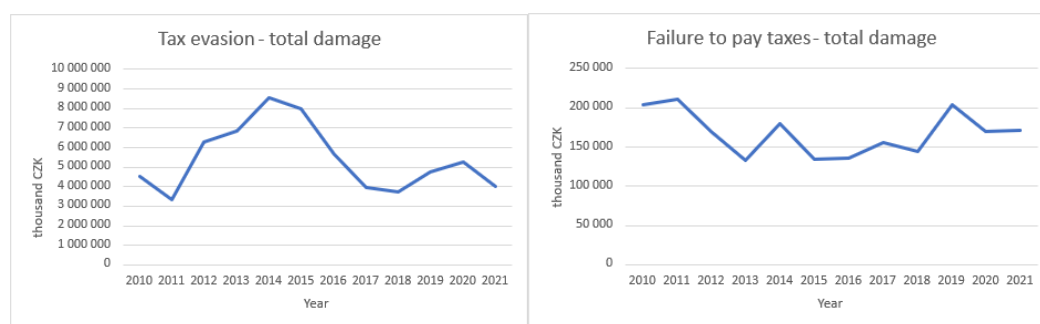
Year	Tax evasion		Failure to pay taxes, social security premiums and similar mandatory payments	
	Totally clarified	Total damage (thousand CZK)	Totally clarified	Total damage (thousand CZK)
2021	446	4 042 007	153	170 627
2020	429	5 250 403	203	169 940
2019	576	4 758 683	566	203 498
2018	654	3 746 824	494	144 894
2017	692	3 980 480	426	156 291
2016	767	5 686 096	363	136 019
2015	478	7 957 739	308	135 021
2014	435	8 572 074	484	179 750
2013	707	6 843 153	315	132 437
2012	435	6 278 758	355	169 310
2011	362	3 361 121	436	210 396
2010	284	4 510 534	330	203 378

Source: Own processing by (Policie ČR, 2022)

The development in the total number of solved crimes is similar, which can be seen from Table 2 and Figure 1 and Figure 2.

Figure 1 Total number of clarified frauds in individual years

Source: Own processing by (Policie ČR, 2022)

Figure 2 Total damage of tax evasion, Total damage of failure to pay taxes

Source: Own processing by (Policie ČR, 2022)

At the same time, it can be seen from the above that the number of cases of crimes of evasion of taxes, fees and similar mandatory payments do not fundamentally differ from the numbers of cases of crimes of failure to pay taxes, social security premiums and similar mandatory payments (Table 2, Figure 1). However, fundamental differences can be seen in the amount of damage caused, where one criminal offense of evasion of taxes, fees and similar mandatory payments incurs an order of magnitude more damage than is the case for the criminal offense of failure to pay tax, social security premiums and similar mandatory payments (Table 2, Figure 2).

4 Conclusions

Tax fraud is a global problem. As a result of tax fraud, states lose billions of sums that could have been allocated to the development of domestic and transnational policies (Kohoutkova & Zidkova, 2015; Sarnowski & Selera, 2020). In the years 2010-2021, the Czech Republic uncovered a total of 6,265 criminal offenses of evasion of tax, fee and similar mandatory payments, which caused damage to the state in the amount of almost CZK 65 billion. According to some estimates, up to 1,000 billion euros a year disappear in this way in the EU (European Parliament, 2018). These funds could be invested, for example, in the development of infrastructure, healthcare or be used in another way, for example to support innovative business or science and research. The question remains, however, what is the level of enforceability of the damage caused. It is necessary to take a realistic look at the stated amounts. If the offender causes damage to the state as a result of a reduction in tax in the amount of 100 million CZK, it is likely that he does not have the said amount at his disposal so that it can be secured for him. It would be naive to think that the perpetrators will voluntarily pay the stated amount to the state. It is therefore necessary to look for the problems of tax evasion and tax fraud already in their essence and try to set up a system of legal rules so that it is clear for entrepreneurs. And at the same time so that they have no reason to harm the state through tax evasion.

We are partially seeing steps in the right direction regarding tax evasion and tax fraud committed in cross-border transactions. In these transactions, we mostly encounter value added tax fraud, when due to the cumbersomeness of the authorities detecting these actions and the need for international cooperation, it is still interesting for the perpetrators to commit these frauds and subsequently hide behind a network of established companies. Registration of fraud within the Community is also problematic, as there is a lack of comparable data and indicators regarding VAT fraud within the Community (Evropský účetní dvůr, 2015). However, even here we see a shift in the form of faster cooperation between financial administration authorities and the police. And, regarding the gradual electronization and the introduction of other obligations for entrepreneurs in relation to value added tax.

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References

- Act No. 40/2009 Coll., Criminal Code, as amended.
- Ahmad, B., Maria-Lenuta, C.-U., & Georgeta, B. (2021). Economic and Non-Economic Variables Affecting Fraud in European Countries. *Risks*, 9, 119. DOI: 10.3390/risks9060119
- Brychta, K., Kupčík, P., & Procházka, V. (2021). Pojmové znaky podvodu na DPH v judikatuře Soudního dvora Evropské unie. *Časopis pro právní vědu a praxi*, 29(3), Article 3. DOI: 10.5817/CPVP2021-3-8
- Dimić, S. (2021). Tax fraud as the most severe form of tax evasion: Review of legislation and practice in Serbia. *Zbornik Radova Pravnog Fakulteta u Nišu*, 60(90), 77–95. DOI: 10.5937/zrpfno-30968
- European Parliament. (2018). *Tax avoidance: MEPs accuse Council of undermining EU's credibility*. News. European Parliament. <https://www.europarl.europa.eu/news/en/headlines/economy/20180126STO94140/tax-avoidance-meps-accuse-council-of-undermining-eu-s-credibility>
- Evropský účetní dvůr. (2015). *Boj s podvody v oblasti DPH v rámci Společenství: Jsou nutná další opatření* [Zvláštní zpráva]. Evropský účetní dvůr. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjA3KXLgc76AhX7gP0HHZPvBtcQFnoECBcQAQ&url=https%3A%2F%2Fwww.eca.europa.eu%2FLists%2FECADocuments%2FSR15_24%2FSR_VAT_FRAUD_CS.pdf&usq=AOvVaw3RwLlzy-8rB35r7tXyXQaV
- Finanční správa České republiky. (2022). *Analýzy a statistiky. Údaje z výběru daní*. Finanční správa České republiky. <https://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/udaje-z-vyberu-dani>
- Karfiková, M. (2018). Daně jako nástroj fungování státu. *AUC IURIDICA*, 64(1), 7–19.
- Karfiková, M., Boháč, R., & Kohajda, M. (2018). *Teorie finančního práva a finanční vědy* (2018th ed.). Wolters Kluwer.
- Kohoutkova, R., & Zidkova, H. (2015). Všeobecný prenos danovej povinnosti a cash-flow verejných rozpočtu Českej republiky. (Reverse Charge and the Cash Flow of the Public Budgets in the Czech Republic. With English summary.). *Acta Oeconomica Pragensia*, 23(6), 47–61.
- 3705/2018 Daň z přidané hodnoty: Daňový podvod, 4/2018, XVI Sbírka rozhodnutí Nejvyššího správního soudu ____ (Nejvyšší správní soud 2018). <https://sbirka.nssoud.cz/cz/dan-z-pridane-hodnoty-danovy-podvod.p3692.html>
- Nováček, M. (1999). Daňové úniky jako společenský jev. *Časopis pro právní vědu a praxi*, 7(3), Article 3.

- OECD. (2021). *Heads of tax crime investigation welcome new OECD report on fighting tax crimes—OECD*. OECD. <https://www.oecd.org/tax/crime/heads-of-tax-crime-investigation-welcome-new-oecd-report-on-fighting-tax-crimes.htm>
- Opreț, L.-A., Turcas, F., Dumiter, F. C., & Brezeanu, P. (2017). Tax evasion between fraud and legality. *Studia Universitatis Vasile Goldis Arad, Seria Stiinte Economice*, 27, 1–11. DOI: 10.1515/sues-2017-0013
- peníze.cz. (2022). *Co je Daňový únik*. Peníze.cz. <https://www.penize.cz/slovník/danovy-unik>
- Petev, B. (2020). Tax Fraud as Security Threat. *Economic Archive*, 4 Year 2020, 70–84.
- Pickhardt, M., & Prinz, A. (Eds.). (2012). *Tax Evasion and the Shadow Economy*. Edward Elgar Publishing.
- Policie ČR. (2022). *Kriminalita—Policie České republiky*. Kriminalita. Statistické přehledy kriminality. <https://www.policie.cz/statistiky-kriminalita.aspx>
- Popescu, L. (2020). Tax Evasion Between Legality And Fraud. *Annals - Economy Series*, 4, 48–53.
- Procházka, V., Kupčík, P., & Brychta, K. (2022). Definční znaky podvodu na DPH v judikatuře Nejvyššího správního soudu. *Časopis pro právní vědu a praxi*, 30(1), Article 1. DOI: 10.5817/CPVP2022-1-6
- Půry, F., & Kuchta, J. (2013). Poznámky k daňové kriminalitě v České republice. *Časopis pro právní vědu a praxi*, 21(2), Article 2.
- Rakovský, P. (2021). *Daňový podvod a zneužití práva v oblasti daní. Právne následky*. C.H.Beck.
- Sarnowski, J., & Selera, P. (2020). European compact against tax fraud—VAT solidarity and new dimension of effective and coherent tax data transfer. *ERA Forum*, 21(1), 81–93. DOI: 10.1007/s12027-020-00603-z
- Sato, A. (2014). Carousel Frauds with Sugar. *Listy Cukrovarnické a Reparské*, 130(5–6), 206–208.
- Schneider, F., Raczkowski, K., & Mróz, B. (2015). Shadow economy and tax evasion in the EU. *Journal of Money Laundering Control*, 18(1), 34–51. DOI: 10.1108/JMLC-09-2014-0027
- Sejkora, T. (2017). *Finančněprávní nástroje boje proti únikům na dani z přidané hodnoty v prostoru Evropské unie* (2017th ed.). Leges.
- Ševčík, M. (2018). *Karuselové podvody*. Leges.
- Šimonová, J. (2018). Daňové úniky – precizácia všeobecnej terminológie (absentujúceho aspektu daňového práva). *AUC IURIDICA*, 64(1), 127–133.
- Turksen, U., & Abukari, A. (2020). OECD's global principles and EU's tax crime measures. *Journal of Financial Crime*, 28(2), 406–419. DOI: 10.1108/JFC-09-2019-0118
- Vondráček, O., & Eibl, M. (2018). Etiketa daňové transparentnosti a odpovědnosti jako nástroj boje proti korporátní daňové optimalizaci: Tax responsibility certification mark as a tool against aggressive corporate tax planning. *Ekonomické Listy*, 9(1), 37–56.

Identification of current financial bubbles on the global real estate markets

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Abstract: The article relates to the topic of speculative price bubbles which arise on the real estate markets. High property prices, historically high inflation and rising construction interest rates have lately brought attention to the question whether a real estate bubble is currently present on the respective markets and if a housing market crash is coming. In order to develop an understanding of this, a theoretical basis of the phenomenon of financial bubbles is crucial. The main aim of the article was to then conduct a quantitative calculation of price valuation indicators of housing affordability and subsequently construct a comparative ranking table for the world real estate markets. Leading up to timeline of first half of 2022, the results indicate an occurrence of a possible financial bubble on the real estate markets of China, Western and Central Europe. Within the present effects of the so-called "bubble in everything", the results were justified by current investment conditions, limitations of the used indicators were considered and preventive measures were proposed.

Keywords: Financial bubbles, overvaluation, price indicators, real estate market, behavioral economics, investor behavior

JEL Classification: R31, G41

1 Introduction

Currently there are a lot of expensive assets in the world economy. That is also partially due to the fact that over the past decade of loose monetary policy and constant central bank money printing, the infamous "bubble in everything" has been created. The financial bubble itself generally represents a state of overvaluation or deviation of asset prices from their true intrinsic value, with a future threat of a sudden drop in the market price. Throughout world history, we have already encountered several such bubbles, with the current milestone of already 385 years since the first tulip financial bubble in the Netherlands in 1637.

The exact cause of any financial bubble can be economic as well as behavioral in nature and is often accompanied by phenomena such as investor herd behavior or moral hazard. Such phenomena eventually escalate into panic buying of selected assets, which, in analogy with the new pandemic of the COVID-19 virus, spreads through the markets like a contagion, while without early identification of the occurrence of a bubble, it is not possible to prevent the significant negative effects of its later bursting. However, it is relatively easy to identify a financial bubble only in retrospect, but it is much more difficult to recognize it in real time, when it hasn't burst yet. Overall, can this article then, in addition to addressing the topicality of the issue, have the potential of a significant benefit not only for financial and state institutions capable of mitigating the effects of bursting bubbles, but also for everyday investors avoiding overvalued and looking for undervalued assets.

The term bubble is a very current topic in the media these days, whether on the domestic or international scene. In the context of the pandemic, we have been probably recently encountered so-called social bubbles more frequently, but within the more economic-financial focus, financial bubbles have been coming to the fore for several years, primarily as a reaction to the unstoppable rise in the prices of various assets across the global economy. In order to be elementarily able to look for the very phenomenon of the financial bubble on the real estate market, it is first of all crucial to define the researched term. At the outset, it is necessary to state that there is still no single clear definition of a financial bubble, as each author characterizes it with smaller or larger differences. The financial bubble itself is further referred to in the literature as: economic bubble, price bubble, speculative bubble, investment bubble or speculative mania (Sivák, 2019).

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One of the first economists to think more closely about asset price bubbles was John Maynard Keynes (1936), who concluded that bubbles primarily form because investors can behave irrationally. Subsequently, according to Siegel (2003), the bubble is explained as a deviation between the real value of the asset and its higher market price. This is also supported by Scherbina (2013), who states that a bubble can be characterized as a time period when speculative investments lead to an overvaluation of prices in a specific sector. It should therefore be emphasized that we understand financial bubbles in a simplified sense as a speculative overvaluation of the price of a selected asset, such as real estate, stock shares, currencies or other goods and sectors, while specifically in the article we will analyze this rate of overvaluation on the real estate markets.

All of the above-mentioned definitions have a common basis in high trading volume, where assets trade at a price or within a price range that significantly exceeds their underlying asset value (Scott, 2020). This basic or fundamental value is described as the present value of all future cash flows received from the asset (Uppal, 2017). Cash flows from shares can thus be measured by dividends paid. However, real assets such as gold or the real estate we are focusing on, do not pay dividends, and instead of dividends, they are, for example, cash flows from the house determined by construction costs and rent (Shiller, 2007).

As noted by Xiong and Scheinkman (2014), the economic consequences of such an asset market bubble can be over-investment, imprudent trading in boom times, as well as a financial crisis with the economy in a slump. These consequences are most likely to occur after the bubble bursts, when investors realize that buying real estate in a particular market is not as profitable, liquid and sustainable as they thought. As soon as it happens, valuations fall below pre-bubble levels (Chang, 2016). It is also essential to emphasize the behavioral and psychological aspects of financial bubbles. American economist and winner of the Nobel Prize in Economics, Robert Shiller, in his publication *Irrational Exuberance*, defines a bubble as "a situation where information about rising prices evoke enthusiasm that spreads like a psychological contagion from person to person, accompanied with stories that explain price increases and they attract a larger and larger group of investors who, regardless of their doubts about the value of the investment, are drawn into speculation partly due to envy of the success of others and partly due to the influence of gambling excitement." (Shiller, 2000).

Likewise, in the context of the current global COVID-19 pandemic, we can apply the definition to bubbles in parallel, where a speculative bubble is, in a certain sense, a social epidemic, the contagion of which is mediated by price movements (Shiller, 2012).

2 Methods

In an attempt to identify price bubbles on the real estate market before they burst, several financial indicators are mentioned in the academic literature, with the help of which it is possible to evaluate whether the assets on the given market are valued objectively or rather irrationally high above the historically established safe values, indicating the possible occurrence of bubbles. In the case of the real estate assets we are investigating, by comparing the current levels of the indicators with previous levels that proved to be unsustainable in the past (i.e., led or at least accompanied the subsequent bursting of the financial bubble), we can make a qualified estimate of whether the given real estate market is still experiencing a bubble.

The detection of bubbles in the real estate market is primarily accompanied by the housing affordability indicator, respectively the ratio of the real estate price to the income of the population in the given area. As a rule, it is the ratio of the average market prices of houses or the price per m² of real estate to the average annual family disposable income (Vogel, 2009).

$$\textbf{Price to income ratio} = \frac{\text{median real estate market price}}{\text{median annual household income}}$$

The first listed indicator of real estate affordability thus determines how much annual income must be saved for the purchase of real estate. The rule that real estate agents and buyers have long used is that you can afford a property if its total price is equal to roughly 2.6 years of your individual income or your household income (Florida, 2017). This ratio is based on historical national averages under healthy economic conditions. Thus, the index generally has a rating of "affordable" from 3.0 and below, to "worse affordability" when the value exceeds 5.0. The more years of family or household income a person has to allocate to the purchase of real estate, the lower the affordability. If the growth of house prices exceeds the growth of household incomes too much, it means that a bubble may develop and fewer households will be able to afford to buy a property, if we abstract from the change in credit capacity (Vogel, 2009).

$$\textbf{Price per m}^2 \textbf{ to income} = \frac{\text{median market price per one m}^2 \textbf{ of real estate}}{\text{median annual household income}}$$

The literature also mentions the ratio of the average price for one m² of real estate to the average annual income, which determines in percentage terms how much of the annual income an individual must allocate to the purchase of one m² of real estate. In general, a value of 20% of the annual income is stated as the limit of affordability (Roberts, 2008). The mentioned indices can be applied to selected international real estate markets and then, according to the defined intervals of 5 years and 20%, it is possible to evaluate whether it is justified to consider a bubble forming in any individual real estate market. Research will utilize the mentioned two marginal limits of overvaluation, which in academic literature are considered the most suitable for uniform complex comparisons, especially in connection with their high indicative value during the last crisis in 2008, as was also further confirmed by the eminent American economist Robert Shiller in his publication *Irrational Exuberance*. However, in the case of further research, the statistical significance of research methodology could be supplemented also with individual comparative bases for selective countries or regions.

Selected property data drawn from one of the world's largest real estate databases, NUMBEO, are reported for the following specific property groups - Apartment (1 bedroom) in city centre, Apartment (1 bedroom) outside of centre, Apartment (3 bedrooms) in city center and Apartment (3 bedrooms) outside of centre. Taking into account the given categories, we can conclude that in the framework of the research we will have to abstract from the impact of age of the property as well as other residential types of property (such as family houses, villas, mansions, mountain huts, etc.).

According to the literature, the very occurrence of financial bubbles is most often observed retrospectively, primarily visually or mathematically on a graphic representation of the price development of a specific asset (Sornette & Cauwels, 2014). As we have already stated, the key component to start the process of unsustainable price growth is mainly positive feedback from investors. This is also called procyclicality in economics and is the exact opposite of negative feedback. But if there is exaggerated positive feedback, the dynamics of price growth will change drastically. Indeed, the growth rate is not constant or based on the real state of the economy, but begins to grow on its own, which leads to hyperbolic growth, which is faster than the exponential mathematically expressed by the equation $y = a^x$ (Porrás, 2016). Such uncontrolled growth then continues until the moment when the price is so high that the model breaks or out of the blue, investors start selling in panic. In physics and mathematics, such a point is called a singularity. This point is then the moment of the bursting of the financial bubble, when a period of unsustainable price growth is followed by a steep fall. Therefore, as part of the research, in addition to quantitative indicators, we will also analyze the graphic portrayal of price developments on selected real estate markets.

3 Research results

The following chapter will be devoted to the interpretation of the quantitative results of the calculation of price indicators and the graphic display of price developments in selected risky countries.

As we have already stated in the previous part, when analyzing the real estate market, we will base our calculations on the table of two indicators of the affordability of real estate in relation to the income of the population. For selected areas with high values of the investigated indicators, we then also apply a graphic representation of the price development in order to determine whether an irrational growth trend can also be observed visually on the price development curve.

Based on the previously determined threshold values - for the total price to income of 5 years and for the price per m² to the annual income of 20%, we observe in the below presented table 1 that the global real estate market is overvalued in most countries based on these two indicators. Abstracting from this fact and focusing on the price of the "most dangerous" areas, we can primarily identify the Asian real estate markets, namely the Chinese market, followed by the markets of Central and Western Europe, as the areas with the lowest real estate affordability prevailing. To give an idea, this situation in the worst-priced area of Hong Kong, currently means in June of 2022 the need to save for at least 47 years to buy a property or save 95.5% of the annual income for the purchase of 1 square meter of the given property. Such a level of saving is unrealizable for the general population, and therefore the price level reflects rather irrational speculative demand leading to the formation of a price bubble.

Table 1 Indicator values for selected real estate markets in 2021 and 2022

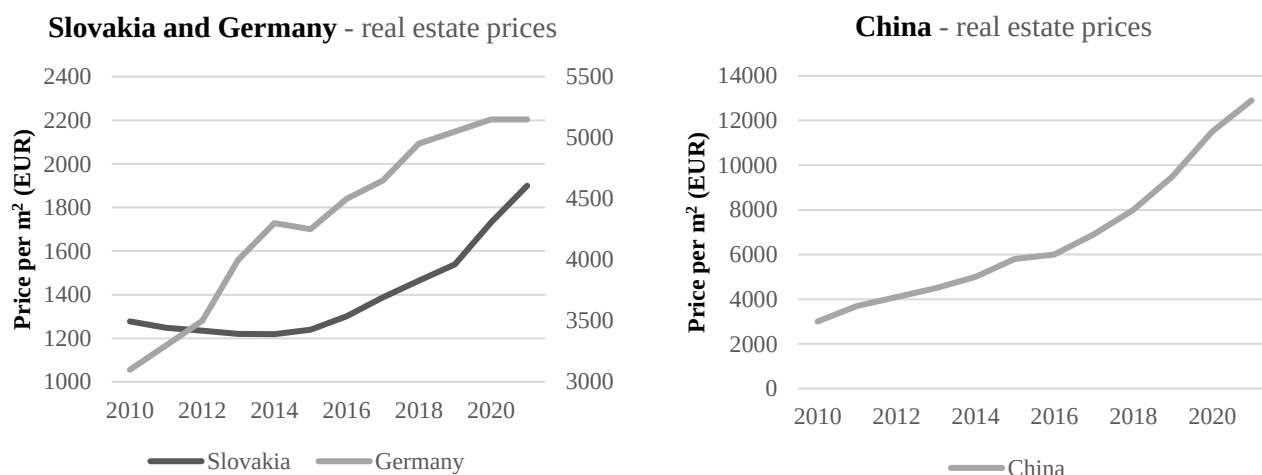
COUNTRY	Price to income 2021 (years)	Price to income 2022 (years)	Price per m² to income 2021 (%)	Price per m² to income 2022 (%)
Hongkong	44,81	47,11	91,5	93,1
China	28,27	29,31	62,7	67,7
Singapore	19,51	20,57	43,3	44,3
Czech Republic	14,65	17,67	28,5	31,7
Japan	12,84	12,93	27,1	29,3
France	12,49	13,01	25,2	26,3
Hungary	11,43	15,41	22,7	29,7
Slovakia	11,17	15,17	21,3	28,9
Austria	10,63	12,17	20,7	23,7
Poland	10,11	11,57	20,9	21,9
Luxembourg	10,07	14,77	19,7	20,9
Great Britain	9,67	10,33	19,1	19,9
Germany	8,96	9,97	17,8	18,9
Switzerland	8,36	9,11	16,6	17,5
Norway	7,79	9,33	11,7	16,3
Canada	7,49	8,03	14,5	15,5
Australia	5,26	6,07	13,9	14,7
USA	4,02	5,93	8,4	9,7
Limit	5 years		20 percent	

Source: Own processing according to data from UBS Global Real Estate Bubble Index 2021 study and NUMBEO database

When comparing the state of valuation on the real estate markets at the end of 2021 compared to the data from June 2022, we can assess that the rate of overvaluation as well as the probability of the occurrence of a financial bubble in the global real estate market have grown accordingly.

Not only has COVID-19 made the housing crisis worse, as buyers and renters looked for more space during lockdowns, with the emergence of the Ukraine conflict since late February of 2022, the inflation rates have globally seen the highest spikes in decades. This has driven up costs of company buildings as well as subsequent increases in profit margins of the real estate developers. With consumer inflation reaching values well over 10% in many European countries and its subsequent impact on decreasing purchasing power of nominal wages, it can be concluded that the housing affordability has significantly worsened even over only just the first 6 months of 2022.

Graph 1 Graphical comparison of real estate price development on the European and Asian markets



Source: Own processing according to data from National Bank of Slovakia, National Bureau of Statistics of China and DESTATIS Statistisches Bundesamt

When graphically comparing the representatives of two areas with a potential financial bubble on the real estate market, China for the Asian market and Slovakia for the Central European market, in both we observe a growing trend consistently since 2010, typically marking the end of the real estate crisis that has lasted since 2008. During the observed period the real estate prices in Slovakia have increased by 49% over the last 10 years, while in China there was an increase of over 302%. According to the National Bank of Slovakia, since 2019 there has been a significantly accelerating growth in real estate prices in Slovakia in values of 10 to 18% per year, which is also reflected in the steeper slope of the price development curve.

Based on the graphic comparison in graph 1, we can conclude that while in China, based on the indicator values as well as the slope and length of the rising trend curve, the price bubble on the real estate market seems to be already well developed, on the Slovak market we observe a bubble just entering the mania phase with a significant danger of any further increases in the future. When compared to Germany as a representative of Western Europe and Western developed countries, it can also be deduced that the latest price growth pace in the emerging economies of Central Europe and Asia is based on the convexity of the curve significantly faster, indicating a high level of housing inaccessibility further intensified by lower average incomes and, overall, representing a major problem surrounding the unsustainability of future growth.

In line with the current high volatility on the markets, it is necessary to insert the calculated values into the context of the economic environment. Data from the Federal Reserve show that over the past 50 years the interest rate on the 10-year US Treasury bond has averaged at 6%. Back during the heights of the Dot-com bubble and the 2008 crisis, the rate was even higher than average, around 6.5%. We can interpret this, that during the previous bubbles, investors had other good options for their money, but they still recklessly accumulated resources in stocks and real estate. Whereas today, the return on investing in safe assets like bonds is so small that you even lose money due to inflation. Therefore, today even risk-averse investors have to look for returns elsewhere, and low interest rates on government bonds force them to look for returns in riskier assets, which pumps up prices in the stock, cryptocurrency and real estate markets.

Regarding the setting of the economy and the implications for assets in the portfolio, it is also necessary to mention the correlation of price growth with inflation growth throughout 2022, as well as with a large amount of money in circulation due to previous quantitative easing of central banks. Price indicators are higher today also because interest rates on loans were on a 40-year secular downward trend until the current year. Lower rates lead to higher demand because there is a lot more money "looking" for investment. One of the basic economic foundations is price as a function of supply and demand, and if demand increases, so does price.

In recent years, the demand for investment assets has increased dramatically. And not only has the volume of money in mutual funds and hedge funds focused on real estate increased, but the great demand is also intensified by the growing presence of retail investors who, thanks to the digital platforms and mobile applications, can enter markets significantly more easily, which was unimaginable in the past.

However, with the current trend of interest rate growth and quantitative tightening not only in the United States, but most recently also announced by the European Central Bank, it is possible that the subsequent mortgage loan prices rise will be the moment that marks the peak of the current real estate bubble, followed by its long-awaited bursting.

4 Conclusions

In accordance with the current phenomenon of the "bubble in everything", the ongoing economic uncertainty caused by the COVID-19 pandemic and, on a global scale, unprecedentedly high inflation due to the ongoing conflict in Ukraine, the topicality and potential contribution of the researched issue is an ideal opportunity to delve deeper into the analysis of financial bubbles in the real estate markets, the bursting of which tends to trigger major economic crises.

Therefore, the main goal of the article was, based on our own analysis, to identify specific areas where the next real estate bubble is developing or could develop. To achieve the stated goal, we analyzed the calculated values of price indicators of real estate availability, specifically for real estate prices per m² as well as for the purchase of an average property. Based on them, we were able to identify three main areas at risk of a current or future financial bubble by the first half of 2022, namely the real estate markets of China, Western Europe and Central Europe. In the year-on-year comparison for the years 2021 and 2022, we also assessed that with the trend of high inflation, there was a significant increase in prices as well as a deepening of the unavailability of housing on the global real estate market.

The primary limitation in evaluating affordability in the real estate market is the individual market context. The market context is a key factor in real estate price indicators, whose affordability level is suitable for a general prediction of future demand, but for a more complex analysis, additional individual factors such as the influence of the location, the potential for future development or the economic situation of the country must be implemented. For example, the real estate market in China analyzed by us is also very specific in itself and requires taking into account the special factors of mass population concentration in small areas, natural conditions of the locations as well as the characteristic rapid growth of the Chinese economy in recent years, which can partly rationalize the country's price settings.

And how can this problem of real estate bubbles be solved? A striking failure of previous financial bubbles is the fact that central banks and governments reacted too late after the bubble already burst with so-called "ex post" measures, such as changing interest rates. But in the matters of financial stability, as in medicine, "prevention" is always better than "cure."

In the conclusion of the article, we would therefore like to propose a possible solution in a greater concentration of state authorities and financial institutions on "ex ante" measures, still in the beginnings of the bubble, such as the creation of government bonds with higher interest rates, issuing early warnings before the emergence of significant financial risks, supporting the BASEL III standard with a higher requirement for banks' liquidity, as well as to regulate excessively speculative investing by higher taxation of investment property, such as, for example, in the real estate market we focused on, often mortgage-financed purchases of second and other real estate assets far beyond what is necessary to secure basic housing for an individual.

Based on the presented facts, we can summarize that even though the areas identified by us are, according to the indicators, textbook examples of bubbles in the real estate market, the limitations of the indicators and the current economic fundamentals can provide a partial justification and mitigation of their seriousness. These arguments however do not trivialize the problem of the current real estate bubbles, but rather present new problems, such as the unsustainability of low interest rates, the continuous inflow of new money or the lack of alternative investment assets, which are currently collectively distorting the markets and increasing the indicators to such high values that, despite the aforementioned justifications, signal a clear occurrence of real estate bubbles.

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References

- Chang, V. et al. (2016). Review of economic bubbles. In *International Journal of Information Management*, 36(4), 497-506.
- DESTATIS - Statistisches Bundesamt. 2022. Wohnen. [online] Available at: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Wohnen/_inhalt.html
- Florida, R. (2017). The New Urban Crisis: How Our Cities are Increasing Inequality, Deepening Segregation, and Failing the Middle Class – and What We Can Do About It. In *International Journal of Urban and Regional Research*. New York: Basic Books. November, 41(6). Available online at: <https://ideas.repec.org/a/bla/ijurrs/v41y2017i6p1028-1029.html>.
- Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. London: Macmillan Press.
- National Bank of Slovakia: Selected macroeconomic indicators. 2022. Available online at: <https://www.nbs.sk/sk/statisticke-udaje/vybrane-makroekonomicke-ukazovatele/ceny-nehnutelnosti-na-byvanie>.
- National Bureau of Statistics of China. 2022. Available online at: <http://www.stats.gov.cn/english/>.

- NUMBEO: Property investment databases. 2022. Available online at: <https://www.numbeo.com/property-investment/>
- Porras, E. (2016). *Bubbles and Contagion in Financial Markets*. Palgrave Macmillan Books.
- Roberts, L. (2008). *The Great Housing Bubble: Why Did House Prices Fall?*. Oregon: Monterey Cypress Publisher.
- Scherbina, A. (2013). *Asset price bubbles – selected studies*. 2013. Available online at: <https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Asset-Price-Bubbles-A-Selective-Survey-40327>.
- Scott, G. (2020). Invest to win. In *Contribution to Investopedia*. 2020, 2-7.
- Shiller, R. J. (2000). *Irrational Exuberance*. Princeton, N.J.: Princeton University Press. 2000, xxi.
- Shiller, R. J. (2007). *Irrational Exuberance (2nd edition)*. Princeton, N.J.: Princeton University Press. 2005, xxv.
- Shiller, R. J. (2012). *Bubbles without Markets*. 23 July 2012. Available online at: <https://www.project-syndicate.org/commentary/bubbles-without-markets?barrier=accesspaylog#yyi4eyj5aZJo3WCs.99>.
- Siegel, J. J. (2003). What is an asset price bubble? An operational definition. In *European financial management Journal*. 9(1), 11-24.
- Sivák, R. et al. (2019). *Finance*. Bratislava: Wolters Kluwer.
- Sornette, D. & Cauwels, P. (2014). Financial bubbles: Mechanisms and diagnostics. In *Notenstein white paper series*. ETH Zurich, April 2014, No. 1. Available online at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2423790.
- UBS Chief Investment Office: *Global Real Estate Bubble Index*. 2021. Available online at: <https://www.ubs.com/global/en/wealth-management/chief-investment-office/life-goals/real-estate.html>.
- Uppal, J. et al. (2017). Financialization and speculative bubbles - International evidence. In: *CAMA Working Papers*, 1(3).
- Vogel, H. L. (2009). *Financial Market Bubbles and Crashes*. Cambridge: Cambridge University Press.
- Xiong, W. & Scheinkman, J. (2014). Overconfidence and Speculative Bubbles. In *Journal of Political Economy*. Princeton: Princeton Press, 111(6). 1183–1219.

Digitization of tax administration

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Abstract: The article deals with electronic communication in the field of tax administration between financial or customs authorities and tax subjects. Tax authorities report electronically filed tax claims and, in contrast, the costs of information technology for tax administrators. It is evident that electronic communication is increasingly common between tax subjects and tax administrators. The epidemiological situation in connection with the disease Covid-19 recorded this growing trend. Future developments may rather slow down this trend due to rising energy costs. On the other hand, the state supports the establishment of data boxes for most tax subjects.

Key words: tax administration, digitization, electronic communication, tax portal, web application

JEL Classification: H21

1 Introduction

The Financial Administration continuously informs, among other things, about steps in the field of electronic communication with citizens, companies and digitization. Electronic filing of the tax return is mandatory for some taxes, for example value added tax. It is evident that more and more tax entities are using electronic communication. The bad epidemiological situation regarding the coronavirus also supported this trend. People engaged in electronic communication with the authorities more to avoid mutual contact. Future developments may rather slow down this trend due to rising energy costs. On the other hand, there is support from the states in the form of free establishment of data pages or free registration in the electronic portals of the tax administration. At the same time, we can add that digitization, which is perceived as a positive step to simplify and speed up the functioning of the tax administration, can also be a sensitive area due to the large spectrum of information in the computer network. Its security can become an increasingly expensive item of tax administration.

2 Methods

The source of a basic information on the development of digitization in tax administration in the Czech Republic is the press and annual reports of tax administration authorities. Information regarding other countries can be found in the Eurostat or OECD databases (Organisation for Economic Cooperation and Development).

2.1 Situation in the OECD countries

OECD (2022) reports that tax administrations continued to deliver quality services for taxpayers during the COVID-19 pandemic, including in many cases delivering wider government support measures, while collecting EUR 12.1 trillion in 2020, according to new data from 58 OECD and other advanced and emerging economies. Tax Administration shows how the pandemic accelerated the shift to digital services with a 30% increase in digital contacts in 2020. Digital channels are now dominating interactions with taxpayers, with around 1.3 billion contacts via online taxpayer accounts, and more than 30 million contacts via chatbots. This is a rapid shift from the pre-pandemic models which may have depended on channels such as post or in-person visits to the tax office. These new channels are often employing behavioural insights which are becoming more widely used in all aspects of a tax administration's work.

Commenting on the report, Bob Hamilton, Chair of the OECD Forum on Tax Administration (FTA) and Commissioner of the Canada Revenue Agency said, "This edition of the Tax Administration Series highlights the range of innovations being undertaken by tax administrations both in their interactions with taxpayers and in their internal operations, including as a result of lessons learnt from the COVID-19 crisis. Leading a tax administration, myself, it is clear to me that digital service delivery, as well as increased agility and flexibility, is going to be of central importance to us in achieving our goals while meeting the expectations of taxpayers in the rapidly digitalising economy."

The report OECD (2022) also highlights how digital transformation is being driven by the manipulation and management of data, which is central across a tax administration's functions. For example, around 90% of tax

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administrations report using data science and analytical tools to facilitate the use of data in all aspects of their work. “One of the big challenges for tax administrations going forward is how to exploit the opportunities that artificial intelligence and machine learning bring so that they can use cutting-edge techniques to further improve services to taxpayers,” said Pascal Saint-Amans, Director of the OECD Centre for Tax Policy and Administration.

We can add to the OECD statistics that the digitization of public administration presupposes the availability of information and communication technology (hereafter ICT) and electronic services in companies and households. For example, in the member states of the European Union, access to and use of communication technologies is very diverse. The northern and western parts of the European Union usually show the highest shares of ICT use, while the eastern and southeastern parts reach the lowest values. Data are available from 2021 or 2020.

The countries of the south-eastern part of the European Union, i.e. Romania, Bulgaria, or even Croatia, have a % share of the total number of companies with more than 10 employees ranging from 51 to 68%, individuals using computer technology ranging from 63 to 68% of the total population aged 16-74.

The OECD (2022a) has released another Tax Administration Series (TAS) for 2022, like its predecessors, provides comparative information on the performance of advanced and emerging tax administrations around the world and seeks to outline the main underlying trends and challenges they face. The OECD has released another Tax Administration Series (TAS) for 2022, like its predecessors, it provides comparative information on the performance of advanced and emerging tax administrations around the world and seeks to depict the main underlying trends and challenges they face. This 2022 edition (10th edition) shows how the trend towards e-government has continued and been accelerated by the pandemic, with digital contact channels now dominating taxpayer interactions. For example, the tax administrations reported that there were approximately 1.3 billion contacts through online taxpayer accounts in 2020 – a year-on-year increase of 27%. The report also highlights how tax administrations are beginning to move towards digital transformation. Around 75% of administrations have a digital transformation strategy in place.

With an increasing number of services provided online, the ways in which tax administrations deal with taxpayers is evolving. Effective digital engagement is driven by two main factors:

- Secure digital identity and authentication
- Collaboration with third-party service providers

2.2 Situation in the Czech Republic

The Act No. 280/2009 Coll., Tax Code, as amended, Act No. 297/2016 Coll., on trust-building services for electronic transactions communicates the procedural issues of digitization by the tax administration and the obligations of tax subjects. The legal framework of digitization can be found in procedural legislation, i.e. Regulation (EU) No. 910/2014 of the European Parliament and of the Council, on electronic identification and trust-building services for electronic transactions in the internal market and on the repeal of Directive 1999/93/EC is the superior legal regulation of the European Union. Substantive legal regulations, i.e. laws on specific taxes, contain information on the obligations of tax subjects to submit tax returns electronically.

Czech Tax Administration (2022a) summarizes the possibilities of electronic filing by Czech tax entities as follows:

- Application online financial office (DIS+)
- Application Electronic submissions for financial administration (EPO)
- Data box
- Third party software

Tax and customs authorities have an established e-filing office as standard, which is intended for receiving all data messages in electronic form. These electronic repositories accept electronic submissions signed with a guaranteed electronic signature based on a qualified certificate issued by an accredited certification service provider. There is a fee for establishing an electronic signature, and certificates stored on the computer need to be renewed after a certain period of time. Electronic filing is possible in the form of a data report provided with a guaranteed electronic signature, in the form and structure and under the conditions published by the Ministry of Finance in the "Electronic filing for tax administration" application, which is available on the website of the Ministry of Finance. To communicate with the tax administrator via the Internet, you need an electronic signature.

In addition, the Czech Tax Administration operates an Automated Tax Information System (hereinafter also referred to as "ADIS"). It is the application technical support of the Financial Administration of the Czech Republic. This is a nationwide application that has a unified technical infrastructure. ADIS consists of sub-modules for financial administration activities – register of tax entities, processing of tax claims (tax declarations, reports or statements) of individual taxes, modules of common cross-cutting activities that are needed for administration, registration, collection

and recovery of taxes, transfer of financial funds to authorized beneficiaries and from the necessary system support modules. Applications within ADIS on the Internet of the Financial Administration of the Czech Republic: My tax portal (Online financial office - tax information box), Electronic submissions for the Financial Administration, Electronic records of sales...), which is a service for tax subjects. Two major changes in the ADIS system took place in 2021, namely the launch of the flat-rate individual income tax regime and the launch of the MY TAX Portal. The creators of the system strengthened the security of the information system against cyber-attacks in order to fully ensure the functionality of the system and to protect personal data from misuse.

From 2022, the Tax Administration will provide web applications instead of interactive tax forms when filling out tax statements. The tax administration justifies this change by improving the information of tax subjects when filling out a tax return and by making the user environment more pleasant.

- **Property tax**

This tax is also paid by small owners, for whom the law has not yet established the obligation to pay tax electronically.

- **Income taxes**

The Czech Republic uses two income taxes. Individuals pay personal income tax and corporations and companies, pay corporate income tax. Both taxes are dealt with by one law. Part of the rules for collecting these taxes from individuals and companies are the same.

The Czech Tax Administration (2022) registered a total of 2,465,997 income tax returns in the 2021 tax period. Of these, 1,494,885 in paper form, i.e. 60.6% (printed EPO 85,997, written 1,408,888), electronically 971,112, i.e. 39.4% (of which electronic EPO 593,567 pcs., data report 377,545). We can divide these numbers between individuals and legal entities:

- Individuals - total returns for the 2021 tax period 2,118,016, of which 650,877 electronically, 1,467,139 paper ones.
- Companies – a total of 347,981 declarations, of which 320,235 electronically, 27,246 paper ones.

Table 1 Share of electronic tax administration in the Czech Republic

	2017	2018	2019	2020	2021
The share of electronically filed tax claims to the tax office in the total number of filed tax claims (%)	66.57	58.80	61.20	64.53	68.52
The share of ICT costs in the total costs of financial administration (%)	12.75	9.41	10.16	12.57	13.01
Share of electronically submitted customs declarations in the total number of submitted customs declarations (%)	98.9	98.20	98.83	98.94	99.59
The share of ICT costs in the total costs of the customs administration (%)	8.89	7.95	8.10	7.11	8.94

Source: Czech Tax Administration (2022)

The Financial Administration of the Czech Republic (Baráková, 2022) reported that in 2021, after the end of the deadline for electronic submission of income tax returns, it records 2,465,997 tax returns. A total of 39.4% of taxpayers used the electronic form of filing this year. "For the second year already, citizens can use the Online Financial Office to file a tax return, and the number of users using it is still growing," says Jan Ronovský, Deputy Director General of the Financial Administration.

Ministry of Finance of the Czech Republic (September 15, 2022) provides data on the number of tax returns filed electronically. Taxpayers submitted 76.1% of their tax returns electronically to the Customs Administration of the Czech Republic. Taxpayers submitted a total 68.5 % of these tax returns to the Financial Administration of the Czech Republic electronically.

- **Consumption taxes (value added tax, excise duties, energy taxes)**

The seller pays these taxes before selling goods and services for final consumption. The tax amount is included in the price of the goods or services. Sellers are business entities obliged to submit tax returns for value added tax, consumption or energy taxes predominantly electronically.

Customs authorities in the Czech Republic collect consumption taxes, energy taxes and import duties. Decree No. 458/2020 Coll., on certain form submissions in the area of competence of the authorities of the Customs Administration of the Czech Republic, provides samples of form submissions. Electronic submissions have the same requirements and required data as printed forms.

According to the Customs Administration of the Czech Republic (2022), the specific goal of projects to expand digitization is to streamline and expand the capabilities of the Customs Administration of the Czech Republic to convert analog documents into digital form by equipping the relevant workplaces with document and large-format scanners. The clerk must manually stamp the incoming documents with a so-called filing stamp and manually transcribe the data from the file agenda into it. Fundamental parts of the further development of the file service are the digitization of documents, the marking of analog documents with bar codes, and the expansion of electronic intelligent forms. Electronic forms do not meet the requirements of the legislation for sending them by data box and their subsequent automated processing.

The need for projects results from these shortcomings:

- Current situation is contrary to the requirements of the legislation,
- Public does not have sufficient comfort associated with the electronicization of public administration,
- Worse perception of the Customs Administration of the Czech Republic in the eyes of the public (compared to offices where electronic filing is already common),
- Time-consuming (work) related to the transcription of the data contained in the form into the relevant applications,
- Not using the opportunity offered by the 602FromFlow Server tool already purchased.

Streamlining the conversion of analog documents into digital form, marking analog documents with 2D codes with the usability of document tracking within its entire life cycle. Introduction of a unified environment for the digitization of analog documents. Elimination of manual transcription of necessary data from analog documents, reduction of error rate and labor.

The taxpayer submits an application for authorization of electronic communication for consumption taxes (EMCS, RZL, when issuing documents for a free tax circulation) and submits the customs procedure on the ZFO form. This is currently the preferred procedure.

3 Research results

Two main state administration bodies deal with tax administration. One of them is the tax office and the other is the customs office. The tax office collects taxes not only from companies, but also from citizens and individuals. The customs administration collects taxes only from firms and companies. We can assume that companies usually manage with a larger volume of financial resources. Large companies are therefore involved in the obligation to file tax returns electronically first. It is likely that this obligation will cause less complications for them than for other smaller entities. This is the reason why the customs administration reports a higher proportion of electronically filed tax returns than the tax administration.

The obligation to submit a tax return electronically is mandatory for the following taxes:

- Value Added Tax - This tax is collected by the tax office and the customs office.
- Excise Duties - This tax is collected by the customs office.
- Energy Taxes - This tax is collected by the customs office.

3.1 Aspects affecting the development of digitalization of public administration

- Use of ICT by citizens and companies and availability of ICT on the market
- Confidence of citizens and companies in ICT security
- Data protection against misuse within the organization
- Network security against external attacks by unauthorized persons
- Compliance with the protection of personal data (General Data Protection Regulation – GDPR)²

² Regulation (EU) No. 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons in connection with the processing of personal data and on the free movement of such data and on the repeal of Directive 95/46/EC

The author sees the advantages and disadvantages of electronic communication in tax administration similarly to Habigerová (2011).

Table 2 Advantages and disadvantages of electronic communication

Advantages of electronic communication	Disadvantages of electronic communication
• Low price (relatively) • Comfort, ease, clarity • Availability at any time • Remote communication • Time savings • Communication of several people at once • Communication with authorities • Data volume transfer • Data archiving • Anonymity without personal contact • A citizen's digital identity enables the citizen to access various services of state administration bodies.	• Impersonal • Lack of feedback • Low data security • Delayed or no response • Internet outages or slow Internet connection • Unavailability all the time • Ignorance of the program • Anonymity • Misrepresentation of information • Lengthiness • Thanks to convenience, the personal disappears • Communication • The purchase price of electronic communication equipment can be a problem for poorer citizens.

Source: Own processing

Impersonal contact can be an advantage in some situations, but a disadvantage in others. Similarly, it also applies to the price, a relatively low price can be perceived differently by different social groups of people.

3.2 Changes in the year 2023

The citizen's digital identity (Citizen's Portal) was accessible before the year 2023. This way, some citizens could prove their identity to the tax authorities and submit a tax claim to the tax administration electronically.

All self-employed persons in the Czech Republic will receive free data boxes from 2023. Self-employed persons and companies will then have to submit tax returns exclusively electronically. They will have a choice of either submissions through a data box, electronic submissions for the Financial Administration (EPO), or the online tax office in the "MY taxes" portal.

The following entities will have a data box established by law:

- legal entity registered in the commercial register;
- legal entity established by law;
- organizational components of a foreign legal entity registered in the commercial register;
- lawyer, tax advisor;
- statutory auditor;
- insolvency administrator;
- expert, court interpreter and court translator;
- public authorities.

4 Conclusions

Electronic communication and digitization is expanding not only in countries that we can consider developed. This develops both at the level of international cooperation and in communication between an individual and an official of the tax administration. OECD data show that the Czech Republic is among the states with an average to slightly higher level of digitization in tax administration. In any case, the tax administration has recently been accelerating steps in the area of digitization. The challenge for the tax administration is the connection of various already existing sub-systems and records with which the tax administration works, but these systems are not yet connected. This will facilitate and speed up the work of tax administration employees. Citizens can identify themselves to tax administrators using a digital identity. In

(General Data Protection Regulation) , is a regulation of the European Union, the aim of which is to significantly increase the protection of personal data of citizens. It was announced in the Official Journal of the European Union on 27 April 2016.

the Czech Republic, citizens are provided with a digital identity free of charge. The tax administrator thus accurately identifies the tax subject.

Digitization of public administration makes sense when information and communication technology is used by a sufficient number of citizens and companies. It is difficult to set a general minimum threshold for all states. I dare to say that the minimum threshold can be, for example, the share of citizens using ICT of at least 60%. At the same time, it should be true that citizens trust public institutions and electronic communication with them. A higher level of abuse of authority by public officials or corruption reduces citizens' trust in state administration bodies. This mistrust can also be reflected in the lower use of ICT when communicating with tax authorities. Another aspect that can reduce the confidence of tax subjects is the security of the ICT network against attacks from the outside environment.

References

- Baráková, Hana (2022). Finanční správa vybrala 2,5 milionu daňových přiznání. Press Release. Prague: The General Directorate of Finance. [on line]. Available at: <https://www.financnisprava.cz/cs/financni-sprava/media-a-verejnost/tiskove-zpravy-gfr/tiskove-zpravy-2022/financni-sprava-eviduje-vice-nez-1-5>
- Czech Tax Administration (2022). Number of tax subjects. Analysis and statistics. [on line]. Available at: <https://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/udaje-z-registru-danovych-subjektu/pocet-danovych-subjektu>
- Customs Administration of the Czech Republic (2022). Forms in the area of SPD, EKO, alcohol labeling, PHM and biofuel distributors, transport of selected products. [on line]. [November 28, 2022]. <https://www.celnisprava.cz/cz/dane/tiskopisy/Stranky/danove-tiskopisy.aspx>
- Decree No. 458/2020 Coll., on certain form submissions in the area of competence of the authorities of the Customs Administration of the Czech Republic
- Habigerová, Monika (2011). Advantages and Disadvantages of Internet Communication in Managerial Conception. Bachelor thesis. Olomouc: Moravian University Olomouc, 34-35.
- Ministry of Finance of the Czech Republic (2022). Report on the activities of the Financial Administration of the Czech Republic and the Customs Administration of the Czech Republic. [on line]. [September 15, 2022]. Available at: <https://www.mfcr.cz/cs/verejny-sektor/dane/danove-a-celni-statistiky/zpravy-o-cinnosti-financni-a-celni-sprav/2021/zprava-o-cinnosti-financni-spravy-cr-a-c-48219>
- OECD (2022). COVID-19 accelerated the digital transformation of tax administrations. [on line]. [September 20, 2022]. Available at: <https://www.oecd.org/tax/administration/covid-19-accelerated-the-digital-transformation-of-tax-administrations.htm>
- OECD (2022a). Tax Administration 2022: Benchmarking OECD and other advanced and emerging economies. OECD iLibrary. [on line]. [September 30, 2022]. Available at: <https://www.oecd-ilibrary.org/sites/1e797131-en/index.html?itemId=/content/publication/1e797131-en#section-d1e985>

The issue of ensuring the participation of accused legal entities

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Abstract: The author of the article is dealing with the issue of securing the participation of accused legal persons in criminal proceedings, which in comparison with securing the participation of physical persons shows significant differences. The author deals in detail with the issue of bringing to court, summons and imposition of a fine on a person who performs acts on behalf of a legal person pursuant to Section 34 of the TOPO.

Key words: Liability of corporations, criminal proceedings, legal entities

JEL Classification: G32, G33, C35

1 Introduction

Criminal proceedings against legal persons have a number of differences compared to proceedings against physical persons, which are due to the specific characteristics of a legal person, which is an artificial organised entity without physical existence and which by its nature does not act and is represented only through physical persons. By their nature, legal persons cannot ensure their participation in criminal proceedings and thus defend their rights. At the same time, it is necessary to distinguish in the proceedings whether this security institution is exercised directly against the legal person or against a physical person who merely acts on behalf of the legal person.

Regulation of the person acting for the legal person

The Act on Criminal Liability of Legal Persons and proceedings against (TOPO) them provides the law enforcement authorities with a physical person who will act with them in substitution for the accused legal person. The special regulation of acts of a legal person in criminal proceedings is provided for in Section 34 of the Act on Criminal Liability of Legal Persons and proceedings against them. For better illustration I present its text below:

§ 34

Acts of a legal person

(1) A legal person shall be represented in proceedings by a person who is authorised to do so in proceedings before the court pursuant to the Civil Procedure Code. That person must prove that he is authorised to act on behalf of the legal person.

(2) A legal person may choose an agent. The power of representation shall be evidenced by a written power of attorney. The power of attorney may also be granted orally in the protocol. An accused legal person may have only one agent in the proceedings at a time.

(3) In proceedings, only one person may act for a legal person at the same time.

(4) A person who is an accused, a victim or a witness in the same case may not perform act in the proceedings. If this occurs in the course of the proceedings, the President of the Court and the public prosecutor in the preliminary proceedings shall call upon the legal person to appoint another person to perform acts in the further proceedings; for this purpose he shall set a time limit of 7 days as a rule for the appointment of such a person.

(5) If the person referred to in subsection (4) is not designated within the time limit, or if the legal person does not have a person capable of performing acts in the proceedings, or if it is demonstrably impossible to serve documents on the legal person or its agent, the President of the Court and, in preliminary proceedings, the judge shall appoint a guardian for the legal person. A person may be appointed guardian only with his or her consent. A person may not be appointed guardian if he may reasonably be considered to have such an interest in the outcome of the proceedings as to justify a fear that he will not properly defend the interests of the legal person. The order appointing a guardian shall be notified to the person who is appointed guardian and, unless the nature of the case so excludes, also to the legal person.

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(6) The person referred to in subsection (1), the agent and the guardian shall have the same rights and obligations in the proceedings as the person against whom the criminal proceedings are being conducted.

(7) If the person referred to in subsection (1), or the agent of the accused legal person or the guardian, fails to appear at the main trial without a proper excuse, the court may conduct the main trial in their absence if the indictment was duly served on the accused legal person, if the accused legal person was summoned to the main trial in due time and in due form, if the provisions on the initiation of the criminal prosecution were complied with and if the accused legal person was notified of the possibility to study the file and to make proposals for supplementing the investigation.

(8) Where a legal person has an agent or has been appointed a guardian, documents addressed to the legal person shall be served only on that agent or guardian, unless the Criminal Procedure Code provides otherwise.

It follows from Section 34(1) of the Act on Criminal Liability of Legal Persons and proceedings against them that, in addition to the above, Section 21(1) of the Civil Procedure Code is also a key provision which determines not only the persons authorised to act for a legal person in civil proceedings but also in criminal proceedings. In accordance with Section 21(1) of the Civil Procedure Code, the following physical persons act for a legal person:

(a) a member of the statutory body;

if the statutory body is composed of several persons, the chairman of the statutory body or,

where appropriate, a member of the statutory body who has been authorised to act for the legal person;

if the chairman or authorised member is a legal person, the physical person who has been authorised or otherwise empowered to act by that legal person shall always act; or

(b) an employee (member) thereof who has been authorised to do so by the statutory body; or

(c) the head of its plant, in respect of matters concerning that plant; or

(d) its proxy, if he or she may act independently pursuant to the proxy granted.

Section 21(2) of the Civil Procedure Code sets out the exceptions under which the aforementioned persons are excluded from acting on behalf of a legal person. These are cases where the application of Section 21(1) of the Civil Procedure Code is excluded either directly by the Civil Procedure Code or by a special law. Such a special law may be, for example, the Insolvency Act, on the basis of which the insolvency administrator will act for the legal person in certain cases. Similarly, if the legal person is in liquidation and a liquidator is authorised to act for it instead of the persons referred to in subsection 1, the liquidator will be authorised to act for the legal person. Where a legal person has been placed under receivership, the receiver shall act. (See ust. § 21 odst. 3 OSŘ)

It also follows from the above-mentioned Section 21(1) of the Civil Procedure Code that the actions of the persons mentioned therein are considered to be the legal entity's own actions. For this reason, the prosecuting authorities must take all actions directly against the accused legal person, not against the physical person acting on its behalf, including service of process. (Jelínek, 2019) Acts of the statutory body of the accused legal person are thus considered to be acts of the legal person. (Jelínek, Herczeg, 2013)

Like the Civil Procedure Code (See ust. § 21 odst. 5 OSŘ), the Act on Criminal Liability of Legal Persons and proceedings against them (See ust. § 34 odst. 3 TOPO) requires that only one person at a time acts on behalf of a legal person in criminal proceedings.

The statutory body of a legal person, the head of its branch or the proxy only has to prove in criminal proceedings that they are authorised to perform acts on behalf of the legal person in accordance with section 34 of the Act on Criminal Liability of Legal Persons and proceedings against them; no further express authorisation is required. However, if an employee of the accused legal person is to act on behalf of the accused legal person, such authorisation is already necessary. The employee of the legal person is obliged to prove that he has been authorised by the legal person to act on its behalf, for example by submitting the internal regulations of the legal person or an explicit authorisation granted by the statutory body, proving his authorisation to act on behalf of the accused. On that basis, the employee is an ad hoc person authorised to act on behalf of the accused legal person to a specific extent. (Forejt, Habarta, Třešlová, 2012)

Statutory body

The task of the law enforcement authorities is to determine whether the person acting on behalf of the legal person has actually proved that he or she is authorised to act for the legal person. However, law enforcement authorities can no longer determine whether or not someone is authorised to act for a legal person. (Jelínek, 2019)

It is primarily the legal person itself that determines who is authorised to act for it in criminal proceedings. According to Section 21(1) of the Civil Procedure Code, this is in particular the statutory body. In the case of a collective statutory body, the chairman, vice-chairman or another authorised member of the statutory body acts for the legal person. A limited liability company which has several managing directors forming a collective body may be represented by each managing director separately. However, in the context of criminal proceedings, a situation could arise where each of the managing directors represents a legal entity and their actions contradict each other. Such a situation can be considered completely inadmissible from the point of view of criminal proceedings. The prosecuting authorities would thus have no choice but to appoint a guardian for such a legal person. An analogous application of Section 29(2) of the Act on Criminal Liability of Legal Persons and proceedings against them would probably result.

A legal person may also be represented by an authorised employee. However, only the statutory body may grant a delegation to an employee. If the above situation were to arise, it would not be possible to appoint an employee of the legal person instead of a guardian, since such an authorisation can only be granted by the statutory body.

In criminal proceedings, a legal person may also choose an agent for its defence, in accordance with Section 34(2) of the Act on Criminal Liability of Legal Persons and proceedings against them. Such a person must be granted a procedural power of attorney in writing. The granting of a procedural power of attorney orally in the protocol is not excluded. A legal person may be represented in proceedings by only one agent. Should there be a change of agent, the power of attorney must first be revoked or terminated and only afterwards be granted to a new agent for representation. (Jelínek, 2019) It is not permissible for more than one agent to be involved in the proceedings, even for a short period of time. Since the law does not expressly require that the chosen agent must be a lawyer, any physical person, regardless of his or her educational background, may be such an agent. This can be perceived as a certain legislative deficiency, when explicitly providing for representation by a lawyer can enhance and extend the guarantees of a fair trial.

In practice, a situation can certainly arise many times when the accused legal person is a limited liability company with only one managing director. In such cases, it is highly likely that criminal proceedings will be initiated not only against the legal entity, but also against the managing director of the legal entity itself. Therefore, if there is a conflict of interest, it is completely impossible for the prosecuted managing director to represent the limited liability company in a criminal case. This follows from section 34(4) of the Act on Criminal Liability of Legal Persons and proceedings against them in conjunction with section 21(4) of the Civil Procedure Code. It will be necessary to appoint a guardian for such a limited liability company, and the criminal prosecution will be initiated on the date on which the order to initiate the criminal prosecution is delivered to the appointed guardian. Any actions taken by the managing director in the interim period, *i.e.* between the service of the order instituting criminal proceedings on the legal entity and the service of the order instituting criminal proceedings on the managing director, cannot be accepted. (Žďárský, 2017)

In accordance with the existing case law, the above written no longer applies and the automatic appointment of a guardian for a legal person pursuant to section 34(5) of the Act on Criminal Liability of Legal Persons and proceedings against them does not occur. It follows from the ruling of the Constitutional Court of the Czech Republic of 23 June 2020, Case No. I. ÚS. 2638/19, that in order to properly ensure the legal person's right to defence, it is necessary to allow even a formally excluded person (*i.e.* the prosecuted managing director who has a conflict of interest) to choose an agent for the legal person pursuant to section 34(2) of the Act on Criminal Liability of Legal Persons and proceedings against them. Instead of the automatic appointment of a guardian for the legal person, the possibility to choose the legal person's agent is in principle left to the formally excluded person, which is a manifestation of the presumption of innocence.

Right to defence

A physical person who represents a legal person in criminal proceedings is obliged to appear duly before the prosecuting authorities when summoned. If he or she fails to appear without a proper excuse, he or she may be brought before the court. If the representing physical person disrupts the course of the proceedings, behaves disrespectfully or insultingly towards the court, the public prosecutor or the police authority, or if he/she disobeys an order or fails to comply with a summons, he/she shall be liable to a fine. It should be noted that the amount of the fine may be up to CZK 500,000, *i.e.* ten times higher than the fine that may be imposed under the Criminal Procedure Code. However, the orderly fine will be payable directly by the accused legal entity, not by the physical person acting on its behalf. (Vidrna in Jelínek a kol., 2013)

Section 32(2) of the Act on Criminal Liability of Legal Persons and proceedings against them allows, under certain conditions, for the transfer of criminal liability to the legal successor of the accused legal person during criminal proceedings. The question then remains whether the already elected agent of the legal person will continue to represent its legal successor. However, it can be assumed that in such a case the legal successor of the legal person would be deprived of its rights, since it would not be able to choose its own representative. If such a situation arises, the successor to the legal person must be allowed to determine who will be authorised to act for him in criminal proceedings. (Šámal a kol., 2012)

In practice, a situation may certainly arise in which the person entitled to act for the accused legal person will be in the position of a witness or a victim. The circumstances which will place such a person in that role may not yet be known at the commencement of the criminal proceedings and may only be discovered in the course of the criminal proceedings. If the conflict of interest described above arises, it is not possible for such a person to continue to represent the accused legal person. This is the same as in the above-mentioned case, i.e. where the person authorised to act for the accused legal person is also in the position of the accused. However, in comparison with the previous case of an accused physical person acting for an accused legal person, it can be assumed that the situation where that person is in the position of a witness or victim will be less frequent.

If any of the three situations referred to above arise, the President of the Court or, in the preliminary proceedings, the public prosecutor shall set a time limit for the legal person to choose another person or representative. The time limit is usually set at 7 days.

If no person is chosen within the above period, the court shall issue an order appointing a guardian without delay. The guardian of an accused legal person may only be a person who has no interest in the outcome of the proceedings and is not in conflict of interest. No person may be appointed guardian against his will.

As already mentioned above, it may only become apparent during the criminal proceedings that the person authorised to perform procedural acts on behalf of the legal entity in criminal proceedings has a conflict of interest. Particularly in corporations with a large number of bodies and employees, it may be difficult to ascertain which particular individual actually committed the offence attributable to the legal person. If it turns out in the course of the proceedings that a person authorised to act in criminal proceedings on behalf of a legal person has participated in or committed a criminal act of the legal person, it is necessary to consider the procedural acts already taken as ineffective. (Čep in Gřivna, 2016)

The legislation governing the appointment of a guardian for a legal person may be problematic, as no ordinary appeal is admissible against this order. The accused legal person can therefore defend itself only by lodging a constitutional complaint. A complaint for breach of the law may also be lodged, but only by the Minister of Justice, so it is classified as an extraordinary remedy. In both cases, however, there will be no quick and effective protection for the legal person. This issue is pointed out, for example, by Říha, who states that the rights of the legal entity are often not sufficiently protected by the appointed guardian. In his articles, for example, he also mentions a case where the appointed counsel for a legal person did not appeal against a decision imposing the most severe possible penalty, i.e. the penalty of dissolution of the legal person. (Říha in Kalvodová, Fryšták, Provazník, 2018)

In the above-mentioned case, it can be seen as problematic that in practice the legal entity can only defend itself very difficult in case of disagreement with the procedural actions taken by the guardian. At the same time, the appointed guardian may often not have a proper understanding of the structure of the legal person, which, moreover, knows practically nothing about its activities. In such a situation, it may be very difficult to defend its rights properly.

The above-mentioned problem has also been addressed by the Union of Defence Counsel, which considers the above to be a violation of the constitutional order, since even a legal person is guaranteed the right to defence. In the opinion of the Union of Defence Counsel No. 1/2017 it is stated that a person who is in the position of a witness should at least be able to determine who will be authorised to act on behalf of the accused legal person in criminal proceedings. (Unie obhájců České republiky, 2017)

Thus, in the framework of the amendment of the Act on Criminal Liability of Legal Persons and proceedings against them, it would be advisable for the legislator to also address the above-mentioned issue.

Collateral institutions

Next, I will deal with the issue of ensuring the participation of the accused legal person in criminal proceedings, which is enshrined, inter alia, in Section 36 of the Act on Criminal Liability of Legal Persons and proceedings against them.

Summons, bringing to court, orderly fine

(1) If a person who performs acts for a legal person under section 34 fails to appear without sufficient excuse, he may be brought before the court if he has been duly summoned.

(2) If a person who performs acts on behalf of a legal person pursuant to section 34 (1), (2) or (4), despite having been previously warned, disrupts the proceedings or behaves in an insulting manner towards the court, the public prosecutor or the police authority, or if, without sufficient excuse, he fails to obey an order or to comply with a summons given to him pursuant to the Criminal Procedure Code or this Act, a fine of up to CZK 500,000 may be imposed on the legal person he represents by the President of the Court and, in the preliminary proceedings, by the public prosecutor or the police authority.

If the guardian commits the act referred to in the first sentence, a fine of up to CZK 50 000 may be imposed on him.

(3) A complaint against a decision under subsection (2) shall be admissible and shall have suspensive effect. Section 146a of the Criminal Procedure Code shall apply *mutatis mutandis* to the decision on the complaint.

Individual collateral institutes can also be found in the Criminal Procedure Code or elsewhere in the Act on Criminal Liability of Legal Persons and proceedings against them. It is then necessary to assess whether a particular measure is also applicable to legal persons and whether it is directed directly against the legal person or against a physical person authorised to act on its behalf.

For example, a legal person may be suspended from exercising one or more objects of activity or restricted in the disposal of its assets pursuant to Section 33(1) of the Act on Criminal Liability of Legal Persons and proceedings against them on the grounds of fear of an act pursuant to Section 67(c) of the Criminal Procedure Code, or section 33(2) of the Act on Criminal Liability of Legal Persons and proceedings against them, if it is expected that the financial penalty will be frustrated. However, by the nature of the case, it is not possible, for example, to bring, detain or take into custody a legal person. (Říha in Jelínek a kol., 2013)

The above-quoted Section 36 of the Act on Criminal Liability of Legal Persons and proceedings against them is intended to ensure the participation of the legal person in criminal proceedings and is one of the prerequisites for the fulfilment of the purpose of criminal proceedings.

The first of the institutes of ensuring the participation of a legal person is a summons. As the institution of summons does not contain an element of coercion, the criminal prosecution authorities are expected to comply voluntarily with the obligation. It is an invitation by the law enforcement authorities to the legal person to appear at a certain date and time at a specified place and to perform a certain procedural act. It is then always the responsibility of the physical person acting on behalf of the legal person in criminal proceedings to ensure that the legal person is present to perform a certain procedural act. In the event of failure to comply with this obligation, the physical person may, if necessary, be brought before the court and must be duly informed of this in the summons. However, in certain justified cases, the individual may be brought before the court without a summons. This could occur if the person authorised to act for the legal person is not permanently resident. However, it is essential that the law enforcement authorities take this approach only in exceptional cases where there is no possibility of serving the summons by any means.

It follows from the text of Section 36(1) of the Act on Criminal Liability of Legal Persons and proceedings against them that bringing to court may only take place after a prior proper summons. It is therefore necessary to deal with the question of what actually be considered as a proper summons. Should it be addressed only to the legal person or must it be addressed directly to the physical person? The third option is to serve the summons on both the legal person and the physical person. Jelínek is of the opinion that the summons must be addressed directly to the physical person acting on behalf of the legal person, and it must be clear from the summons that it is that person who is to appear in person to perform the procedural act. (Jelínek, 2019) Říha takes the opposite view, arguing that the summons should be addressed directly to the legal person and submits that this can be deduced from an interpretation of the specific provisions of the Act on Criminal Liability of Legal Persons and proceedings against them, where the summons of the legal person is provided for in particular in Section 34(5) and (7), from which he concludes that not only decisions but also summonses are to be served on the legal person. (Říha in Jelínek a kol., 2013) In this case, I agree with Říha's view and I also consider that the legal person should be summoned directly. If the summons is addressed directly to the legal person, the legal person will be able to decide which physical person will represent it when carrying out the procedural act. Nor it can be excluded that, in the interval between the summons and the date on which the procedural act is to take place, the legal person may wish to designate another physical person to continue to act for it in the criminal proceedings. If, for example, in connection with the performance of a certain procedural act, some specific knowledge concerning the activities or, for

example, the organisational structure of the legal person is required, the legal person may appoint an employee who has such detailed knowledge to perform that act and can thus better defend its rights than a member of the statutory body.

The law enforcement authorities may also impose an orderly fine. However, the special legal regulation in relation to legal persons differs in this case from the regulation contained in the Criminal Procedure Code as regards the amount of the fine, the Act on Criminal Liability of Legal Persons and proceedings against them allows for the imposition of a fine of up to CZK 500,000. Since the obligation to pay the fine is incurred directly by the legal person, this can be seen as a certain sanction for the choice of a physical person. (Jelínek, 2019)

2 Conclusion

In view of the above mentioned, it is clear that the issue of ensuring the participation of accused legal persons in criminal proceedings has significant differences compared to securing the participation of physical persons. The existing legislation has a number of legislative deficits which have not always been overcome by the interpretation of the law enforcement authorities, and even in the academic debate there is no uniformity of opinion, as discussed in more detail in this article. For the future, I would consider it advisable if the legislator also focuses on extending the guarantees of a legal person to a fair trial, where, from my point of view, its position is considerably worse than that of a physical person.

References

- Čep, D. (2016) *Úskalí obhajoby právnické osoby v trestním řízení*. In: Gřivna, T. (2017) *Právo na obhajobu. Teorie a praxe 21. století*. Plzeň: Aleš Čeněk.
- Forejt, P., Habarta, P., Třešlová, L. (2012) *Zákon o trestní odpovědnosti právnických osob a řízení proti nim s komentářem*. Praha: Linde.
- Jelínek, J. (2019) *Trestní odpovědnost právnických osob v České republice – problémy a perspektivy*. Praha: Leges.
- Jelínek, J. a kol. (2013) *Trestní odpovědnost právnických osob v České republice. Bilance a perspektivy*. Praha: Leges.
- Jelínek, J., Herczeg, J. (2013) *Zákon o trestní odpovědnosti právnických osob. Komentář s judikaturou* (2. vydání). Praha: Leges.
- Říha, J. *Pět let uplatňování trestní odpovědnosti právnických osob českou justicí*. In: Kalvodová, V., Fryšták, M., Provazník, J. (2018) *Trestní právo (stále) v pohybu: pocta Vladimíru Kratochvíli*. Brno: Masarykova univerzita.
- Říha, J. *Zajištění účasti právnických osob na trestním řízení*.
- Šámal, P. a kol. (2012) *Trestní odpovědnost právnických osob. Komentář* (1. vydání). Praha: C. H. Beck.
- Unie obhájců České republiky. *Stanovisko unie obhájců č. 1/2017 k otázce práva na obhajobu obviněných právnických osob v České republice a jednání za ně* [Online]. Retrieved January 26, 2021, from www.uocr.cz/stanoviska
- Vidrna, J. *Některé procesní aspekty zákona o trestní odpovědnosti právnických osob a řízení proti nim*.
- Žďárský, Z. (2017) *K trestní odpovědnosti právnických osob v ČR nejen z pohledu Nejvyššího státního zastupitelství*. Státní zastupitelství, č.1.

List of abbreviations

Sb.	Collection of Laws
Sb. m. s.	Collection of International Treaties
NOZ	Law no. 89/2012 Coll., Civil Codex
ZOK	Law no. 90/2012 Coll., the Commercial Companies Cooperatives (Business Corporations Act)
TOPO	Act no. 418/2011 Coll., the law on criminal liability of legal persons and proceedings against them
TZ	Law no. 40/2009 Coll., Criminal Code Act
TŘ	Act no. 141/1961 Coll., The Law on Criminal Procedure (Criminal Procedure Code)
OSŘ	Act. No 99/1963 Coll., Civil Procedure Code

Reporting expenses and revenues according to IFRS and Czech accounting legislation in the energy sector

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Abstract: Energy companies present a segment that is currently being watched very closely. The record energy prices created by the stock market generate multifold profits for these types of companies. Building on historical traditions, customs, and the economic and legislative environment, accounting regulation in different countries takes place in different forms and bodies. Currently, the primary accounting standards dominating not only the territory of the European Union are International Financial Reporting Standards (IFRS). The contribution will attempt to analyze the profit and loss statements in this industry for selected companies that report according to International Financial Reporting Standards and Czech accounting legislation.

Keywords: Profit/loss statement; Czech accounting legislation; International Financial Reporting Standards; Energy

JEL Classification: M41, K32, Q5

1 Introduction

The global increase in demand for energy with depleting natural resources forces us to plan an effective and sustainable energy policy that will ensure energy security in the future (Liaquat & Mahmood, 2017). Resource depletion and stricter environmental standards urgently require more sustainable revenues from limited resource demand (Piscicelli & Ludden, 2016). The energy sector is considered the most important for reducing gas emissions and promoting renewable energy sources (Wysokińska, 2013). The integration of this idea into national policies is necessary for the transition to a greener economy (Rakauskiene & Okuneviciute-Neveauskiene, 2015; Folcut & Grigore, 2016; Guillen-Royo et al., 2017).

In the Czech Republic, as in other EU countries, there are two parallel accounting frameworks, namely EU regulations and Czech accounting regulations (Jilek, 2018). By implementing EU accounting directives into our accounting legislation, our country is also becoming part of global harmonization, primarily through IFRS (Kellnerová, 2007).

The economic implications of the implementation of International Financial Reporting Standards (IFRS) have been the subject of extensive literature (e.g. Iatridis & Rouvolis, 2010; Brüggemann et al., 2013; Benkraiem et al., 2022). Studies confirmed that the use of IFRS improves the comparability and quality of accounting information, promotes investment growth and lower expenses of capital (Barth et al., 2008). However, the transition to IFRS also brings difficulties for companies in the form of increased expenses, lack of experience, technical differences, and time consuming (Brown & Tarca, 2005, Gassen & Sellhorn, 2006). The decision to provide voluntary disclosure based on IFRS is mainly influenced by the size and profitability of the company (Dumontier & Raffournier, 1998; Glaum, 2000; Tarca, 2004).

According to some studies, the impacts of IFRS implementation are not entirely clear (Ball, 2016; Uzma, 2016; García et al., 2017; André & Kalogirou, 2020) and its results and acceptance alone will not automatically bring the expected benefits (Albu & Albu, 2012; Christensen et al., 2013; Daske et al., 2013; Benkraiem, et al., 2022). Because of legal and other institutional obstacles, the process of harmonisation is different in each country and proceeds at a substantially different pace (Baker & Barbu, 2007, Nakao & Gray, 2018). For example, authors Silva et al. (2021) were motivated by ongoing debates about the obstacles and benefits of adopting IFRS and found that in both Portugal and Brazil, eight years after the formal adoption of IFRS, further efforts are still needed to achieve full international accounting convergence.

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The aim of the paper is to describe the differences between individual accounting systems – International Financial Reporting Standards (IFRS) and Czech Accounting Legislation (CZ) on a sample of companies in the energy sector with an impact on financial statements. The motivation for choosing these companies was mainly the fact that activity in the field of energy is currently the subject of great interest, and in addition, this sector is closely related to the circular economy.

2 Methods

The Amadeus database (<https://amadeus.bvdinfo.com>) was used in this work. A sample of companies operating in the given sector is determined and whose financial statements concern both accounting systems for 2015-2019. A more detailed classification was first made in the NACE - D section under the heading 351 - Electricity generation, transmission, and distribution when searching for companies. This group consists of activities related to the mass production of electricity, its transmission from generation facilities to substations, and distribution to end-users. The time series was then linked to the available data of individual companies listed in the database. The selection was made here so it was always the same companies (not just the field). The final sample for this analysis consisted of 20 companies, with half reporting according to IFRS and half reporting according to Czech accounting legislation. The group of ten companies reporting according to IFRS consists of the largest energy producers in the EU - 3 companies from Italy, as well as three companies from the United Kingdom, two companies from Germany and one company each are represented by Austria and Belgium. The group of companies reporting according to CZ consists of ten joint-stock companies based in the Czech Republic.

To evaluate the items of the financial statements in specific sessions and contexts, a vertical analysis will be used for profit and loss statement (income statement). The reporting of expenses and revenues is presented here in a unified statement - i.e., the economic result was constructed at the level of "ordinary income statement - standard expenses and revenues (i.e., operating + financial activity). Therefore, the comparability of this part of the statement should be treated by systematic processing of the database used. This work aims to identify how significant differences exist in both accounting systems by identifying significant differences between these sub-elements of the statements and using the Student's t-test at the level of significance $\alpha = 0.05$. Evaluated quantities include revenues, expenses, profit/loss. The EBIT analysis will also include an evaluation of the return on assets (ROA). The analysis of the results will identify the causes and reasons for differences in financial statements using accounting information obtained from the annual reports of specific companies included in the sample.

3 Research results

The analysis of the profit and loss statement begins with an overview of the companies' development of expenses and revenues. Absolute values are now given here, from which a decrease (approx. 4%) in both quantities is evident in CZ (Table 1). Revenues are not in a good situation, but this is due to the overall development of electricity prices on international markets, production, and other factors, which are not the subject of this contribution. On the contrary, a positive trend can be found because CZ companies responded to the decline in revenues by saving expenses. IFRS saw higher revenue than expenses, which is again a positive trend.

Table 1 Development of revenues and expenses/expenses (Th. €), 2015-2019

Item	2015	2016	2017	2018	2019	Average	Growth rate
Total revenues							
- CZ	394 445	322 923	324 255	311 967	333 558	337 430	-4.10%
- IFRS	2 740 511	2 851 870	2 721 904	2 796 470	2 899 112	2 801 974	1.42%
Total expenses							
- CZ	377 106	308 460	304 911	290 049	314 916	319 089	-4.41%
- IFRS	2 684 134	2 337 957	2 439 441	2 449 309	2 733 695	2 528 907	0.46%

Source: own processing

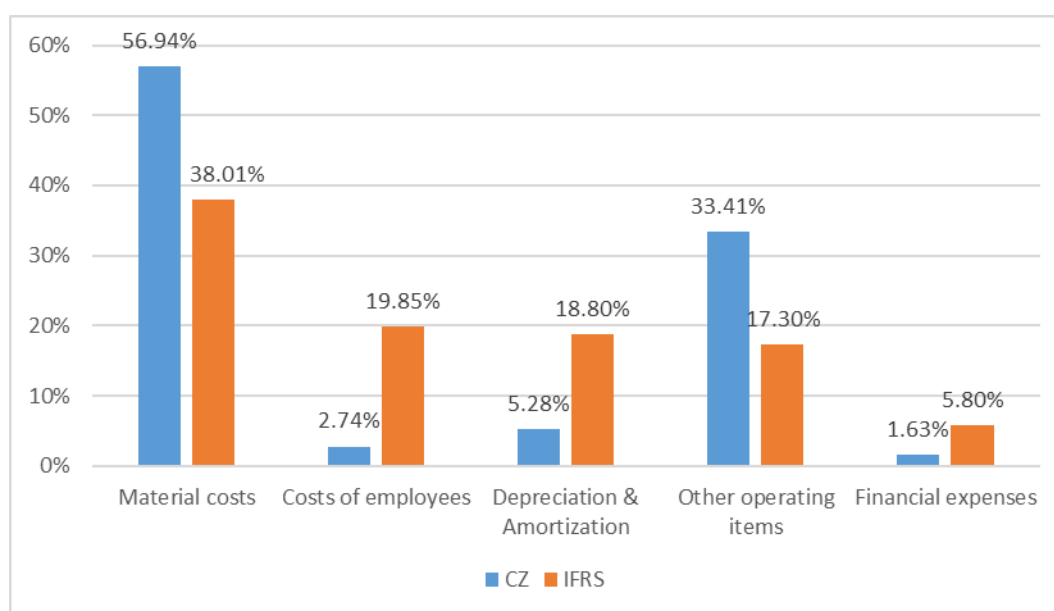
A more detailed vertical analysis of revenues showed that for the group of companies reporting according to CZ, the item operating revenues was mainly accounted for by sales (on average 92% of total revenues). Financial revenues were only around 2%, and the rest was concentrated in other operating revenue. These revenues represent, for example, sales of unnecessary assets, compensation from insurance companies, and possible subsidies (this, however, cannot be ascertained in detail in the database used). A slightly more different development is IFRS, where it accounts for about

64% of sales, which is almost a third less. The group of other operating revenues can provide a partial explanation, where the percentage shift took place (reaches about 20%). It can only be assumed here that this may be caused, for example, by the sale of assets in foreign currencies, which thus form larger volumes and thus a share in total revenues.

A significant innovation in this area is the newly adopted IFRS 15 - Revenue from Contracts with Customers, with the validity of its application from 2018. At the same time, it is one of the results of the convergence process of IFRS and US GAAP. In contrast to the Czech accounting regulations, in which the moment of revenue reporting is only mentioned at the moment of the realization of the accounting event, IFRS attributes fundamental importance to revenue. Its main goals are fulfilled through the so-called 5-step model (Identification of contract, Performance obligations, Transaction price, Allocation of price to performance obligations, and Recognition of revenue). Due to its new acceptance, a suitable addition to that article in further research will be the monitoring of the application in the conditions of energy companies.

The expenses group consists of standard inputs for which there is no significant difference in terms of the methodology of accounting systems. A more detailed look at their structure is given in the graph 1. The resulting percentage differences between individual groups of companies could instead be attributed to differences due to territorial conditions, different management, size and efficiency of companies, and other factors, which, as stated for the revenues group, are not the subject of this work.

Figure 1 Share of expense items in total expenses, 2015-2019



Source: own processing

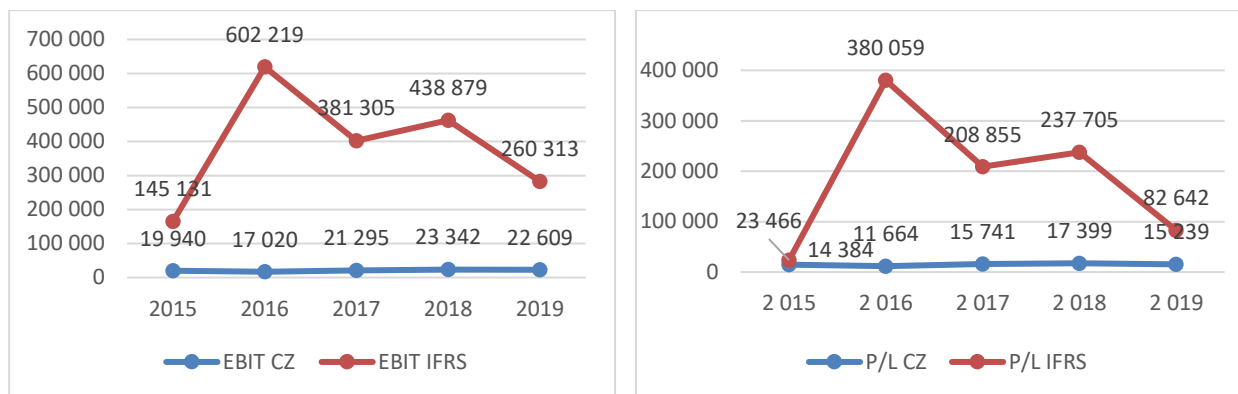
For the group of CZ companies, material expenses (almost 60%) and other operating items accounted for the largest share of total expenses, with about 34% (Figure 1). In the IFRS group of companies, the share of material expenses was also the highest (approximately 40%). In the case of CZ, this item decreased by approx. 5% during the period under review, while in IFRS, there was an increase of approx. 2%.

The other expense groups were relatively balanced up to 20% - the share of the expenses of the remaining items of employees, which would correspond, for example, to the expenses arising from the item employee benefits. The number of employees also plays a crucial role here, where the average value for the CZ group is less than 400, but for IFRS 6,700. The average growth rate for expenses of employees was the highest of all groups in this category for CZ (approx. 15%).

For depreciation & amortization, there is a clear link to a higher share of fixed assets. However, the difference in growth rates is interesting, which is 7% for CZ and -7% for IFRS. Although the financial expenses were almost threefold for the IFRS group, they did not exceed 6% and were essentially expected due to the larger structure of total liabilities for IFRS. Within this statement, a shortcoming of the Amadeus database was identified: the lack of data on the other comprehensive income item in the statement of other comprehensive income, including operations related to the revaluation of fixed assets items.

Comparisons of the main elements of the operating area of the profit and loss statement of the CZ and IFRS companies performed using the Student's t-test, with the calculated reliability values P, confirmed the existence of significant differences at the significance level α 0.05.

Figure 2 Degrees of the economic result (Th. €), 2015-2019



Source: own processing (with Rosendorfová, 2021)

The types of economic results are shown in Figure 2 - EBIT and P/L. This display shows the different sizes of CZ and IFRS in order values, and the development itself is also different. P/L for the group of companies CZ slightly decreased in 2016. In contrast, IFRS in 2016 recorded an extreme increase for the group of companies. Since 2017, on the other hand, the P/L item of groups of companies has been moving at the same pace, which included a slight increase followed by a slight decrease. However, regarding the time horizon between 2015 and 2019, it can be stated that the P/L of the CZ and IFRS groups of companies increased.

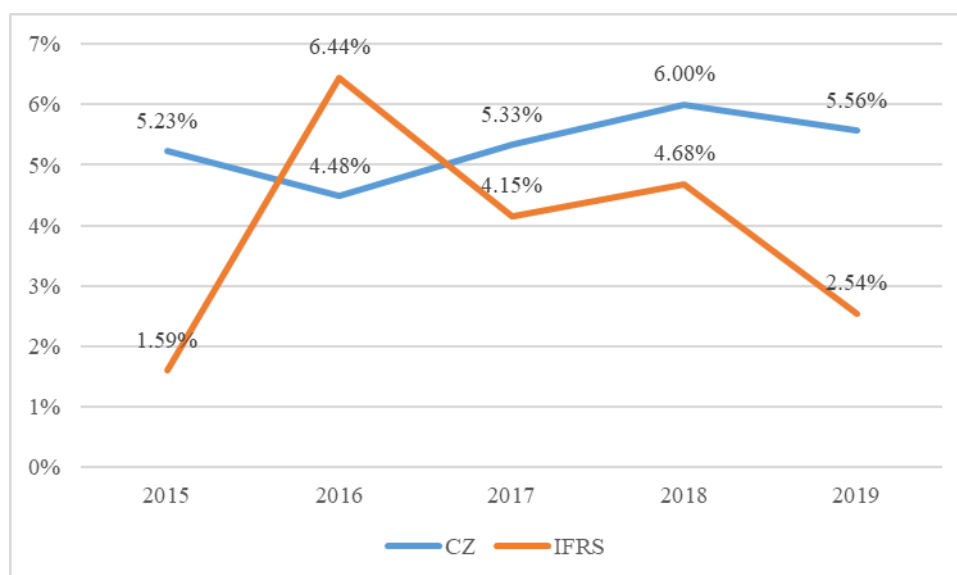
A possible explanation for the decrease in profit in IFRS groups from 2016 is a change in the structure of energy production. Eurostat data shows EU energy production by source in Mtoe from 1990 to 2018. In the last ten years (2008-2018), the trend in energy production was generally negative for solid fossil fuels, oil, natural gas, and nuclear energy. Energy production in the EU has changed significantly in favour of renewables over the last decade, with a positive trend of 49.2% (Eurostat, 2020).

The highest share of energy production in the EU in 2018 was accounted for by renewable energy sources (34.2%), followed by nuclear energy (30.8%), solid fossil fuels (18.3%), and natural gas (9.3%). Crude oil and petroleum products (3.9%) and non-renewable waste (2.1%). The structure of energy sources and their share of consumption in different countries depends on the natural resources available, the structure of their economies, and individual energy decisions.

The construction of the P/L indicator is based on EBIT, which is further reduced by the financial loss (realized in both groups of companies) - and that in CZ drew on average around 15%, but in IFRS more than twice as much (about 32%). Another correction of EBIT to P/L was the tax liability - for CZ, 17% and IFRS about 25%.

An illustrative example of the impact of differences between the two accounting systems will be demonstrated in the Return on Assets - ROA. EBIT is a category of profit or loss, which is included in the return on assets (ROA) to assess the total return on capital, regardless of the sources from which business activities were financed (Figure 3).

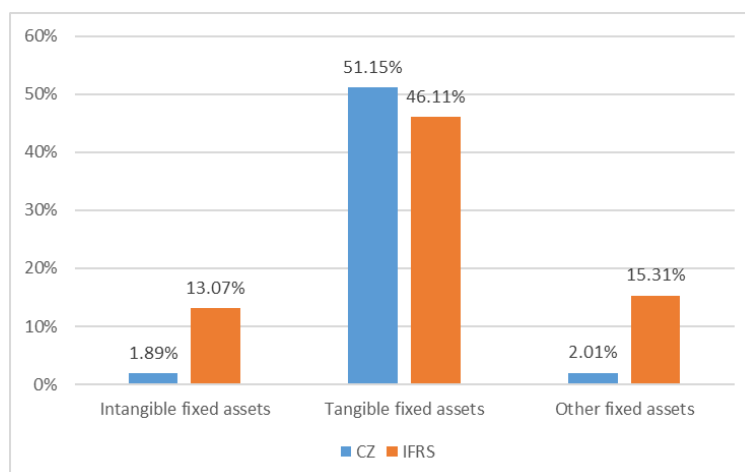
Figure 3 ROA (%), 2015-2019



Source: own processing

Given the higher values of the EBIT item of the IFRS group of companies (entering the ROA numerator), it was evident to assume that the values of the ROA indicator would also be higher in the case of the IFRS group of companies. However, from the values given in the graph, higher values are clear on the contrary for the CZ group of companies, whose average ROA for the observed period was even closer to the industry average in energy (5,36 %) (Rosendorfová, 2021). The lower values of the ROA indicator in the IFRS group of companies can be found in the second item entering the denominator of its calculation, namely total assets. The growth rate of the indicator is thus up to double in CZ conditions. For a better understanding of the mentioned development, it is also appropriate to add the structure of assets. The CZ group of companies had an average value of fixed assets in total assets by about 20% lower in the observed period. Both groups of companies were dominated by fixed assets, which corresponds to the types of companies engaged in energy production. This type of activity can be more demanding on property security. A detailed view of the structure of fixed assets is presented in the Figure 4.

Figure 4: Share of fixed assets items on total assets, 2015-2019



Source: own processing

According to IFRS legislation, the group of intangible assets reaches about 13% of total assets (compared to CZ with only about 2%). An unambiguous explanation is hidden in the item goodwill. Goodwill arises from business combinations from which consolidation units are formed. In addition, compared to other intangible fixed assets (and CZ conditions), goodwill is not amortized but only tested for impairment.

There is a not very significant difference (on average about 5%) tangible assets, including the primary means of electricity generation. However, it is necessary to mention here significant differences in the reporting of both systems. The first important issue is the issue of valuation. The IFRS conceptual framework recognizes four fundamental valuation

bases: historical cost, replacement cost, fair value, and present value. For example, A2A, s.p.a. in its annual report, states the following valuation methods. Tangible assets are valued at acquisition cost, including any additional costs directly related to bringing the asset to working condition (e.g., transport, customs, installation, etc.). Acquisition costs are increased by the present value of the estimated costs of dismantling the property or restoring the location from environmental protection. Borrowing costs directly attributable to the purchase or construction of a qualifying asset are capitalized as part of the cost (see IAS 23 - Borrowing Costs). The second significant difference is in the so-called investment property (Standard IAS - 40 Investment Property, IAS 40 Investment Property) and leases (IFRS 16 - Leases). Investment property includes real estate (land or buildings) held not for business purposes but rent or capital appreciation. Investment property is recorded at cost, including ancillary costs net of related accumulated depreciation and any impairment losses. The item leases or right of use include rights to use the assets of other entities, which are reported as leased assets and depreciated over the life of the contracts. These procedures are not known in the CZ version. Furthermore, even assets used based on leasing are reported only in off-balance sheet records (not in the balance sheet). This significantly distorts the reported assets that are used for economic activity. However, changes are being prepared in this area, which must first go through the legislative procedure (Rosendorfová, 2021).

Similar shares as intangible assets can be found in the group of other fixed assets. These are related to larger companies holding more shares than other companies (IFRS approx. 15%, CZ approx. 2%). In addition to equity investments, other fixed assets would also include financial assets (financial instruments: IFRS 9 - Financial Instruments, IFRS 9 Financial Instruments). Financial instruments are measured at fair value when the asset is recognized (fair value, which includes the effect of current market conditions). The result is that the reported value of assets at fair value will be higher than assets at historical prices, which is the principle of valuing most components of assets in the conditions of CZ. In addition, for IFRSs, tangible and intangible assets are tested for impairment. For example, Acea, s.p.a. annually performs an impairment test using the discounted cash flow method to determine the recoverable amount.

Another possible difference affects the volume of expenses under IAS 37 - Provisions, Contingent Liabilities, and Contingent Assets. Their display also includes differences between IFRS and CZ. According to the CZ, some types of reserves do not meet the above conditions and must therefore be reversed for IFRS purposes (e.g., a reserve for general repairs of tangible fixed assets when the company has no current obligation, as there is no contractual or non-contractual obligation to carry out planned asset repairs; this is dealt with in IFRS using component depreciation). Furthermore, some items reported as a reserve under CZ represent a different type of liability under IFRS (e.g., the tax reserve, reserve for untaken vacation, reserve for a loyalty program). Another significant difference, already mentioned above, is that under IAS 16 - Property, Plant, and Equipment, the account for restoring the site to its original state is included in the purchase price of long-term tangible assets.

The terminology of the names of individual items - the use of both expressions cost or expense is prevalent in the practice of the listed companies. However, the term expense should be used according to the meaning. In the same way, the name of the reports itself sometimes differs in practice. Often companies use the designation Income statement or Profit/loss statement. However, it is understandable that this is only a formal view, not a substantive one, which would disrupt the reporting of individual items. A widely used form is the reporting of objects according to purpose breakdown. Similarly, when reporting assets, equity, and liabilities, the terminological terms used are both Balance sheet and Statement of financial position.

4 Conclusions

The paper tried to describe the fundamental differences between the CZ and IFRS systems in a sample of companies in the energy field, leading to the display of assets and resources and revenues and expenses. Accounting (financial) statements are the main outputs of accounting systems that inform users about the financial structure and performance. However, they are affected by methodological rules for reporting, valuation, and other sub-procedures. Efforts to unify the various financial reporting principles have been going on for almost a hundred years, and a unified consensus is often challenging. Probably the largest applied initiative in the form of IFRS is generally accepted, but its binding use depends on the incorporation into the country's legislation. That is a political agreement. It is therefore understandable that this incorporation into national accounts is often problematic, if at all impossible. However, it is valid for the EU (as well as many other modern Western countries) that if companies are traded on public markets, they should apply IFRS rules when preparing their financial statements.

Evaluation of economic results shows the different sizes of both groups (in terms of order values, structure, and the development itself is also different). However, in terms of the time horizon, it can be stated that the economic result of both groups increased. The negative development in the IFRS group since 2016 can be explained by the change in the production structure towards renewable sources. CZ companies have a relatively stable profit development. The lower values of the ROA (at an average value of about 5%) indicator in the IFRS group can be found in the second item entering

the denominator of its calculation, namely total assets. The mentioned methods of valuing assets and liabilities result in one of the main differences between CZ and IFRS: the broader possibilities of applying fair value in valuation or revaluation and determining total input costs for tangible assets.

Unfortunately, developments in the field of energy do not currently provide possible relevant predictions, which will understandably impact the financial results of energy companies. Current developments suggest that these companies will be more profitable, even excessively profitable. And according to the reports of individual national governments and the entire EU, it is possible to expect additional taxation in the form of a "windfall tax."

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References

- Albu, N., & Albu, C. N. (2012). International Financial Reporting Standards in an emerging economy: lessons from Romania. *Australian accounting review*, 22(4), 341-352. DOI: 10.1111/j.1835-2561.2012.00196.x
- André, P., & Kalogirou, F. (2020). IFRS adoption by UK unlisted firms: subsidiary-versus group-level incentives. *Accounting Forum*, 44 (3), 215-237. DOI:10.1080/01559982.2019.1627715
- Baker, C. R., & Barbu, E. M. (2007). Trends in research on international accounting harmonization. *The International Journal of Accounting*, 42(3), 272-304. DOI: 10.1016/j.intacc.2007.06.003
- Barth, M. E., Landsman, W. R., & Lang, M. H. (2008). International accounting standards and accounting quality. *Journal of accounting research*, 46(3), 467-498. DOI: 10.1111/j.1475-679X.2008.00287.x
- Benkraiem, R., Bensaad, I., & Lakhel, F. (2022). How do International Financial Reporting Standards affect information asymmetry? The importance of the earnings quality channel. *Journal of International Accounting, Auditing and Taxation*, 46, 100445. DOI: 10.1016/j.intaccudtax.2021.100445
- Brown, P., & Tarca A. (2005). A commentary on issues relating to the enforcement of international financial reporting standards in the EU. *European Accounting Review*, 14 (1), 181-212. DOI: 10.1080/0963818042000338997
- Brüggemann, U., Hitz, J. M., & Sellhorn, T. (2013). Intended and unintended consequences of mandatory IFRS adoption: A review of extant evidence and suggestions for future research. *European Accounting Review*, 22(1), 1-37. DOI: 10.1080/09638180.2012.718487
- Christensen, H. B., Hail, L., & Leuz, C. (2013). Mandatory IFRS reporting and changes in enforcement. *Journal of accounting and economics*, 56(2-3), 147-177. DOI: 10.1016/j.jacceco.2013.10.007
- Daske, H., Hail, L., Leuz, C., & Verdi, R. (2013). Adopting a label: Heterogeneity in the economic consequences around IAS/IFRS adoptions. *Journal of accounting research*, 51(3), 495-547. DOI: 10.1111/1475-679X.12005
- Dumontier, P., & Raffournier, B. (1998). Why firms comply voluntarily with IAS: An empirical analysis with Swiss data. *Journal of International Financial Management and Accounting*, 9 (3), 216-245. DOI: 10.1111/1467-646X.00038
- Eurostat 2020. *Energy, transport and environment statistics*. Luxembourg: Publications Office of the European Union. DOI: 10.2785/522192
- Folcut, O., & Grigore, N. R. (2016). EU's sustainable growth strategy: some implications on Romanian labour market. *Progress in Industrial Ecology, an International Journal*, 10(1), 79-89. DOI: 10.1504/PIE.2016.078088
- García, M. D. P. R., Alejandro, K. A. C., Sáenz, A. B. M., & Sánchez, H. H. G. (2017). Does an IFRS adoption increase value relevance and earnings timeliness in Latin America? *Emerging Markets Review*, 30, 155-168.
- Gassen, J., & Sellhorn, T. (2006). *Applying IFRS in Germany: Determinants and consequences* (working paper). University of Berlin. DOI: 10.2139/ssrn.906802
- Glaum, M. (2000). Bridging the GAAP: The changing attitude of German managers towards Anglo-American accounting and accounting harmonization. *Journal of International Financial Management and Accounting*, 11 (1), 23-47. DOI: 10.1111/1467-646X.00054
- Guillen-Royo, M., Guardiola, J., & Garcia-Quero, F. (2017). Sustainable development in times of economic crisis: A needs-based illustration from Granada (Spain). *Journal of Cleaner Production*, 150, 267-276. DOI: 10.1016/j.jclepro.2017.03.008
- Iatridis, G., & Rouvolis, S. (2010). The post-adoption effects of the implementation of International Financial Reporting Standards in Greece. *Journal of International Accounting, Auditing and Taxation*, 19(1), 55-65. DOI: 10.1016/j.intaccudtax.2009.12.004
- Jílek, J. (2018). *Hlavní účetní systémy IFRS a US GAAP*. [Major accounting systems IFRS and US GAAP]. Czechia: Grada.
- Kellnerová, J. (2007). *Harmonizace národních účetních systémů v Evropské unii*. Theses, Faculty of Economics and Administration, Masaryk University, Brno.

- Liaquat, S., & Mahmood, H. (2017). Electricity consumption and economic growth in Pakistan: Menace of circular debt. *International Journal of Economics and Business Research*, 13(3), 227-245. DOI: 10.1504/IJEER.2017.083315
- Nakao, S. H., & Gray, S. J. (2018). The impact of IFRS in Brazil: The legacy of mandatory book-tax conformity. *Australian Accounting Review*, 28(4), 482-495. DOI: 10.1111/auar.12223
- Piscicelli, L., & Ludden, G. (2016). The potential of Design for Behaviour Change to foster the transition to a circular economy, In Lloyd, P. and Bohemia, E. (eds.), *Future Focused Thinking - DRS International Conference 2016*, 27–30 June, Brighton, United Kingdom. DOI: 10.21606/drs.2016.489
- Rakauskiene, O. G., & Okuneviciute-Neverauskiene, L. (2015). Strategic guidelines of increasing employment and reducing unemployment in the context of EU (Lithuanian case). *Transformations in business & economics*, 14(2), 224-253.
- Rosendorfová, K. (2021). *Analýza finančních výkazů – komparace podle jednotlivých právních úprav*. Thesis. Jihočeská univerzita v Českých Budějovicích.
- Silva, A. P., Fontes, A., & Martins, A. (2021). Perceptions regarding the implementation of International Financial Reporting Standards in Portugal and Brazil. *Journal of International Accounting, Auditing and Taxation*, 44, 100416.
- Tarca, A. (2004). International convergence of accounting practices: Choosing between IAS and U.S. GAAP. *Journal of International Financial Management and Accounting*, 15, 60-91. DOI: 10.1111/j.1467-646X.2004.00102.x
- Uzma, S.H. (2016). Expense-benefit analysis of IFRS adoption: Developed and emerging countries. *Journal of Financial Reporting and Accounting*, 14 (2), 198-229.
- Wysokińska, Z. (2013). Transition to a Green Economy in the Context of Selected European and Global Requirements for Sustainable Development. *Comparative Economic Research. Central and Eastern Europe*, 16(4), 203-226. DOI: 10.2478/cer-2013-0034

Physical stock inventory – the possibility of applying audit procedures of the COVID-19 pandemic period to the future

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Abstract: The obligation of the assets and the liabilities inventorying of the accounting units is based on Act no. 563/1991 Coll., On Accounting. The accounting units which have the obligation to verify the financial statements by the auditor must provide unrestricted access to all information relevant to the preparation of the financial statements to the auditor. In this context, essential requirements are places on the auditor regarding the obligation to attendance at the physical stock inventory counting, if the inventories are material to the financial statements. The auditor conducts audit procedures that provide the sufficient and appropriate audit evidence. The assessment of the information obtained in this way is always dependent on the professional judgment of each auditor. The paper presents the application of the audit procedures at the physical stock inventory especially during the COVID-19 pandemic period in accordance with regulations, and offers possible views on usage of these procedures to the future.

Keywords: inventories; physical stock inventory; audit procedures; COVID-19 pandemic period

JEL Classification: M41, M42

1 Introduction

The obligation of accounting units to inventorying assets and liabilities is included in Act No. 563/1991 Coll., On Accounting, as amended. There is no decree on the inventorying for business entities in the current legislation, the business entities can use for inspiration Decree No. 270/2010 Coll., On Inventorying of Assets and Liabilities, as amended, which is intended for state non-profit organizations. The inventorying accounting procedures are regulated strictly by Czech Accounting Standard 007 Inventory differences and losses within the norms of natural stock depletion. An integral part of the regulations relating to the inventorying of the assets and liabilities is certainly an internal directive of the accounting unit, which specifies the actual execution of the inventorying of the assets and liabilities. With regard to the verification of financial statements, the accounting units are obliged to provide the auditor all information relevant to the preparation of the financial statements, including evidentiary information about existence and condition of the inventories through the auditor's participation at the physical stock inventory.

In modern history, epidemics and pandemics have tended to avoid the Czech Republic. The COVID-19 pandemic, which demonstrably appeared in the Czech Republic in March 2020, represented a major impact not only on the Czech economy (www.nzip.cz). The COVID-19 pandemic meant a risk for domestic companies, especially in the form of a lower number of employees who either had to enter quarantine, or were forced to stay at home with their children due to closed schools, as well as the risk of a reduction in the number of customers, the government restrictions in the form of a temporary ban on business activities in 2020 or the varying degrees of the restrictions on trade and services in 2020-2022.

Thus, during the pandemic, companies faced the obligation to comply with the condition of the inventorying, just as auditors faced the obligation to personally participate at the physical stock inventory. At that moment, these were situations that were hard to imagine for the companies and the auditors. The question remains in what form, to what extent, and therefore in what quality physical stock inventories were conducted by the company, by what procedures were used to obtain audit evidence about the existence and condition of the company's inventories, and whether it is possible to learn from the pandemic time, and try to use certain auditor's procedures to the future years as well.

2 Methods

In the following chapter, the legal obligation to audit accounting units is defined in accordance with Act No. 563/1992 Coll., On Accounting, as amended. Subsequently, the inventorying and the physical stock inventory are described according to the current legal regulations of the Czech Republic, i.e. Act No. 563/1992 Coll., On Accounting, Decree No. 500/2002 Coll., by which certain provisions are conducted of Act No. 563/1991 Coll., On Accounting, for accounting

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units that are entrepreneurs recording in the double-entry bookkeeping system and Czech Accounting Standard 007 Inventory Differences and Losses within the Norms of Natural Declines in Inventories (hereinafter CAS 007). An essential part of the paper is the definition of the conditions and obligations of the auditor to attendance at the physical stock inventory counting, if the inventories are material to the financial statements, according to the International Auditing Standard 501 “Audit evidence – specific considerations for selected items” (hereinafter ISA 501).

The paper presents and analyzes the issue as described in the regulations listed above. The main research methods used in the paper are the method of description, analysis and synthesis. The subject of this paper is, based on the legislative definition of the physical stock inventory and the auditor's obligation to attendance at this physical stock inventory counting, to demonstrate the audit procedures applied not only during the COVID-19 pandemic period and to offer the possible use of the audit procedures from the pandemic period to the following years.

2.1 Statutory audit obligation

The obligation to audit Czech accounting units by their categories is regulated by Act No. 563/1991 Coll., On Accounting. The category of the accounting unit is always decisive for the verification of the financial statements by the auditor. Large and medium-sized accounting units are always required to have their financial statements verified by the auditor, small accounting units only if one criterion is exceeded for two consecutive periods, on the condition that it is joint-stock company or state funds. For other small accounting entities, the rule of exceeding two criteria for two consecutive periods applies. Act No. 563/1991 Coll., On Accounting then lists the required criteria. The obligation to verify the financial statements for micro accounting units is imposed only by special legal regulations. Act No. 563/1991 Coll., On Accounting also lists cases in which accounting units do not need to have their financial statements verified by the auditor.

2.2 Inventorying and physical stock inventory according to legislative regulations

The obligation to conduct the inventorying to document the balances of individual items (i.e. the assets and liabilities) of the financial statement is imposed on all accounting units by Act No. 563/1991 Coll., On Accounting. Act No. 563/1991 Coll., On Accounting regulates the obligation of the inventorying in Part Five with only two paragraphs, namely § 29 and § 30. Müllerová & Šindelář (2016) describe the purpose of the inventorying as ensuring the control of the factual correctness of the accounting and the control of the reality of the valuation of the assets and the liabilities in the accounting.

The accounting units conduct the inventorying in accordance with the provisions of Act No. 563/1991 Coll., On Accounting, either at the time when they compile the financial statements (i.e. periodic inventorying), or during the accounting period (i.e. continuous inventorying):

- *Periodic inventorying* – the accounting units can start the inventory no earlier than four months before the balance sheet date and end the inventory no later than two months after the balance sheet date. The accounting units can set a day for ascertainment of the actual state, which also precedes the balance sheet date, and they can complete the ascertainment of the actual state according to the accounting records that demonstrate the increases and decreases of the assets and the liabilities incurred between this date and the date of the financial statements.
- *Continuous inventorying* – the accounting units can conduct the continuous inventorying only for the inventories for which they record according to the types or to their storage locations or materially responsible persons, and also for long-term tangible movable asset that is constantly in motion and does not have a permanent place where it belongs. Each accounting unit determines the term of the inventorying, each type of the inventories and long-term tangible assets must be inventoried at least once per accounting period.

Accounting units determine the actual state of all assets and liabilities through the inventorying, and verify whether the ascertained actual state corresponds to the state of the assets and liabilities in the accounting, and whether there are no reasons for correction items charging (Decree No. 500/2002 Coll.). The actual state of the assets whose existence can be visually assessed, i.e. long-term tangible assets, inventories or financial assets (e.g. cash, valuables etc.), is found out through a so-called physical stock inventory. The accounting units can determine the actual state by e.g. counting, measuring, weighing or similar numerical methods during the physical inventory (Act No. 563/1991 Coll., On Accounting).

The accounting unit is obliged to record any identified inventory differences to the current accounting period for which the inventorying is conducted, even if the inventorying is only conducted at the beginning of the following accounting period (CAS 007). The inventory differences mean the differences between the actual state established by the physical or documentary stock inventory and the state in the accounting – the actual state is lower than state in the accounting, the difference is marked as the deficit, and according to CAS 007, it is recorded to other operating costs; the actual state is higher than state in the accounting, the difference is marked as a surplus, and it is recorded to other operating revenues.

2.3 Auditor's attendance at the physical stock inventory

As set out in ISA 501, the auditor's objective is to obtain the sufficient and appropriate audit evidence about the existence and condition of the inventories. At the same time, if the inventories are material to the financial statements, the auditor is obliged to obtain the sufficient and appropriate audit evidence about the existence and condition of the inventories by:

- attendance at the physical stock inventory counting in order to evaluate the management's instructions and procedures for recording and controlling the results of the entity's physical stock inventory; observe the performance of management's count procedures; inspect the inventories and perform test counts;
- performing audit procedures over the entity's final inventory records to determine whether they accurately reflect actual inventories count results.

ISA 501 also regulates situations that may arise in practice:

- the physical stock inventory is conducted at a date other than the date of the financial statements – the auditor shall perform audit procedures to obtain audit evidence about whether changes in the inventories between the count date and the date of the financial statements are properly recorded;
- the auditor is unable to attend at the physical stock inventory counting due to unforeseen circumstances – the auditor shall make or observe some the physical stock inventory on an alternative date and perform audit procedures on transactions between the two dates;
- the auditor's attendance at the physical stock inventory is not possible – the auditor shall perform alternative audit procedures to obtain sufficient and appropriate audit evidence regarding the existence and condition of the inventories. If it is not possible to do so, the auditor shall modify the opinion in the auditor's report in accordance with International Auditing Standard 705 "Modifications to the Opinion in the Independent Auditor's Report" (hereinafter ISA 705).

3 Research results

The Results chapter first of all presents the most common problem areas associated with the physical stock inventory. Furthermore, it summarizes the possible applied audit procedures in obtaining audit evidence through the participation or non-participation of the auditor at the physical stock inventory counting because of the moment of conducting this inventory according to current regulations, and also focuses on the audit procedures applied during the COVID-19 pandemic, and offers possible uses to the following years.

3.1 Physical stock inventory – problem areas

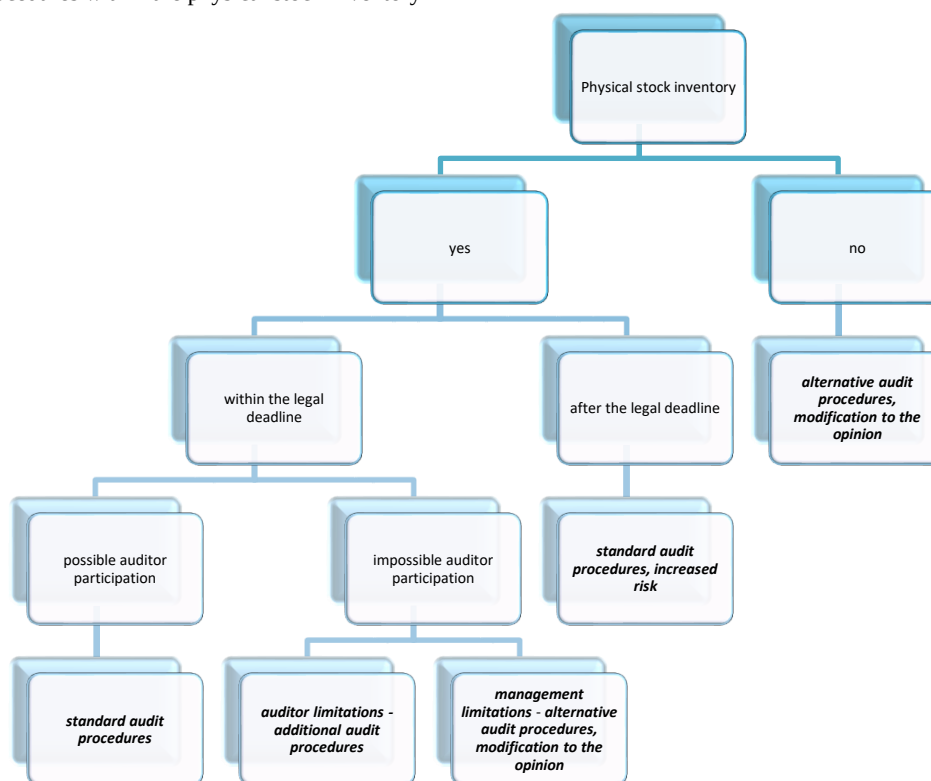
§ 30 paragraph 6 of Act No. 563/1991 Coll., On Accounting, allows accounting unites to start the physical stock inventory no earlier than four months before the balance sheet date and to complete it two months after the balance sheet date, this gives accounting unites enough space to conduct the physical stock inventory. Nevertheless, problematic areas appear, especially e.g.:

- setting an unreasonably short deadline for conducting the physical stock inventory;
- insufficient definition of the inventoried assets;
- non-updated internal directive, or even the internal directive does not exist, or the accounting unit does not follow the internal directive when conducting the physical stock inventory;
- the physical stock inventory is not conducted, the record balances from the accounting are written down;
- conducting the physical stock inventory for a long time before the balance sheet date – insufficient proof of the inventories level between the physical stock inventory and the balance sheet date, misrepresentation of the actual inventories level to the balance sheet day;
- some problems with recording of the inventory differences – the differences are recorded into the following accounting period instead of the current period, the deficits are incorrectly recorded as tax-deductible costs, furthermore, the deficits are incorrectly recorded as tax-deductible costs.

3.2 Physical stock inventory – audit procedures

Figure 1 summarizes the possible applied audit procedures because of the physical stock inventory by the accounting unit and the auditor's attendance. The content of the figure is subsequently characterized in more detail.

Figure 1 Audit procedures within the physical stock inventory



Source: Own processing

A frequent variant is the situation, when the accounting unit has conducted **the physical stock inventory within the legal deadline with the personal attendance of the auditor** who performs the standard audit procedures. The main purpose of the auditor's attendance at the physical stock inventory counting is to check and evaluate the setting and application of the physical stock inventory process itself in the accounting unit, and recalculate the selected inventories sample, which must be sufficiently large. In practice, the accounting unit has a total of six month to conduct the physical stock inventory, so the physical stock inventory can be conducted at a date other than the date of the financial statements:

- The physical stock inventory is conducted before the balance sheet date with the attendance of the auditor, the auditor conducts the standard audit procedures on the physical stock inventory date, and verifies the transactions (i.e. increases and decreases) between the date of the physical stock inventory and the balance sheet date, it is so-called “*rollforward method*”. However, the auditor must verify the data of increases and decreases specific inventories items with the help of accounting documents, which the auditor must support with the audit evidence, such as delivery notes, invoices, etc.
- On the other hand, the auditor uses „*rollback method*“, if the physical stock inventory is conducted by the accounting unit on a later date than the balance sheet date. The auditor must retroactively recalculate the final balances of the specific inventories items through the accounting documents made after the balance sheet date, which must be further verified again by the auditor.

If **the auditor's attendance at the physical stock inventory counting is not possible**, even though the accounting unit conducts the physical stock inventory within the legal deadline, this may be due to either limitation from the auditor's side, or limitation from the management's side. The limitation from the auditor's side is due to an unforeseeable event (e.g. quarantine during the pandemic). The auditor may replace his attendance at the physical stock inventory counting with another person who must meet the requirements of § 14e paragraph 3 of Act No. 93/2009 Coll., On Auditors, as amended (it must be a team member who is sufficiently trained). However, if the auditor is unable to replace his attendance with the authorized team member, the auditor is required to conduct the physical stock inventory on another date, and conduct audit procedures on transactions between the two dates. The auditor is able to obtain the sufficient and appropriate audit evidence about the reliability of the physical stock inventory conducted by the accounting unit only in this way. The auditor can then proceed to other additional audit procedures based on his professional judgment and according to the amount of assessed audit risk. The limitation from the management's side of the auditor's attendance at the physical stock inventory counting could have been caused during the pandemic, for example, by the fact that the company's management either did not allow, or expressly prohibited the auditor's personal attendance due to the spread of the risk of transmission of COVID-19. The auditor must decide whether to conduct the alternative audit procedures, as ISA 501 states. However,

ISA 501 does not specify exactly what is meant by alternative audit procedures. ISA 501 only adds that if the auditor cannot conduct alternative procedures that would ensure to obtain the sufficient and appropriate audit evidence about the existence and condition of the inventories, the auditor is required to modify his opinion in the auditor's report. The alternative audit procedures are thus able to cover increased audit risk, which is caused by limitation of the audit procedures from the management's side. If it is possible to conduct alternative procedures, it is not necessary to modify the auditor's opinion. The auditor can consider the alternative audit procedure, for example, a remote audit access with the help of an online transmission, supplemented by the inspection of the warehouses, and the recalculation of the inventories sample on another day. The auditor's decision criterion, whether to use the remote audit access and apply the alternative audit procedures, is the evaluation of the risk of the frauds at the accounting unit, and the setting of its internal control system. At the beginning of the remote audit access, it is also necessary to mention that this procedure is not suitable in all cases, because not everything that the auditor obtains through simple observation, questioning, or inspection can replace the remote audit access. The remote audit access also has its limitations consisting of, for example, a possible manipulation, an organization of the warehouse spaces, an increased risk of the correctness of the calculation, a nature of the inventories (for example, when the inventories are measured in volume, weight, etc.), the need to call in an expert, and last but not least, it is also necessary to consider the possibility of a technical failure of the online transmission. Despite existing limitations, the auditor must decide, on the basis of his professional judgment, whether or not the alternative audit procedure is appropriate and provides audit evidence. The auditor should sufficiently document the procedure of the remote audit access through the recording. A person making the recording also plays an important role here. For the sake of objectivity, it should be the person completely independent of the inventory committee, the accounting office, the warehouse management, etc. – i.e. the employee who will only conduct the instructions given by the auditor. On the other hand, the auditor may also decide, based on his professional judgment, that the remote audit access is not credible. This may be a situation where the auditor conducts the audit for the first time in the accounting unit, i.e. the auditor does not have sufficient knowledge of the overall inventorying process in the accounting unit. Furthermore, the internal control system related to storage is not sufficiently set up, the warehouses are not clearly organized, or due to the creation of new warehouse spaces. In this case, the auditor is obliged to modify his opinion in the auditor's report in accordance with ISA 705, and to inform the management of the accounting unit about this fact.

Another variant is the situation when **the accounting unit has conducted the physical stock inventory after the legal deadline**, e.g. because the accounting unit did not have time to conduct the physical stock inventory during the pandemic. The accounting unit should ideally conduct the physical stock inventory as soon as possible, as it is obliged to comply with the obligations of Act No. 563/1991 Coll., On Accounting, and this fact should be stated and explained in an appendix to the financial statements. The auditor must then assess the impact of this fact on the accounting unit's financial statements in terms of increased risk. The auditor conducts the standard audit procedures, but should also focus, among other things, on checking of the settled inventory differences (i.e. deficits and surpluses), whether they were charged by the accounting unit into the accounting period to which they actually belong, and not to the following accounting period. Furthermore, the accounting unit can face the sanctions for failure to comply with the obligation to conduct the inventorying of the assets and liabilities within the legal deadline according to Act No. 563/1991 Coll., On Accounting.

If **the accounting unit does not conduct the physical stock inventory**, the auditor cannot participate at the physical stock inventory counting, and the auditor must communicate this fact to the management and to persons entrusted with administration and management. The auditor must consider the effect of not conducting the physical stock inventory on the audit risk assessment, especially in the area of frauds. The physical stock inventory is the main control consisting in verifying the condition and existence of the inventories. In the event that the accounting unit does not conduct the physical stock inventory (the inventories are material to the financial statements), it is rightly considered a serious deficiency of the accounting unit's internal control system. At the same time, it has an impact not only on the evaluation of risks in the area of the inventories, but also in the area of completeness and correctness of the costs and revenues amount. In such a case, the auditor may again use the alternative audit procedures. Again, if alternative audit procedures cannot be conducted because the auditor evaluates them as insufficient to obtain audit evidence, the auditor is required to modify the opinion in the auditor's report in accordance with ISA 705. By the fact that the accounting unit risks modifying the opinion in the auditor's report as a result of the physical stock inventory not being conducted, it also commits an offense according to § 37a paragraph 1 letter g) of Act No. 563/1991 Coll., On Accounting which is punishable by a sanction of up to 3% of total assets. Without the inventorying, the accounting is incomplete, inconclusive, does not reflect the actual state of the assets and the liabilities, and is therefore not correct.

4 Conclusions

The inventorying obligation of the accounting units is based on Act no. 563/1991 Coll., On Accounting. Although the law leaves enough time to conduct the physical stock inventory, the accounting units often tend to underestimate the

physical stock inventory, to conduct it only formally based on the accounting documents, or not to conduct it at all. Although when the inventorying is conducting correctly, the accounting unit can at most reveal deficiencies in administration, such as poorly organized work in the warehouse or divided competences, or even how the management of the accounting unit seriously intends to do with controls in the area of the inventories. Otherwise, the accounting unit will at most find that the accounting balances correspond to the actual balances. Without the inventorying, the accounting is incomplete, inconclusive, does not reflect the actual state of the assets and the liabilities, and is therefore not correct according to § 8 paragraph 2 of Act No. 563/1991 Coll., On Accounting. In this way, the accounting unit commits an offense according to this Act which is punishable by a sanction of up to 3% of total assets.

The limitations associated with the given issue resulted mainly from the emergence of a completely new situation – the COVID-19 pandemic, with which neither the accounting units nor the auditors themselves had previous experience. The Results chapter presents the possible positions of the alternative audit procedures in the sense of the remote audit access, which, however, also has disadvantages, and therefore the use of this method is always dependent on the professional judgment of each auditor.

References

- Český účetní standard 007 Inventarizační rozdíly a ztráty v rámci norem přirozených úbytků zásob.
Mezinárodní auditorský standard ISA 501 Důkazní informace – specifické aspekty vybraných položek.
Mezinárodní auditorský standard ISA 705 Modifikace výroku ve zprávě nezávislého auditora
Müllerová, L. & Šindelář, M. (2016). Účetnictví, daně a audit v obchodních korporacích. Praha: Grada.
Státní zdravotní ústav, Ústav zdravotnických informací a statistiky ČR. (2021). COVID-19: úvod, inkubační doba, původce a sezónnost onemocnění. [online]. Retrieved from <https://www.nzip.cz/clanek/447-covid-19-zakladni-informace>
Vyhláška č. 270/2010 Sb., o inventarizaci majetku a závazků, ve znění pozdějších předpisů.
Vyhláška č. 500/2002 Sb., kterou se provádí některá ustanovení zákona č. 563/1991 Sb., o účetnictví, ve znění pozdějších předpisů, pro účetní jednotky, které jsou podnikateli účtující v soustavě podvojného účetnictví.
Zákon č. 563/1991 Sb., o účetnictví, ve znění pozdějších předpisů.
Zákon č. 93/2009 Sb., o auditorech, ve znění pozdějších předpisů.

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