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), Nisssim (Nisssim, 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. (Ohlnson, 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, Neuimaier 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 yearn=2016)

Years	2017	2018	2019	2020
Total	0,4444	0,3841	0,3340	0,3180
The smallest enteprisses. (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 enteprisses. (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 quantile. 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 quantile.

Table 4 Correlation between ROA and future profitability. Breakdown by land share in ANC (for yearn=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).

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