Are Slovak farms financially healthier as a result of the Common Agricultural Policy of the European Union?

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Abstract

Research background: The main goal of the Common Agricultural Policy (CAP) is to support farmers and improve their productivity. Agriculture is a specific sector of the economy, characterized by income support for farmers to ensure the availability of quality food. However, the question remains whether Slovak farms are financially healthy under the influence of the reformed CAP of European Union (EU)?
Purpose of the article: The main goal of the article is to evaluate the financial health of Slovak farms using selected prediction techniques pointing to the impact of the CAP of EU.
Methods: We have used data obtained from the financial statements of Slovak farms in the years 2009-2020. The financial health of farms will be assessed using selected generally constructed models of multivariate discriminatory analysis (Altman Z-score, IN 05, Creditworthiness Index, Taffler model), but also prediction models that have been specially constructed for the Slovak agricultural sector, such as G-index and CH-index. To detect the statistical differences between the years 2009-2013 and 2014-2020 in the value of prediction models of farms were used statistical t-tests of conformity in the surveyed sample.
Findings & Value added: The results can be evaluated on two levels. The first of them is a look at the analysis of the financial health of Slovak farms in the context of the interpretation of the regulations of the Common Agricultural Policy of EU. The second output is an evaluation of the financial health of farms in the selected time period.

Keywords: *Financial health; Farms; Common Agriculture Policy; Prediction techniques*

JEL Classification: *C12; Q14; G33*

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1 Introduction

The objective of the company is to create benefits for the owners in the form of profit, which should be sustainable in the long run or to ensure the growing market value of the company. Due to the constantly changing economic and political environment, companies operating in the agricultural sector are under constant pressure to monitor, record and apply various methods of financial analysis, in order to identify possible financial problems of the company in the future. Despite the need of cost-effectiveness, the farm should operate in a sustainable and ecological way, in order to preserve biodiversity and the soil. For this reason, the public sector plays an irreplaceable and important role for the agricultural sector. The Common Agricultural Policy (CAP) enters into a relationship between society and agriculture through a set of measures, regulations and strategies to support farmers and maintain the competitiveness and sustainability of agriculture. The CAP has gone through a number of major reforms over the time, affecting the functioning and financing of the whole agricultural sector. The 2013 reform focused mainly on a more global and integrated approach and adjusted the main direction of the CAP for the period 2014-2020. The programme period has been extended, considering the pandemic coronavirus situation, with the objective to ensure the necessary predictability and certainty for European farmers until the end of 2022, when the new Common agricultural policy enters into force. The reforms under the CAP aim at providing the financial support for farmers through direct payments. The "Report on Agriculture and Food sector in the Slovak Republic for the year 2019" shows that agriculture sector in 2019 achieved a profit before taxes in the value of 83 mill. €. However, in comparison with the 5-year average (2014-2018), the profit level was lower by almost 10 mill. €. The economic result has been affected by a decline in production, which subsequently reflected in a loss of sales, and could not have been compensated even by a slight increase in agricultural prices.

The main role in the economy of agricultural sector played the public supports, without which the majority of farms would suffer a loss. Almost 73% of the financial support of Slovak agriculture was provided from EU sources, and only part of the expenditures was co-financed from the state budget of the Slovak Republic. The percentage share of total support in revenues reached almost 35%, and in direct payments 17.4%.[†] The economic results of farms have been affected by several income-cost and production factors, which had a significant impact on the overall financial health of companies. To the main factors belong the decline in the sector's production, decline in sales of own products, an increase in agricultural prices and cost factors, an increase in supports and the number of agricultural workers, a continuing trend of crop production dominance over the livestock production, a decline in hectare yields and cattle stocks, pigs and sheep, the negative impact of weather during the growing season, low interest rates with an impact on the increased credit burden of businesses, the application of rational measures to acquire new techniques and technologies, etc. Taking into account the mentioned facts, it can be clearly stated that the agriculture is a very specific sector within the national economy of Slovakia, where the economic results of the company are largely influenced by a number of exogenous (external) non-influencable factors. However, the question remains whether the farms operating in the Slovak Republic are financially healthier due to CAP instruments. The basic premise, which the authors of the study will analyse, is the assumption that farms in the period 2014-2020 show significantly different values of indicators of selected prediction models than in the previous period 2009-2013 (multiannual financial framework of CAP was set for 2007-2013, however, due to the availability of data, the period 2009-2013 has been chosen). Based on the assumption, the main objective of the paper was determined.

[†]file:///D:/prevzate%20subory/sprava_o_polnohospodarstve_a_potravinarstve_v_slovenskej_republike_za_rok_2019.pdf

The objective of the paper is to statistically verify whether there exist the differences between selected values of prediction models in the period 2014-2020, and in the previous period 2009-2013 and subsequently answer the established hypotheses concerning better financial health of farms in the programme period CAP 2014-2020.
The main objective of the paper is divided into partial objectives. The first partial goal is to create a literature review of studies that address the prediction of financial health in the agricultural sector. The second partial objective of the paper is to draw conclusions about the financial health of Slovak farms.
The source of data for the analysis is the financial statements compiled by farms in the years 2009-2020. For this reason, it is necessary to emphasize the weaknesses of financial reporting in the Slovak Republic. First of all, it is the historical focus of reporting in Slovakia and a strong tax orientation with the aim to visually decrease the economic result, which forms the basis for the payment of taxes. Also, in many cases, it is impossible to adjust the values of assets and liabilities towards their fair value.

1.1 Literature review

Nowadays, there exist a large number of prediction models that have been constructed during the certain period of time, in different economic and political conditions, and for different sectors of the economy. Their main idea is the prompt identification of possible financial problems of the company in the future. The initiators, in the field of construction models for predicting the financial health of companies, have become the authors in the 1930s of 20th century, during the Great Depression (Smith, Winakor, 1935, Merwin, 1942, Fitzpatrick P.J., 1932 and others). These papers were continuously followed by the papers of Beaver W.H. (1966), Altman E.I. (1968), Ohlson J.A. (1980), Tamarih M. (1976), Beerman M. (1982), whose constructed prediction models are an inspiration for other authors. The intention of the literature review is not to characterize the individual prediction models, rather to bring their summary in the agricultural sector.

Despite the increase in number of predictive studies in recent years, and their constant innovation in the application of innovative techniques for assessing the financial health of companies, it is necessary to state, that only a very small number of scientific studies focus. Moreover, these studies are in many cases limited to the use of multivariate discriminatory technique. Table 1 summarizes the prediction studies applied in the agricultural sector. Table 1 contains in the second column, after the authors of the study, the type of study T/P (Theoretical/Practical), or P (Practical). The mentioned characteristics of the study were added based on application, whether in the study new prediction models are constructed, in the next step verified, validated and implemented (studies Hampel et al. 2012, Vavřina et al., 2013, Stehel et al. 2019), whether the study is practical (P), aimed at verifying already created prediction models by other authors, e.g. Pompescu (2014), Grushnienie (2016), Rajin et al. (2016) and Karas et al. (2017). These studies verify already created prediction models, mostly the Altman's Z-coefficient (1968, 1983), and other constructed prediction techniques on new financial data of farms. The Table 1 also summarizes the applied prediction technique, the field of application, and summarizes the key results of the studies.

Table 1. Literature overview for the bankruptcy prediction in agribusiness sector

Author (s)	*Type of study*	*Applied prediction technique*	*Application field*	*Results of the study*
Brewer et al. (2012)	T/P	Synthetic Credit rating model	U.S. farms	The paper focused on the probability of default, which is a function of three key financial variables: Capital Debt Reapayment Capacity, Owner Equity Percentage and Working Capital Percentage. For each analysed year the farms were classified according to farm type, gross sales class and by region to assess the financial health of each sector.
Boratyńska, Grzegorzewska (2018)	T/P	FsQCA (logic, fuzzy theory and Boolean minimization)	Agribusiness entities in Poland	Main purpose of the study is fsQCA implementation for bankruptcy prediction of agribusiness entities and comparison with classical quantitative methods. The findings indicate that managers should carefully build or/and select existing methods of bankruptcy prediction, and adjust them to the type, size, and risk of business activity.
Grushniene (2016)	P	Altman's Z score	Lithuanian agricultural companies	The purpose of the paper was to apply Altman's Z score (1968, 1990) on the traded Lithuanian agrocultural holdings. Study showed that Z score model is aa practical tool and can be used in assessing the risk of insolvency in agricultural companies, as well as risk management actions of management.
Hampel et al. (2012)	T/P	Production function approach (PF)	Agriculture companies from Czech Republic	PF approach seems to be adequate to distinguish between bankrupted and highly rated companies including prediction of this status. Authors conclude that highly rated companies use limited resources better than bankrupted companies.
Karas et al. (2017)	P	Revised Altman's Z score (2000), Altman-Sabato's model (2006), Model IN05 (Neumaier, Neumaierová, 2005)	Agriculture companies	Authors found out the traditional bankruptcy prediction models, that were designed for the manufacturing companies, are not efficient in the agricultural sector. They presented a few practical implications for the managers: a higher level of reinvesting the profits back to the business, the depreciation of the fixed assets is a significant source of operating cash flow and a special attention should be paid to performance indicators that are based on EBITDA.
Klepac, Hampel (2017)	T/P	Logistic regression, the Support vector machines method with the RBF ANOVA kernel, the Decision trees and the Adaptive Boosting based on decision trees	European agribusiness companies	The results of the study showed, that with the increasing distance to the bankruptcy, there decreases the average accuracy of the financial distress prediction and there is a greater difference between the active and distressed companies in terms of liquidity, rentability and debt ratios. The Decision trees and Adaptive boosting offer a better accuracy for the distress prediction than SVM and logit methods.

Author (s)	*Type of study*	*Applied prediction technique*	*Application field*	*Results of the study*
Lukason (2014)	T/P	-	Estonian agricultural sector	The paper focuses on reasons and financial characteristics of firm failure in agricultural sector. Half of the analysed firms failed because of factors from both, internal and external environment.
Popescu (2014)	P	Altman's Z score (1983)	Agricultural companies in Romania	The paper apply Altman's Z score to predict bankruptcy risk of the agricultural companies dealing with dairy farming. These companies have a low profitability, and the degree of bankruptcy is high.
Rajin et al. (2016)	P	Altman's Z score (1983), Kralicek's DF model, Quick test	Serbian agricultural sector	Results suggest that Kralicek's DF model indicates better financial state of the company than Altman's Z score, considering the characteristics of the market in which the model is formed. Authors conclude that each of the applied method gave different answers. Therefore, they recommend that in analyzing the probability of bankruptcy always take into account indicators of different methods.
Septaningtiyas et al. (2020)	T/P	Logistic regression analysis	Indonesia agricultural sector	The paper developed new prediction model for the agricultural sector companies. The model produces accuracy using data sampple validation with results above 50%.
Stehel et al. (2019)	T/P	Neural network (Kohonen network)	Agriculture companies from Czech Republic	Using cluster analysis the authors were categorized companies into different groups. In the same group are companies with the most analogous results of financial analysis. The average values of individual financial indicators were calculated for each cluster. The results of the networks offer the possibility of a comprehensive evaluation of the Czech agricultural sector and the identification of companies with the greatest positive impact on the outputs of the agricultural sector. Neural networks offer an effective tool for predicting the development of individual sectors of the national economy.
Vavřina et al. (2013)	T/P	Altman's Z score (1983), Logit model, DEA with bankruptcy frontier, Production function approach	Agribusiness companies from Visegrad Group	Authors presented the validation results for each of the four applied prediction methods, outline the strengths and weaknesses of each approach and discuss the valid suggestions for the effective detection of financial problems in the specific branch of agribusiness.

Source: Own resourcing

2 Methods

According to the main objective of the paper, the main hypothesis has been stated. The main objective of the paper is to verify the statement that farms operating in the Slovak Republic are financially healthier due to the reformed Common Agricultural Policy of the European Union in years 2014-2020, compared to years 2009-2013. The statement can be confirmed or rejected by verifying the following hypothesis:

H: We assume that the values of the determined prediction models for the assessment of the financial health of agricultural companies in the period 2014-2020 statistically significantly differ from the level of values in the period 2009-2013.

The tool for verifying the stated hypothesis is a t-test for equal mean values of two independent sets. The tested sets of companies are created as random selections. The application of the t-test for equal mean values requires firstly to evaluate the homogeneity of the variances of the two selected groups, which is verified on the basis of the Levene's test for equal variances of two sets. Levene's test for equal variances allows to confirm or reject the hypothesis of the equality of variances in the group of ratios of financial health of agricultural companies in 2014-2020 and in the group of companies in 2009-2013. The hypotheses of the Levene's test can be written as follows:

$$H_0: \delta_1^2 - \delta_2^2 = 0 \quad (1)$$

$$H_1: \delta_1^2 - \delta_2^2 \neq 0 \quad (2)$$

where δ_1^2 and δ_2^2 are the variances of the basic sets of companies in two analysed periods, from which random selections are chosen.
The Levene's test is evaluated based on the p-value, which indicates the lowest possible level of significance for rejecting the null hypothesis. In the case of rejection of the null hypothesis, it is possible to assume the inequality of variances of the observed characteristic in the two analysed periods. Based on the evaluation of the test for equal variances, the choice of the test statistics of the t-test for equal mean values of two independent sets can be determined. The hypotheses of the t-test for equal mean values of two independent sets can be written as follows:

$$H_0: \mu_1^2 - \mu_2^2 = 0 \quad (3)$$

$$H_1: \mu_1^2 - \mu_2^2 \neq 0 \quad (4)$$

where μ_1 and μ_2 are the mean values of individual sets of companies in two analysed periods, from which random selections are made. In the case of confirmation of equality of variances, the following testing statistics is used:

$$t = \frac{\overline{x_1 - x_2}}{sp\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad (5)$$

where

$$sp = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} \quad (6)$$

where $\overline{x_1}$ and $\overline{x_2}$ are sample arithmetic means of the two sets, n_1 and n_2 represent the number of observations in the individual sets, s_1 and s_2 are the sample standard deviations of the selected groups, and sp is the common sample standard deviation.

In the case of rejection of the hypothesis for equal variances of the two selected groups, the testing statistics is expressed by the following relation:

$$t = \frac{\overline{x_1 - x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \tag{7}$$

where $\overline{x_1}$ and $\overline{x_2}$ are the sample arithmetic means of the two sets, n_1 and n_2 represent the number of observations in the individual sets,, s_1 and s_2 are the sample standard deviations od selected sets. The results of the t-test for equal mean values of the two independent sets are also evaluated by comparing the p-values with the normal levels of significance. Based on the testing, the results of individual prediction models, which statistically significantly differ in the two examined periods, will be interpreted. The results will be supported by graphical interpretation of selected values of prediction models in two analysed periods.

Farm can be considered as an economic unit that differs in the structure of assets and liabilities, different economic activity within the agricultural sector, size, investment activity, size and quality of cultivated land, etc. The agricultural sector is particularly specific because of the different economic focus of the agricultural companies, concretely crop production, including vegetables and horticulture, livestock production, crop production combined with livestock production, services for crop and livestock production and hunting, game trapping and breeding, including related services. Purves et al. (2015) analyse the relationship between financial and non-financial factors of financial failure predictors in farms. It is not possible to state a generally valid prediction model for assessing the financial health of agricultural companies, because the existing prediction models were constructed for different time periods, in different political and economic conditions and for different sectors of the economy (**Table 2**). For this reason, two prediction models, constructed based on the discriminant analysis, specifically constructed for Slovak agricultural companies, were selected, namely the CH-index (1998) and the G-index (2002). Verification of both models (CH-index, G-index) in comparison with Altman's Z-score is analysed on a set of new data on farms in the studies Valášková et al. (2017) and Boďa, Úradníček (2019). The authors discuss in the studies the suitability of its use for new financial data on agricultural companies, which has changed significantly in recent years due to transformational changes in the agricultural sector and the rules of the Common Agricultural Policy. Csikova et al. (2019) discuss the limitation of financial health prediction in companies from post-communist countries V4.

All selected prediction models, which are summarized in **Table 2** are constructed based on the multivariate discriminant analysis. The specification of financial variables of selected prediction models is shown in **Table 3**.

Table 2. Overview of analysed prediction models

Predictive Analytics Model	Author/Year of study	Sector	Formula	Cut-off points
Altman's Z score model	Altman I. Edward/ 1983 (revised 1968)	companies which do not issue shares traded on a regulated market	$Z' = 0{,}717x_1 + 0{,}847x_2 + 3{,}107x_3 + 0{,}42x_4 + 0{,}998x_5$	Z'<1,2 failure Z'>2,9 non failure Z'=1,2 to 2,9 grey area
Index 05	Neumaierová, Neumaier/2005	medium and large industrial companies in the Czech Republic	$IN_{05} = 0{,}13y_1 + 0{,}04y_2 + 3{,}97y_3 + 0{,}21y_4 + 0{,}09y_5$	IN05<0,9 failure IN05>1,6 non failure IN05=1,6 to 0,9 grey area
Index bonity (IB)	Maczynska E. model II/1994	industrial companies in Poland	$Index\ bonity = 1{,}5I_1 + 0{,}08I_2 + 10I_3 + 5I_4 + 0{,}3I_5 + 0{,}1I_6$	IB<-1 failure IB>1 non failure IB=-1 to 1 grey area
Taffler's Z score model	Taffler R.J./1983	industrial companies	$Z = 0{,}53T_1 + 0{,}13T_2 + 0{,}18T_3 + 0{,}16T_4$	Z<0,2 failure Z>0,3 non failure Z=0,2 to 0,3 grey area
CH-index	Chrastinová/1998	agribusiness companies in Slovakia	$CH = 0{,}37x_1 + 0{,}25x_2 + 0{,}21x_3 - 0{,}10x_4 - 0{,}07x_5$	CH≤-5 failure CH≥2,5 non failure CH=-5 to 2,5 grey area
G-index	Gurčík/2002	agribusiness companies in Slovakia	$G = 3{,}412x_1 + 2{,}226x_2 + 3{,}277x_3 + 3{,}149x_4 - 2{,}063x_5$	G≤-0,6 failure G≥1,8 non failure G=-0,6 to 1,8 grey area

Source: Own resourcing

Table 3. Financial variables in prediction models

Predictive Analytics Model	Financial variables in the formula
Altman's Z score model	*x1=net working capital/total assets, x2=retained earnings/total assets, x3=EBIT/total assets, x4=equity/total liabilities, x5=sales/total assets*
Index 05	*y1=total assets/liabilities, y2=EBIT/interest paid, y3=EBIT/total assets, y4=total revenues/total assets, y5=current assets/current libilities*
Index bonity (IB)	*I1=(gross profit+amortization)/total liabilities, I2=total assets/total liabilities, I3=operating profit/total assets, I4=operating profit/sales revenue, I5=stocks/sales revenue, I6=total revenues/sales revenues*
Taffler's Z score model	*T1=EBT/short-term liabilities, T2=current assets/total liabilities, T3=short-term liabilities/total assets, T4=sales/assets*
CH-index	*x1=EAT/total assets, x2=EAT/total revenues, x3=cash flow/liabilities, x4=liabilities/total revenues, x5=liabilities/total assets*
G-index	*x1=retained earnings/total liabilities, x2=EBT/total liabilities, x3=EBT/total revenues, x4=cash flow/total liabilities, x5=stocks/total revenues*

Source: Own resourcing

3 Results and Discussions

The intention of the following section is to identify significant statistical differences between the values of selected prediction models for the group of farms in 2009-2013 and the group of farms in 2014-2020, when a new reformed CAP was adopted. The ambition was to find connections in the aspects of the financial health of the farm with regard to the time factor. The sample sets of farms in two selected time periods were conceived by random selection from the basic set, while outliers were removed from both sample sets. All analysed farms operate in the field of agriculture and forestry, their ownership is cooperative or private and they perform their activities in various regions of the Slovak Republic. The homogeneity of the variances of the two selected groups was evaluated using the Leven's test for equal variances. Based on the results of Leven's test was conditioned the choice of a suitable t-test statistic for equal mean values. The results of the t-test for equal mean values of two independent sets were compared with the significance level $\alpha = 0{,}05$.

A statistically significant difference at the significance level $\alpha = 0{,}05$ between the mean value of the indicators in the group of farms in 2009-2013 and the group of farms in 2014-2020 was confirmed in the prediction models: *Altman Z-score (1983), Taffler model (1983) and the G-index (2002)*. Based on these prediction models, *it can be assumed that the level of values of the determined prediction models for assessing the financial health of farms in the period 2014-2020 differs statistically significantly from the level of values in the period 2009-2013*. It follows that the reforms adopted under the Common Agricultural Policy for 2014-2020 had an impact on the resulting values of the financial health of farms, as they were statistically significantly different from the values in the previous time period. The process of globalization and mutual integration of the rules and settings of the CAP in the countries of the European Union, taking into account selected prediction techniques, was also reflected in the values of the financial health of Slovak farms.

However, the question remains whether the CAP had a positive or negative impact on the resulting values of the financial health of farms. Comparing the average values of the Altman Z-score model (1983) in 2009-2013 and in 2014-2020, we came to the conclusion that the arithmetic mean of financial health values in 2014-2020 was lower than in the previous period, which may indicate deteriorating financial health of farms. In the case of comparing the average values obtained using the Taffler model (1983), we can state higher average values of financial health in the years 2014-2020, which may, on the contrary, indicate better financial health of farms by adopting a reformed CAP. The average values of financial health obtained using the G-index (2002) also refer to the deteriorating financial health of farms in 2014-2020. The resulting values of financial health obtained using the Altman Z-score model and the G-index placed farms in the grey zone, while the results obtained using the Taffler model ranked farms among the prosperous companies.

Agriculture is a specific sector of the country's economy, and even interventions in the form of the CAP and the resulting support for farmers do not necessarily mean that farms will be categorized as financially healthy.

4 Conclusions

The main idea of the presented paper was to verify whether the processes of globalization within the setting of new rules of the reformed CAP in the EU countries in 2014-2020 have an important impact on the values of financial health of farms in the Slovak Republic compared to the previous time period 2009-2013. For this purpose, six prediction models based on multivariate discriminant analysis were selected, of which two models were

specifically constructed in the conditions of Slovak farms. Using a t-test for equal mean values of two independent sets, we came to the conclusion that there are statistically significant differences between the values of financial health in 2009-2013 and 2014-2020 in the case of calculation based on Altman Z-score coefficient (1983), Taffler model (1983) and G-index (2002). However, by a more detailed analysis of the average values of the financial health of farms using the Altman Z-score model and the G-index, we came to the conclusion about the deteriorating financial health of farms in 2014-2020. It is important to note that the prediction models used in the study were constructed for different industries, in different economic conditions and for different time periods. Due to its dependence on financial aid under CAP rules, agriculture is a specific sector that is subject to turbulent changes resulting from a number of uncontrollable factors, such as climate change, weather changes, changes in agricultural commodity prices, changes in input commodity prices and more others. For this reason, it is necessary to incorporate these changes into the prediction techniques and focus on the application of innovative techniques (support vector machines, neural networks, decision trees and DEA models) of financial health assessment on a set of farms.
Further research in this area will focus on comparing the values of financial ratios in the group of financially healthy farms and the group of farms in financial distress in both time periods examined and to identify possible causes of deteriorating financial health of farms.

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