Are profitable firms also financially healthy? Empirical evidence for pig-breeding sector

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Abstract

This article aims to investigate the financial health of firms belonging to the pig-breeding sector in Visegrad group countries in the period 2007-2015 and to prove a relationship between profitability and financial health of the companies. We calculated profitability using return on assets (ROA) and return on sales (ROS) and financial condition with the help of two Z-Score models and IN05 index. We have revealed a relatively strong link between profitability indicators and financial health of companies. However, there are some differences. There is a more stable link between profitability indicators and IN05 index in comparison to both Z-Score models. There is also a higher and more stable relationship between ROA and financial health comparing to ROS and all three indexes (IN05, both Z-Score models).

Keywords: Altman Z-Score models. IN05 index. Visegrad group countries.

1. Introduction

Agriculture, like other industries, is exposed to growing competitive pressures. By integration of European economies and deepening globalisation, international competition plays a growing role. However, the sector has still its specificities, thanks to the common agricultural policy of the European Union associated with agricultural subsidy policy and to its high dependency on the natural environment. Nevertheless, the managerial and economic logic and the importance of strategic management are comparable to other businesses (Guimarães et al., 2009; Lososova and Zdenek, 2014).

The evaluation of the performance and financial health of a company is one of the central themes of business sciences, and it is the subject of a large number of empirical studies as well.

The approach of individual authors to assessing the performance and financial health of companies varies from one study to another, and the methods used to quantify them are different. Profitability of a firm belongs to the most important indicators of firm performance and brings essential information for shareholders and stakeholders. Return on assets (ROA), return on sales (ROS) and return on equity (ROE) are the most frequently used performance indicators in empirical studies (Hult et al., 2008). Not only the company's profitability is important, but mainly the overall financial health, which is essential for the long-term sustainability of the business. Here arises the importance of this study and the verification of the idea of Gu (2002, p.33) that "[u]nprofitable firms with cumulative losses are likely to end up with negative net worth and eventually head for bankruptcy" and vice versa? Based on the literature review, we found very few studies dealing with this link. That is the reason, why we decided to investigate research questions:

What is the link between profitability and financial health? Are companies that are more profitable also financially healthy? Moreover, what is the relationship in the field of pig breeding?

Agricultural pig-breeding companies are characterised by relatively low profitability compared to other types of farming in the Czech Republic. Common Agricultural Policy least supports these firms, and the impact of operating subsidies does not significantly increase the income of enterprises compared to other agricultural companies (Boudný and Špička, 2012; Bašek et al., 2010). Because of this fact, this sector is one of the most vulnerable

sectors in the Czech agriculture sector. However, since the year 2012, the profitability of the Czech pig breeders has grown due to favourable prices and better efficiency (Špička, 2014). Špička (2014) investigated financial situation of the Czech pig breeders in the period 2007 – 2013, so for instance, the influence of Russian import ban on products from the European Union member countries has not been analysed since August 2014. Dunay and Vinkler-Rajcsányi (2016) highlighted the problems of the pig sector in Hungary – e.g., changes in consumption habits, lack of capital or lack of land ownership.

This study aims to examine the financial health of firms belonging to the pig-breeding sector in V4 countries in the period 2007-2015 and to prove the link between financial health and profitability to find out if the profitable firms are also in good financial condition.

2. Literature Review

Many authors have solved the analysis of financial health, and it is still an evolving topic. Beaver (1966) contributed significantly to this issue by analysing the ability of financial indicators to predict the bankruptcy of large companies. On this basis, he proposed a set of six indicators whose analysis allowed predicting the risk of failure. Profitability is a significant item in this model, however the combination with other indicators gives more accurate forecast. His work was followed by other authors led by Altman (1968) who introduced his multivariate linear discriminant Z-Score Model. This model was further developed resulting in the ZETA model. Both models employ a combination of variables more or less influenced by profit but the profit is not the only important factor. Reliability of both models was further discussed by Altman (2000) and further tested, for example by Grice and Ingram (2001), who used data from 1988 to 1991, with overall reliability being 57.8 % compared to 83.5 % in Altman (1968). Their results showed significantly higher reliability for the manufacturing firms than for the general sample. Lízal (2002) verified the application of the Altman model and the testing of its capabilities in the Czech environment, and he focused mainly on the identification of risk factors. Dolejšová (2014) categorised the use of the Altman model in the Czech literature and then verified the applicability of the model to small businesses in Moravia. The general applicability of the Z-Score Model was verified in a study based on data from 34 countries including the Czech Republic, Poland, Hungary, and Slovakia and it was found to be very satisfactory (Altman et al., 2017).

Neumaierová and Neumaier (2005) created four IN models and can be seen as pioneers in assessing the financial health of Czech firms. The IN95 bankruptcy model was created in 1995 and the second one was the credit-scoring model IN99. IN01 was a combination of the bankruptcy and credit scoring model, and it was subsequently upgraded to IN05 (Neumaierová and Neumaier, 2005). Even IN models combine several variables and some of them are connected to the profit. Machek (2014) compared IN99 and IN05 indexes and modified Altman Z-score model. Based on the Czech companies from 2007 to 2012, he verified a very good ability of all models to predict. The question of the validity of the models from the sector's point of view, especially with a focus on agriculture, was discussed by Karas and Režňáková (2017). They analysed data for small and medium-sized agriculture enterprises using the Revised Z-Score Model (Altman, 2000), Altman-Sabato's model (Altman and Sabato, 2007) and Model IN05 and concluded that it was suitable to modify the models to improve their validity. Karas and Režňáková (2017; 2018) also draw attention to the existence of a link between the company's financial health and their short-term debts and profitability. Before them already Gu (2002) documented relationship between profitability and the risk of bankruptcy on the basis of five profitability ratios. Rashid and Abbas (2011) based their bankruptcy prediction model for Pakistan on sales to total assets, EBIT to current liabilities and cash flow ratio. Liang et al. (2016) found that one of the important features for effective bankruptcy prediction is profitability. Also in other V4 countries, we can meet the Altman model application. Režňáková and Karas (2015) tested the suitability of the Altman Z-Score for companies in the Czech Republic, Poland, Hungary, and Slovakia. Their study concluded that the accuracy of assessment using the method was significantly lower in these countries excluding Hungary and that it was appropriate to adjust the coefficients and boundaries of the zones. They did not consider the unadjusted model transferable between different economies.

Rybárová et al. (2016) applied the model when tested the improving condition of the construction industry in Slovakia. The authors calculated three variants of Altman's Z-Score and compared the results to the Credit reform SI private model which they did not introduce in more details because of a business secret. The applicability of the Altman's Z-Score model to the Slovak business environment was discussed by Boďa and Úradníček (2016). Both the 1968 original model and its revised 1983 form were found to be suitable for predicting the risk of bankruptcy and the risk of a company financial crisis. The validity of American Altman's Z-Score, Czech IN05, Polish Poznanski's model, Hungarian Virag and Hajda's

model, Canadian Springate's model, and the UK Taffler's model were tested by Misankova et al. (2017) on a sample of Slovak companies. Their test showed the best result in the case of the Polish model (above 90% accuracy) while other models showed slightly more than 50% reliability.

Ékes and Koloszár (2014) tested among others the validity of the Altman Z–Score in comparison to specific Hungarian models on a sample of Hungarian SME enterprises. The results of all models were not counted very satisfactory because the reason was seen mainly in specific circumstances of Hungarian SMEs in comparison to big foreign companies. On the other hand, Rozsa (2014) used successfully the Altman Z–Score model to assess the dairy industry in Hungary.

Ptak-Chmielewska and Matuszyk (2014) tested the validity of bankruptcy models in Poland. They compared the Altman's Z-Score model with the Cox survival model (Cox, 1972). The Cox model was considered a suitable alternative tool for bankruptcy models in the view of the lower predictive validity of Altman's Z-Score in the Polish environment. However, the usage of Altman's Z-Score was seen acceptable, and its lower validity is explained by the high heterogeneity of the SME's sample.

3. Material and Methods

The study examines the link between financial health and profitability. We employ frequently used indicators of profitability: return on assets and return on sales. Return on assets (ROA) = Earnings before interest and taxes (EBIT)/Total assets; and Return on sales (ROS) = Earnings before interest and taxes (EBIT)/Sales. We decided to use only ROA and ROS because ROE as a profitability indicator is associated with the problem of mistaken positive if both equity and profit reach a negative value.

More methods could be applied to assess the overall financial health. Most of them are based on a combination of financial ratios. Ones of the frequently used are bankruptcy models which belong to common tools of the financial analysis of a firm and summarize selected aspects of the business (most often profitability, liquidity, indebtedness, and activity). These models enable to distinguish simply the firms having good financial health and businesses that are in financial distress and are threatened by bankruptcy. So just these models are employed in this study, specifically two variants of Altman's Z-Score model: Z'-Score model

and Z´´-Score model (Altman, 1983, 1968) and IN05 index (Neumaierová and Neumaier, 2005). According to previous studies testing the reliability of the selected bankruptcy models, these models become the good fit bankruptcy models for V4 countries (Altman et al., 2017).

Altman Z´-Score model could be described as follows (Altman, 1983):

$$Z' = 0.717.X_1 + 0.847.X_2 + 3.107.X_3 + 0.450.X_4 + 0.998.X_5.$$
(1)

Where X_1 is working capital/total assets, X_2 denotes retained earnings/total assets, X_3 is earnings before interest and taxes/total assets, X_4 represents book value of equity/book value of total liabilities, X_5 is sales/total assets, and Z´ is overall index.

According to the value of Z´-Score, we can identify financially distressed and non-distressed entities. If Z' is smaller than 1.23, the firm is threatened by bankruptcy (Distress zone); if Z' is higher than 2.90, the firm is in good financial condition, and there is not financial distress (Safe zone). The values between 1.23 and 2.90 denote Grey zone, where the conclusion is ambiguous.

According to Altman et al. (2017), this model is suitable mostly for private manufacturing firms. To fit the model better for both manufacturing and non-manufacturing firms and publicly listed and privately held firms, Altman (1983) modified it and removed the variable X_5 from the model to decrease the industry effect which is more likely to play a role if the assets turnover is taken into account. A new version of the model is known as Z´´-Score model and is as follows (Altman, 1983):

$$Z'' = 6.56.X_1 + 3.26.X_2 + 6.72.X_3 + 1.05.X_4.$$
(2)

Variables X_1-X_4 are the same as in Z´-Score model. Here the firms are also classified into three zones based on the value of Z´´-Score: $Z'' \leq 1.1$ is Distress zone; $1.1 < Z'' \leq 2.6$ is Grey zone and $Z'' > 2.6$ denotes Safe zone.

IN05 has followed the formula (Neumaierová and Neumaier, 2005):

$$IN05 = 0.13. P_1 + 0.04. P_2 + 3.97. P_3 + 0.21. P_4 + 0.09. P_5.$$
(3)

Where P_1 denotes assets over liabilities, P_2 is EBIT over interests, P_3 denotes EBIT over assets, P4 denotes total revenue over assets and P_5 is the ratio of current assets over short-term liabilities. The companies are divided into three zones. If the value of IN05 is lower than 0.90, the company is probably not prospering. The value higher than 1.60 places the firm into a prosperity zone. Values between 1.60 and 0.90 put the company into the grey zone (Neumaierová and Neumaier, 2005).

To consider whether there is a direct link between profitability and financial health, we use Pearson correlation coefficient and also Spearman rank correlation coefficient to take into account possible non-linearity of the relationship (de Vaus, 2002). For the computation, we employ MS Excel and STATA software.

The data for this study are compiled from the Amadeus database. We use data about firms belonging to the swine-breeding sector and having breeding as the main activity (group 01.460 The raising of swine). We use Statistical classification of economic activities in the European Community Rev.2 (NACE Rev.2). We selected data for the Czech Republic, Slovakia, Hungary, and Poland for the period 2007-2015. We selected entities that were active (reported the sales) in examined years and provided all necessary data for assessing the financial health.

Descriptive statistics are presented in the Appendix in Tables 13 to 20. For each country was created two tables. There are presented mean and standard deviation for sales, total revenues, total assets and EBIT in a first table and mean and standard deviation of z-score indexes and IN05 in a second table. Descriptive statistics for the Czech Republic are listed in Tables 13 and 14, for Slovakia in Tables 15 and 16, for Hungary in Tables 17 and 18. Mean and standard deviations for the sample of Polish firms are shown in Tables 19 and 20. As can be seen in these tables, we used an unbalanced panel data. The research sample for each year and country is also shown in Tables 13 to 20.

4. Results and Discussion

Correlation coefficients for the link between both Z-Score indexes and profitability indicators (ROA, ROS) are calculated for each country. For the Czech Republic, according to the results of the Pearson correlation coefficients (see Table 1), the statistically significant linear dependence between all financial health indexes (Z', Z'' and IN05) and the ROA indicator is visible. The relationship between the financial health indexes and the ROS

indicator confirm rather non-linearity link for most of the years, especially for IN05 indicators, as you can see in Table 2. There is a statistically significant relationship (at the 1 per cent level) between IN05 indicator and ROS in all years.

Table 1: The Czech Republic: Pearson Correlation Coefficients

	2007		2008		2009		2010		2011	
N	37		37		38		40		42	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.672***	.554***	.611***	.494***	.132	.196	.318**	.097	.443***	.347**
Z´´	.712***	.599***	.603***	.443***	.010	.032	.312**	.080	.356**	.137
IN05	.574***	.353**	.089	.074	.410**	.076	.366**	.153	.394***	-.112

	2012		2013		2014		2015	
N	37		35		38		27	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.376**	-.171	.178	.243	.322**	.319*	.445**	.451**
Z´´	.482***	-.009	.318*	.205	.322**	.186	.437**	.320
IN05	.754***	-.013	.647***	.509***	.770***	.360**	.725***	.376*

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

Table 2: The Czech Republic: Spearman Correlation Coefficients

	2007		2008		2009		2010		2011	
N	37		37		38		40		42	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.699***	.657***	.599***	.614***	.044	.044	.293*	.278*	.154	.091
Z´´	.723***	.656***	.656***	.613***	.084	.074	.290*	.272*	.166	.116
IN05	.908***	.839***	.900***	.862***	.761***	.707***	.882***	.861***	.871***	.843***

	2012		2013		2014		2015	
N	37		35		38		27	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.444***	.146	.203	.141	.372**	.223	.304	.172
Z´´	.442***	.282	.264	.253	.363**	.288*	.302	.225
IN05	.753***	.548***	.758***	.717***	.820***	.742***	.591***	.504***

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

The year 2008 was the only one when the linear relationship between ROA and IN05 was not confirmed (see Table 1). The reason for statistical independence in 2008 was the increasing total assets of firms in decreasing company profit (see Table 13 in Appendix). In 2007 and 2008, the Czech companies had the worst financial results for the entire survey period. The cause can be seen in the sharp decline of pig carcasses prices in one year. According to the State Agricultural Intervention Fund (2008), in the first week of January 2006, the price for 1 kg of class E pig carcasses was less than 44 CZK, while a year later it was just under 39 CZK. In January 2008, the situation was even worse, and the price dropped

to 37.41 CZK per 1 kg. This trend is also reflected in declining sales between 2007 and 2008 (see Table 13). The drop in prices was undoubtedly caused by a dramatic year-on-year increase in both live pig imports (from 15.3 to 40.9 million USD) and pork meat (from 337 to 464 million USD) (International Trade Center, 2018).

For Slovak firms (the results are presented in Tables 3 and 4), the ROA and financial health indexes are very similar to those of Czech firms. There is a very high linear dependence (most of Pearson's correlation coefficients is higher than Spearman's correlation coefficients) in all years for the relationship between ROA and IN05 and most years for both z-score indexes. In addition, for the relationship between ROS and the financial health indexes, most of the Pearson correlation coefficients are statistically significant, and the linear relationship is confirmed here as well.

Table 3: Slovakia: Pearson Correlation Coefficients

	2007		2008		2009		2010		2011	
N	28		28		36		36		34	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.504***	.459**	.768***	.699***	.410**	.299*	.079	.118	.516***	.366**
Z´´	.508***	.517***	.772***	.660***	.256	.111	.085	.115	.521***	.360**
IN05	.882***	.721***	.976***	.716***	.679***	.427***	.530***	.482***	.685***	.243
	2012		2013		2014		2015			
N	34		32		31		30			
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS		
Z´	.414**	.282	.598***	.610***	.334*	.512***	.546***	.571***		
Z´´	.202	.160	.504***	.498***	.460***	.596***	.474***	.720***		
IN05	.777***	.431**	.561***	.572***	.758***	.944***	.821***	.343*		

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

Table 4: Slovakia: Spearman Correlation Coefficients

	2007		2008		2009		2010		2011	
N	28		28		36		36		34	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.552***	.342*	.492***	.406**	.292*	.359**	.253	.231	.185	.115
Z´´	.415**	.224	.267	.203	.008	.024	.237	.216	.057	.065
IN05	.754***	.573***	.622***	.562***	.834***	.779***	.813***	.818***	.670***	.592***
	2012		2013		2014		2015			
N	34		32		31		30			
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS		
Z´	.307*	.188	.386**	.372**	.323*	.336*	.387**	.275		
Z´´	-.006	-.059	.235	.150	.309*	.382**	.172	.117		
IN05	.694***	.606***	.897***	.833***	.659***	.634***	.769***	.732***		

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

For Hungarian companies (see Tables 5 and 6) we can observe a linear statistical dependence on the link between ROA and most of the financial health indexes. However, there are exceptions - this is especially the year 2010, where there is either no linear dependence (the relationship between ROA and IN05) or the correlation coefficients are lower (statistically significant at the 10 per cent level). Lower linearity can be found in 2015 as well. A similar but even stronger trend can be seen in the relationship between ROS and financial health indexes. I.e., linear dependence is weak or none in the crisis years 2008 to 2010 and again in 2015. In 2015, a weak (for ROA) or no (for ROS) correlation was likely due to a sharp drop in profits from an average of 119 million forints in 2014 to 24 million forints in 2015. Sales, total revenues and total assets fell very little (see Table 17 in the Appendix). One of the likely causes of this situation is the introduction of Russian sanctions for imports not only of pork meat in August 2014.

Table 5: Hungary: Pearson Correlation Coefficients

	2007		2008		2009		2010		2011	
N	75		58		73		66		60	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.516***	.510***	.645***	-.007	-.573	.187	.249**	.048	.674***	.269**
Z´´	.553***	.558***	.714***	.248*	.976***	.023	.221*	.073	.429***	.321**
IN05	.780***	.731***	.597***	.105	.987***	.011	.093	.061	.070	-.010

	2012		2013		2014		2015	
N	76		69		74		73	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.759***	.519***	.477***	.441***	.385***	.260**	.307***	.037
Z´´	.616***	.487***	.618***	.600***	.517***	.488***	.365***	.066
IN05	.305***	.786***	.640***	.448***	.724	.600***	.247*	.020

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

Table 6: Hungary: Spearman Correlation Coefficients

	2007		2008		2009		2010		2011	
N	75		58		73		66		60	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.281**	.202*	.571***	.355***	.414***	.208*	.301**	.168	.603***	.477***
Z´´	.268**	.281**	.604***	.558***	.394***	.372***	.281**	.227*	.580***	.535***
IN05	.721***	.669***	.724***	.608***	.703***	.591***	.801***	.735***	.872***	.806***

	2012		2013		2014		2015	
N	76		69		74		73	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z´	.608***	.484***	.560***	.438***	.505***	.226*	.566***	.502***
Z´´	.609***	.600***	.571***	.566***	.503***	.473***	.432***	.492***
IN05	.840***	.803***	.802***	.763***	.760***	.657***	.836***	.833***

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

Even in 2013, Hungary exported meat to the Russian Federation for more than 54 million dollars. In 2015, there was no export of pork meat to Russia. Hungarian companies had to find quickly other markets (they were successful, e.g., total exports of pork meat between 2013 and 2015 declined only by 14%) for their meat and at the price of lower margins, which was reflected mainly in their profits. Sales fell only by 5.6% (see Table 17 in the Appendix).

In Poland, there are very similar results for the Pearson and Spearman correlation coefficients (see Tables 7 and 8) for all three financial health indexes and the relationship between the two indicators of profitability. However, while both z-score indexes are weak (Z") or very weak (Z'), a statistically significant linear relationship can be observed in the relationship between IN05 and both profitability indicators.

Table 7: Poland: Pearson Correlation Coefficients

	2007		2008		2009		2010		2011	
N	22		30		32		32		34	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z′	-.153	-.208	.272	-.182	.038	-.414**	-.124	-.094	-.103	-.077
Z′′	-.130	-.042	.158	.032	.268	.068	-.090	-.052	.404**	.436***
IN05	.729***	.731***	.708***	.495***	.460***	.009	.441**	.300*	.622***	.479***
	2012		2013		2014		2015			
N	36		37		41		33			
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS		
Z′	.157	-.272	.242	-.131	.958***	-.075	.840***	-.091		
Z′′	.615***	.291*	.486***	-.044	.449***	.099	-.610	-.171		
IN05	.763***	.397**	.726***	.080	.970***	-.030	.884***	.309*		

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

Table 8: Poland: Spearman Correlation Coefficients

	2007		2008		2009		2010		2011	
N	22		30		32		32		34	
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS
Z′	-.074	-.130	.278	-.137	-.030	-.577	-.315*	-.402**	.006	-.500***
Z′′	.092	.180	.326*	.182	.280	.091	-.155	-.213	.196	-.032
IN05	.831***	.854***	.830***	.538***	.525***	.085	.460***	.333*	.509	.122
	2012		2013		2014		2015			
N	36		37		41		33			
	ROA	ROS	ROA	ROS	ROA	ROS	ROA	ROS		
Z′	.210	-.326*	.336**	-.040	.289*	-.185	.164	-.264		
Z′′	.374**	.275	.389**	.261	.456***	.297*	-.048	-.042		

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IN05	.659***	.361**	.662***	.359**	.710***	.370**	.692***	.414**

Notes: ***significant at the 1 per cent level, **significant at the 5 per cent level, *significant at the 10 per cent level

In all examined years, there was a statistically significant dependence (at the 1 per cent level) between ROA and IN05. There was no link between ROS and IN05 for 2009, 2013 and 2014. Between 2008 and 2009, Polish firms rapidly increased profit (from 1.4 million to almost 3 million PLN) to total revenues growth of only 5.8 %. It might be due to an increase in the export of live pigs which increased more than twice (from 24 million to 50.4 million USD) to Russia between 2008 and 2009. Compared to 2005, it was a five-fold increase. However, for total pork exports, the increase between 2005 and 2009 was moderate, and exports even declined between 2008 and 2009.

Nevertheless, as the import of meat between 2008 and 2009 declined, it did not have a negative effect on the financial results of companies. The most significant drop in profits can be seen between 2013 and 2015, mainly due to Russian sanctions in August 2014. While in 2013 the Polish firms exported meat to the Russian Federation for 132 million USD, in 2014 it was only 7 million USD, and in 2015 the export was zero (International Trade Center, 2018).

Generally, for all V4 countries, there is a stronger link between IN05 and both profitability ratios compared to z-score indexes, which is consistent for instance with the study of Machek (2014). If we look closely at Tables 9 to 12 listed in the Appendix (which show the number of companies classified in individual zones according to the results for individual financial health indexes), we can note that for most countries and years, the index IN05 classifies more companies into distress zone than both z-score indexes. As it is shown in Table 10, the only exception is Slovakia, where the number of companies in the distress zone according to IN05 and z-score indexes is much more balanced than in other countries (with the exception of the year 2010).

It is reflected in the similar statistical dependencies for IN05 and z-score indexes presented in Tables 3 and 4. As it was noted above, the only exception is the year 2010, where the relationship between z-score indexes and profitability ratios are statistically insignificant (as opposed to IN05). In 2010 we can see (see Table 10) the big difference between the number of companies assigned to the distress zone according to IN05 on one side and both z-score indexes on the other side. The results for Slovak firms are in line with the study by

Rybárová et al. (2016), which revealed strong dependence between financial ratios and the probability of bankruptcy in Slovak companies (measured by Altman z-scores indexes).

Conversely, for Poland, as described above, the correlation coefficients for both z-score indexes are weak which also corresponds to the different results in the number of listed companies in each zone. For example, in 2010 (see Table 12 in the Appendix), index IN05 ranks only 12 companies in the safe zone, while z-score indexes 30 (Z´´) and 23 (Z´).

5. Conclusion

This paper aimed to examine the financial health of companies from the pig-breeding sectors in Visegrad group countries and to prove if there was a positive link between profitability and financial conditions of these firms. Profitability and financial health of firms were negatively impacted by two events – Russian sanctions from August 2014 and the economic situation in 2008 and 2009. Russian sanctions affected Polish and Hungarian firms which exported a relatively significant share of their production to the Russian Federation. Economic recession, which started in 2008, negatively influenced sales and financial condition of companies from the Czech Republic, Slovakia, and Hungary. Polish firms increased in all indicators (sales, EBIT, IN05, Altman Z-scores) in 2009 and this fact is consistent with GDP growth in Poland in this year. Poland was the only country from the European Union members where GDP increased between the years 2008 and 2009.

It has been proved that firms that are more profitable are in a better financial condition in comparison to less profitable counterparts. However, there are some slight differences among countries, years and profitability indicators. We can see a more stable relationship between profitability indicators and IN05 index in comparison to both z-score models. There are also some years, where Pearson correlation coefficients are not statistically significant, for instance, no linear link between profitability and z-scores models (or IN05 index) for Polish and Hungarian firms in 2015 which was caused by Russian sanctions on imports of most of the agricultural products.

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Appendix

Table 9: The Financial Health of Companies from the Czech Republic

	2007			2008			2009			2010		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	17	17	30	20	21	30	14	21	26	17	17	29
Grey area	17	6	7	13	5	5	19	4	11	3	0	7
Safe zone	3	14	0	4	11	2	5	13	1	20	23	4
Total	37	37	37	37	37	37	38	38	38	40	40	40
	2011			2012			2013			2014		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	16	19	28	12	9	12	10	12	20	10	14	13
Grey area	20	6	11	21	10	17	20	4	9	23	6	14
Safe zone	6	17	3	4	18	8	5	19	6	5	18	11
Total	42	42	42	37	37	37	35	35	35	38	38	38

	2015		
	Z´	Z´´	IN05
Distress zone	5	8	9
Grey area	19	3	17
Safe zone	3	16	1
Total	27	27	27

Note: Distress zone: Z´≤1.23, Z´´ ≤1.1, IN05 ≤0.9; Grey zone: 1.23 < Z´ ≤ 2.9, 1.1 < Z´´≤ 2.6, 0.9 < IN05 ≤ 1.6;

Safe zone: Z´>2.9, Z´´>2.6, IN05 >1.6

Table 10: The Financial Health of Companies from Slovakia

	2007			2008			2009			2010		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	19	14	19	16	10	19	31	19	31	9	8	30
Grey area	7	4	7	11	8	8	4	7	5	12	0	5
Safe zone	2	10	2	1	10	1	1	10	0	15	28	1
Total	28	28	28	28	28	28	36	36	36	36	36	36
	2011			2012			2013			2014		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	22	15	26	20	13	22	22	14	25	18	16	17
Grey area	11	10	7	14	10	9	10	4	6	10	4	11
Safe zone	1	9	1	0	11	3	0	14	1	3	11	3
Total	34	34	34	34	34	34	32	32	32	31	31	31
	2015											
	Z´	Z´´	IN05									
Distress zone	21	18	22									
Grey area	7	4	6									
Safe zone	2	8	2									
	30	30	30									

Note: Distress zone: Z´≤1.23, Z´´ ≤1.1, IN05 ≤0.9; Grey zone: 1.23 < Z´ ≤ 2.9, 1.1 < Z´´≤ 2.6, 0.9 < IN05 ≤ 1.6;

Safe zone: Z´>2.9, Z´´>2.6, IN05 >1.6

Table 11: The Financial health of Companies from Hungary

	2007			2008			2009			2010		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	29	19	51	23	13	28	27	20	36	8	8	42
Grey area	44	18	20	34	14	22	41	21	29	25	0	18
Safe zone	2	38	4	1	31	8	5	32	8	33	58	6
Total	75	75	75	58	58	58	73	73	73	66	66	66
	2011			2012			2013			2014		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	20	12	31	26	24	37	25	15	33	25	19	31
Grey area	35	19	18	45	17	28	41	7	24	45	14	29
Safe zone	5	29	11	5	35	11	3	47	12	4	40	14
Total	60	60	60	76	76	76	69	69	69	74	74	74
	2015											
	Z´	Z´´	IN05									
Distress zone	29	21	46									
Grey area	41	14	15									
Safe zone	3	38	12									
Total	73	73	73									

Note: Distress zone: Z´≤1.23, Z´´ ≤1.1, IN05 ≤0.9; Grey zone: 1.23 < Z´ ≤ 2.9, 1.1 < Z´´≤ 2.6, 0.9 < IN05 ≤ 1.6;

Safe zone: Z´>2.9, Z´´>2.6, IN05 >1.6

Table 12: The Financial Health of Companies from Poland

	2007			2008			2009			2010		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	4	5	7	6	8	12	6	8	9	2	2	6
Grey area	15	3	11	17	4	10	18	5	12	7	0	14
Safe zone	3	14	4	7	18	8	8	19	11	23	30	12
Total	22	22	22	30	30	30	32	32	32	32	32	32
	2011			2012			2013			2014		
	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05	Z´	Z´´	IN05
Distress zone	6	5	7	4	8	12	10	4	9	8	7	11
Grey area	15	7	10	24	7	19	18	7	14	21	10	11
Safe zone	13	22	17	8	21	5	9	26	14	12	24	19
Total	34	34	34	36	36	36	37	37	37	41	41	41
	2015											
	Z´	Z´´	IN05									
Distress zone	9	9	12									
Grey area	15	6	12									
Safe zone	9	18	9									
Total	33	33	33									

Note: Distress zone: Z´≤1.23, Z´´ ≤1.1, IN05 ≤0.9; Grey zone: 1.23 < Z´ ≤ 2.9, 1.1 < Z´´≤ 2.6, 0.9 < IN05 ≤ 1.6;

Safe zone: Z´>2.9, Z´´>2.6, IN05 >1.6

Table 13: Descriptive Statistics: The Czech Republic – Sales, Total Revenues, Total Assets and EBIT in CZK Thousands

Year	N	Sales		Total revenues		Total Assets		EBIT	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	37	173172	283353	185541	303379	170069	173370	-9891	163745
2008	37	168648	280168	186991	306556	180171	198595	-11841	19957
2009	38	161756	242567	170890	261985	171578	186037	-424	9384
2010	40	146190	216992	163065	242635	165747	178112	-778	14405
2011	42	162914	256692	187237	292175	167612	189165	1388	15151
2012	37	201810	295496	225288	329443	198592	213236	11337	14248
2013	35	208834	307689	232772	332042	201909	232542	1696	15752
2014	38	190961	297768	209221	320973	189462	222672	8691	14575
2015	27	232825	328768	259890	360668	234154	253959	8514	13639

Table 14: Descriptive Statistics: The Czech Republic –Z´, Z´´ and IN05 in CZK Thousands

Year	N	Z´		Z´´		IN05	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	37	1.21	1.19	0.98	4.36	-1.00	3.86
2008	37	1.05	1.47	0.30	4.97	-5.47	25.54
2009	38	1.54	1.54	1.34	5.00	-0.35	2.81
2010	40	5.06	15.43	15.32	59.38	-1.20	5.93
2011	42	1.50	1.61	1.34	5.59	-5.55	31.42
2012	37	1.89	1.56	2.53	4.86	1.09	1.16
2013	35	1.76	1.03	2.91	3.99	-0.01	15.28
2014	38	1.84	1.06	2.72	3.41	1.08	0.84
2015	27	1.84	1.20	3.08	3.62	1.10	0.83

Table 15: Descriptive Statistics: Slovakia – Sales, Total Revenues, Total Assets and EBIT in EUR Thousands

Year	N	Sales		Total revenues		Total Assets		EBIT	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	28	3643	3258	3773	3505	8 511	9373	-18.04	622.82
2008	28	3 822	3904	4 052	4203	8 355	10133	114.43	788.01
2009	36	2588	3237	2605	3326	6956	9425	25.17	749.23
2010	36	2 757	3645	2 781	3669	6 983	9241	128.03	537.46
2011	34	3 412	4510	3 545	4680	7 484	10756	258.91	697.52
2012	34	3 693	4979	3 930	5586	7 671	11328	457.71	1091.22
2013	32	3 958	5950	4 136	6190	7 804	11453	321.72	1183.47
2014	31	4 173	5510	4 269	5875	8 125	13015	473.52	1150.11
2015	30	3 919	4887	4 066	5208	8 451	1298	215.30	602.30

Table 16: Descriptive Statistics: Slovakia – Z´, Z´´ and IN05 in EUR Thousands

Year	N	Z´		Z´´		IN05	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	28	1.15	1.12	1.51	3.37	0.20	2.25
2008	28	0.97	1.05	1.35	4.53	-0.56	6.04
2009	36	0.72	0.88	0.03	1.45	0.63	3.40
2010	36	3.79	12.43	12.36	47.56	0.05	1.53
2011	34	0.88	0.98	0.88	4.30	0.52	0.74
2012	34	1.09	0.62	1.51	2.46	0.61	1.08
2013	32	0.92	0.73	1.31	4.07	0.09	1.99
2014	31	1.25	0.97	1.31	3.43	0.54	1.37
2015	30	0.96	1.10	0.58	4.39	0.43	1.07

Table 17: Descriptive Statistics: Hungary – Sales, Total Revenues, Total Assets and EBIT in HUF Thousands

Year	N	Sales		Total revenues		Total Assets		EBIT	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	75	1166041	1769348	1494289	2565003	1429693	1616318	-2564	190274
2008	58	1244270	1576736	1504746	1778925	1576121	1546844	42 275	120160
2009	73	1085565	1244875	1295703	1382523	1686529	1572533	68855	96590
2010	66	1157633	1082953	1371 281	1193339	1931 410	1694442	443,73	128096
2011	60	1362 011	1309556	1671 735	1468276	2167 922	1850194	176651	67 411
2012	76	1410 607	1352849	1703 519	1570274	2037 585	1814080	68 578	231864
2013	69	1650 380	1533517	1978 704	1760169	2334 324	1983944	78 543	209645
2014	74	1703 046	1552334	2029 047	1791617	2407 836	2087441	119075	191144
2015	73	1607 535	1545030	1992 830	1792836	2385 638	2062137	24151,	261996

Table 18: Descriptive Statistics: Hungary –Z´, Z´´ and IN05 in HUF Thousands

Year	N	Z´		Z´´		IN05	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	75	1.38	0.75	2.46	2.77	0.59	0.76
2008	58	1.44	0.76	2.47	2.78	0.97	1.09
2009	73	1.49	1.04	0.77	13.09	0.28	6.13
2010	66	2.49	5.41	6.15	21.13	-4.63	42.87
2011	60	1.56	1.04	2.79	2.64	-11.45	96.17
2012	76	1.50	1.02	2.31	3.11	-26.60	228.08
2013	69	1.50	0.77	3.77	3.46	0.74	1.86
2014	74	1.59	0.74	2.76	2.54	1.06	0.80
2015	73	1.42	0.98	2.52	3.65	-0.63	11.50

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Table 19: Descriptive Statistics: Poland – Sales, Total Revenues, Total Assets and EBIT in PLN Thousands

Year	N	Sales		Total revenues		Total Assets		EBIT	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	22	18 511	31513	19 757	34107	30 021	60361	1 804	4982
2008	30	16 687	33020	17 959	35755	24 777	59703	1 430	3820
2009	32	17 342	35720	18 787	40210	24 723	65089	2 971	10364
2010	32	17 002	35865	18 596	41059	25 319	67508	2 373	8159
2011	34	11 707	12381	12 613	12802	13 547	13254	1 400	2141
2012	36	12 678	13994	13 508	14491	13 880	14204	1 669	2509
2013	37	13 388	14830	14 057	15318	14 341	13607	1 324	2212
2014	41	13 621	12297	14 417	12980	13 856	13641	938	2169
2015	33	11 291	11832	12 214	13597	12 830	13027	508	1436

Table 20: Descriptive Statistics: Poland – Z´, Z´´ and IN05 in PLN Thousands

Year	N	Z´		Z´´		IN05	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
2007	22	1.77	0.97	3.25	2.82	0.92	1.07
2008	30	2.68	2.93	3.46	3.01	1.07	2.07
2009	32	2.91	3.35	3.42	2.67	1.66	1.09
2010	32	11.75	28.40	38.21	109.30	1.34	1.30
2011	34	3.24	3.45	4.32	3.03	1.78	1.47
2012	36	2.51	2.14	3.65	2.85	1.59	1.05
2013	37	2.24	1.86	5.02	3.60	1.50	1.44
2014	41	7.45	29.80	4.16	3.62	2.79	7.30
2015	33	3.52	5.79	2.76	3.93	1.38	3.37