THE USE OF THE ALTMAN MODEL IN EVALUATION OF ECONOMIC PERFORMANCE OF A CORPORATION IN THE CRISIS PERIOD IN THE BUILDING SECTOR IN THE CZECH REPUBLIC

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Abstract

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The article is focused on verification of the presumption of poor financial management in companies operating in the building sector. Many authors have written about a financial situation of enterprises in the building sector, especially after the economic crisis in the year 2008, when some of them claim and their results confirm that the main reason of bankruptcy of these companies was not the economic crisis but mainly poor financial management. Our results, which were obtained especially by the method of financial analysis and further by a mathematical and statistical method, support this statement. Within the mathematical and statistical methods, there was return on equity used as an explanatory variable, mainly because all variants of the Altman Z-Score are based on the calculation of ratio indicators, which do not include this type of return. Based on the conducted tests it is possible to state that it is highly desirable for the monitored enterprises in the building industry to reach positive values of return on equity.

Keywords: building industry; bankruptcy; financial situation; Altman model; sales; economic performance

INTRODUCTION

The building industry in the Czech Republic is represented especially by small and middle-sized enterprises, which is also confirmed by the data stated in the publication by authors (Neumaierová 2005, Neumaierová and Neumaier, 2014). The building industry is an important industry in relation to employment; currently it employs almost 450 thousand people, however, the number of employed has decreased in the last 4 years. With decreasing total sales and a number of employees, there is also decreasing direct labour. Natural persons are prevailing in the building industry (Stavebnictví ČR, 2014). From 2008 to 2013 there was gradually decreasing volume of the building production. A share of the building industry in

the gross domestic product has been decreasing. In the year 2008, the building industry created 13.86 % of GDP, in the year 2013 it was 10.23 % (Stavebnictví ČR, 2014). In the period 2008–2012, there survived only enterprises, which chose a suitable method of financial management.

The objective of the article is to verify the presumption of poor financial management in companies operating in the building industry.

The authors Kuběnka, Králová used the Altman Z'-Score model in the building industry (2013), where they assume that the crisis did not have to be the main cause of a poor financial situation of enterprises. They stated three verified hypotheses: the building industry is getting over the crisis; minimally 20% of enterprises in the industry showed symptoms of the crisis; the prediction of bankruptcy in

the building industry was also confirmed. Altman Z'-Score model can be customized for different industries using discriminatory analysis (Lee, 2013).

The article by Jindřich Špička (2013), who conducted the comparison of enterprises close to bankruptcy with enterprises that are in a good financial situation, deals with a financial situation of enterprises in the building industry before bankruptcy. Results of analysis: one of the main reasons of bankruptcy is inappropriate financial management. The processing of this article will be based especially on the findings of this author. Similar assessment is also used in China for stable business development (NG 2011). There are also alternative approaches to assessing risk factors in building performance using fuzzy sets and factor discriminatory analysis (Baloi, 2003; Sueyoshi, 2009).

Performance measurement methods used in the construction sector were also reviewed by Xu *et al.* (2016). They focused on the strengths and weaknesses of each measurement method and compared their differences. The authors summarize the results of individual studies showing that performance measurement in the construction industry can be broken down into project performance measurement, performance measurement from an organization perspective, and measurement of results related to stakeholders requirements. The authors also concluded that the most commonly used assessment methods in the construction sector are being used gap analysis, integrated performance index, statistical methods, and data envelopment analysis method. The performance information generated from the measurement encompasses frameworks and hierarchical indicators, and functions and score.

MATERIALS AND METHODS

Works of E. I. Altman in the area of financial distress prediction models were used for the evaluation of a financial situation.

The Z'-Score model (Altman, 1983, 1968) is an adaptation of the Z-Score model for companies, according to many critics (Grice, 2001), shares of which are not listed on the stock exchange. $Z\text{'-Score} = 0.717\,X_1 + 0.847\,X_2 + 3.107\,X_3 + 0.420\,X_4 + 0.998\,X_5$. The ratio indicators: X_1 – Working Capital/Total Assets, (Working Capital is defined as net working capital); X_2 – Retained Earnings/Total Assets; X_3 – EBIT/Total Assets; X_4 – Book Value Equity/Total Debt; X_5 – Sales/Total Assets. The original Z-Score was changed so that the indicator X_4 contains a book value of equity instead of a market value of equity, in order to derive a discriminant function for private companies in the Z' model but also in the Z'' model (see below). There were also changed weights of individual indicators. The zones: $Z' > 2.90$: Safe Zone, $1.23 < Z' < 2.90$: Grey Zone, $Z' < 1.23$: Distress Zone (Altman 1993, 1995, 2002ab, 2006).

The Z''-Score model was created for non-manufacturing companies (telecommunications, retail, airlines, etc.) and emerging markets. Therefore, this model does not contain the indicator X_5 – Sales/Total Assets stated in the Z'-Score model. The Z''-Score model = $6.56\,X_1 + 3.26\,X_2 + 6.72\,X_3 + 1.05\,X_4$. The ratio indicators: X_1 – Working Capital/Total Assets, (Working Capital is defined as net working capital); X_2 – Retained Earnings/Total Assets; X_3 – EBIT/Total Assets; X_4 – Book Value Equity/Total Debt. The zones: $Z'' > 2.6$: Safe Zone, $1.1 < Z'' < 2.6$: Grey Zone, $Z'' < 1.1$: Distress Zone. This model was used especially for evaluation of financial health outside the USA, in emerging markets (Altman *et al.,* 1995; Altman and Rijken, 2000, 2004).

The model was further extended by the constant of +3.25, which enables a comparison of results of these models with results of the US Bond Rating. The adjusted EMS model is denoted as Z''EM-Score. It is given by the equation: $Z\text{''EM-Score} = 6.56\,X_1 + 3.26\,X_2 + 6.72\,X_3 + 1.05\,X4 + 3.25$. The zones: $Z\text{''EM} > 5.85$: Safe Zone, $4.35 < Z\text{''EM} < 5.85$: Grey Zone, $Z\text{''EM} < 4.35$: Distress Zone.

Given that the most data about bankrupted enterprises in the building industry were available until the year 2012, the analysed period is from the year 2008 to 2012. Accounting data were acquired from the Amadeus database. In some cases,

	Z''EM-Score		Rating		Z''EM-Score		Rating	
		> 8,15	AAA		5,65 – 5,85		BBB–	
	7,60 –	8,15	AA+		5,25 – 5,65		BB+	
	7,30 –	7,60	AA		4,95 – 5,25		BB	Gray
	7,00 –	7,30	AA–		4,75 – 4,95		BB–	Zone
Safe	6,85 –	7,00	A+		4,50 – 4,75		B+	
Zone	6,65 –	6,85	A		4,15 – 4,50		B	
	6,40 –	6,65	A–		3,75 – 4,15		B–	
	6,25 –	6,40	BBB+		3,20 – 3,75		CCC+	Distress
	5,85 –	6,25	BBB		2,50 – 3,20		CCC	Zone
					1,75 – 2,50		CCC–	
						< 1,75	D	

1: *Z''EM-Score and US Bond Rating ekvivalent.*
Source: Altman, Hartzell and Peck, 1995.

there were added information from the Commercial register. There were created two statistical sets for the analysis of enterprises, the sections CZ-NACE 41 Construction of building and CZ-NACE 42 Civil Engineering were chosen. In the first case there were included 15 active enterprises, in the second case 15 enterprises in bankruptcy or liquidation (with regards to the availability of data there were analysed only 13 bankrupted enterprises).

Enterprises located in the Czech Republic were in both analysed groups chosen based on common features: middle-sized, limited liabilities companies according to the specification of the Amadeus database, with a sales turnover over 1 million, the filter up to 5 million EUR was used with the condition that chosen companies reached this turnover at least once in the monitored period; the total assets from 10 thousand EUR to 5 million EUR, which a company reached at least once in the monitored period; a number of employees 15 and more. There were used ratio indicators of liquidity, activity, profitability and debt. Input data for the calculation of individual indicators were always calculated for a whole analysed group.

In the first case, there was used the Altman model for prediction of the future financial development, thus Z'-Score (Altman, 1983).

Further, there was also used a model Z"EM-Score. Results of the model were used especially for identification of significant influences, which had the highest impact on a resulting value of this model.

The authors stated two research questions:

Was the objective of companies to reach mainly positive values of return on equity (calculated as EBIT/Equity)? How the ROE indicator developed?

Which factors from the stated Altman models had a decisive influence on bankruptcy?

A statistical analysis of defined groups of sets (see below) was conducted if poor financial management is one of the main causes of economic decline of corporations operating in the building industry, without the influence of the financial crisis, which started in the year 2008, on these results. In accounting data, there were determined two explained variables with the use of Z'-Score, specifically:

● Z'-Average_bankrup – averages of Altman Z'-Score in individual bankrupted enterprises,
● Z'-Average_active – averages of Altman Z'-Score in individual active enterprises;

and explanatory variables with the use of Z"EM-Score, which are similar to the previous case.

As explanatory variables, there were determined return on equity ROE in the whole industry in the years 2008 – 2012 using the benchmarking diagnostic system INFA of the Ministry of Industry and Trade, and average values of ROE of active and bankrupted enterprises. The calculations of average values were carried out in Excel. The reason for selection of return on investment as an explanatory variable was, that all variants of the Altman Z-Score

are based on the calculation of ratio indicators that do not include return on equity ROE. Return on Equity (ROE) has reporting capabilities for owners and stakeholders and, unlike ROA, takes into account the structure of liabilities. (Neumaier and Neumaierová, 2005) In spite of all the shortcomings, ROE is widely used in practice. Based on systematic work with reports, it is a simple concept for identifying problem areas of the business and their subsequent correction. (Parrino and Kidwell, 2009) The following explanatory variables are results:

● ROE_ind – return on equity in the entire industry,
● ROE_bank – return on equity of bankrupted enterprises,
● ROE_active – return on equity of active enterprises.

Based on the specified explained and explanatory variables, there were analysed two functional relationships, for which there are stated expected signs of applications of economic verification. The authors assume that with increasing return on equity ROE by one unit there will be increase of the Altman Z'-Score and Z"EM-Score, what will confirm a positive correlation between both variables. Individual functional relationships are as follows and they are used for both variants:

● Z'-Average_bankrup = f (ROE_ind, ROE_bank), where f (+ ROE_ind, + ROE_bank),
● Z'-Average_active = f (ROE_ind, ROE_active), where f (+ ROE_ind, + ROE_active).

For all explanatory variables (ROE_ind, ROE_bank, ROE_active) there are expected positive influences. The assumption is a positive value, because we expect direct economic verification in both cases of the Altman Z'-Score and Z"EM-Score depending on ROE. With an increase in ROE by one unit we expect the + sign, because there will be an increase of both variables of the Z-Score with the confirmation of positive correlation.

RESULTS AND DISCUSSION

Analysis of active companies

Sales in the active companies had been increasing. A slight break occurred only in the year 2011, when sales decreased by approximately 12 % in comparison to the year 2010. Nearly identical development was noted in total assets. Average values of return on assets and return on equity gradually decreased in individual years. Thus, it can be inferred that in the active companies the objective of entrepreneurship was not an increase of return on equity but still this value moved in positive numbers. This trend in the analysed sample almost copied the overall development in the building industry in the Czech Republic in the years 2008–2012 in both types of returns. From the perspective of liquidity, average values of all types of liquidities moved within recommended intervals, or more precisely in some years even above them. This fact might mean inefficient use of current assets and unnecessary detention of cash

but also precaution of individual enterprises in the context of creation of financial cushion. This statement can be also substantiated by resulting values of debt, which were moved in the interval of 50% to 60%. A majority of the analysed enterprises showed a relatively low level of long-term bank loans; total debts were created mainly by short-term liabilities. It can be assumed that the main motive of gradual decrease of debt and retention of money was security related to accidental, or more precisely unexpected, expenses. Režňáková *et al.* (2010) confirm validity of the rule: "the less predictable cash flow, the higher security balance of financial resources is necessary to be kept". If we compare resulting values of accounts receivable turnover time and accounts payable turnover time (for calculation of accounts payable and receivable turnover times there were used only short-term trade accounts payable and short-term trade receivables from a balance sheet), it is clear that the analysed set of 15 enterprises had no problem with payment of liabilities and no significant problem with collection of receivables, because it payed all accounts payable before collecting receivables.

According to Civil Code, it is obligatory to pay accounts payable in 30 days. Although the active companies did not have a fundamental problem with payment or collection of financial resources, this term was not kept in any case. Accounts payable turnover in the analysed years were moved in the interval of 55 to 70 day, in case of accounts receivable turnover, the interval was 60 to 75 days. The difference between accounts receivables and accounts payable turnover in the analysed set of enterprises were moved in the interval of 10–25 days (except for the year 2011), which means that an enterprise was required to pay this period from different own or foreign resources, what was connected with additional costs for financial resources, which was not positive for enterprises.

Analysis of bankrupted companies

Sales of the bankrupted companies had increasing character during the whole monitored period (2008–2012). Nevertheless, sales were significantly lower than those in the active companies. A state of total assets faltered only in the year 2011, when there was a decrease by 25% (this variation was caused especially by a decrease in current assets). It is obvious from the development of values of individual types of return of the bankrupted enterprises, that profitability of the analysed companies was gradually decreasing. Average values of the indicator ROA as well as the indicator ROE were decreasing from the year 2008, and from the year 2010 until the year 2012 they were reaching negative values, or more precisely from the year 2010 it was not possible to evaluate ROE because in these years EBIT as well as equity were negative. Thus, it is possible to deduce from the set of bankrupted companies, that the objective of entrepreneurship was not and increase and

maintenance of a positive value of the ROE indicator. Values of current and quick liquidity almost moved at the same level, which shows the fact, that the examined companies did not keep any financial resources in stocks. The reason could be the lack of financial resources, which is also shown by average values of quick liquidity, which did not reach recommended values in the interval of 0.2–0.5 in any of the analysed years (quick liquidity moved in the interval of 0.1–0.2, when, at the same time, the value of 0.2 was reached only in the year 2009). Indebtedness of the bankrupted companies was developing unfavourably since 2008. In the year 2008, the average of total indebtedness was 96%, in the year 2012 125.4%, which means that foreign capital was higher than total assets of a company. From the year 2010 companies reported loss and thus also a negative profitability. Values of activity–accounts payable and accounts receivable turnovers clearly describe a poor financial situation.

Although accounts payable turnover was gradually decreasing, the development cannot be considered as positive. It was also influenced by the development of sales of the set of analysed bankrupted companies. Although sales were increasing, they were insufficient in comparison to the necessity of financial resources. Sales in the year 2008 were by 27% lower than total liabilities (trade liabilities). According to the development of assets, companies probably tried to develop their business, nevertheless, this effort did not have a positive contribution in the form of additional sales from the operational, i.e. main activity of entrepreneurship. Accounts receivable turnover compared to accounts payable turnover seemed to be at a good level because it was lower, which means that customers had relatively good payment behaviour and the trade deficit was negative. Nevertheless, this deficit was very high and it caused long-term insolvency. The long-term insolvency causes distrust of suppliers and it might propose insolvency proceedings from the side of a supplier.

Altman model – Z'-Score

In Tab. I there are shown resulting values for active and bankrupted enterprises in the years 2008–2012.

The resulting values of active enterprises belong to the so-called "Grey zone" in the years 2009 and 2010 with the value of Z'-Score slightly below 2.99. The years 2008, 2011 and 2012 can be interpreted as a period, when active enterprises prospered. It is also possible to consider the economic crisis lasting from the year 2008, which, however, was not liquidating for these enterprises.

In the bankrupted companies, the Altman Z'-Score value moves in the zone of bankrupting enterprises during the whole period, when values have a decreasing tendency, which represents serious existential problems leading to bankruptcy. In 4 bankrupted enterprises of the analysed sample values of the Z'-Score were very positive, nevertheless 3 of them are in insolvency proceeding

I: *Development of the Altman Z'-Score in the years 2008–2012*

Z'-Score	2008	2009	2010	2011	2012
Z'-Active companies	3.441332	2.865023	2.960908	3.151838	3.042422
Z'-Bankruptcy companies	1.975183	1.930441	1.490247	1.390629	0.150136

Source: Authors' calculations
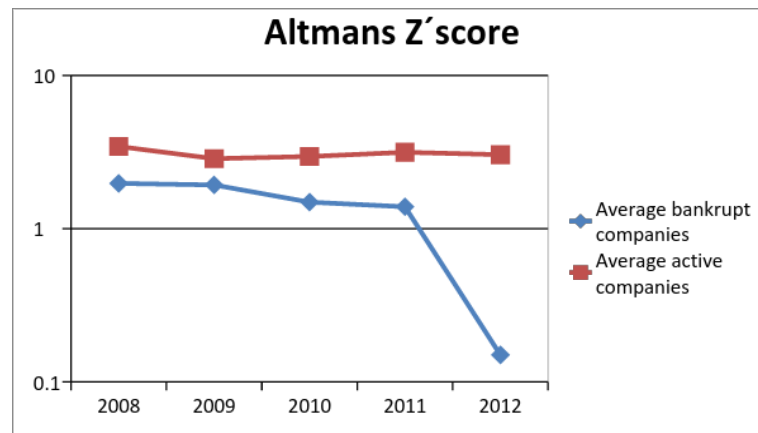
2: *Graphical representation of development of the Altman Z'-Score in the years 2008 - 2012*
Source: Authors' calculations

requested either by a creditor or a debtor and one of the enterprises is in bankruptcy. Thus, it is probably not appropriate to talk only about the impact of the crisis, because values of the Altman Z'-Score were in the bankruptcy interval since the beginning of the monitored period. It can only be concluded, that the crisis, maybe thanks to the domino effect, which is also mentioned in the article by Špička (2013) and Erkens (2012), only "supported" the critical financial situation of the bankrupted enterprises. In case of bankrupted enterprises we cannot forget the fact of gradually increasing sales, which could show poor financial management, or more precisely poor management of payment ability. The following Fig. 2 shows the development of Z'-Score for both groups of enterprises in the monitored years.

A decline is obvious in the semilogarithmic Fig. 4 since the year 2008. The active enterprises oscillate around the value 3, when changes in the individual years are not very significant and they are in the zone of prospering companies. On the other hand, the bankrupted companies had an increasing tendency in 2008, although since the year 2009 there occurred a sharp decline of values of the Z'-Score towards the bankruptcy zone, especially in the year 2011 and 2012. It can be deduced from reports based on statistics of the Czech Statistical Office and the Association of Entrepreneurs in the Building Industry in the Czech Republic, that the year

2010 was the worst year for the building industry, however, the year 2009 was the milestone years, when a decline occurred after 10 years of increasing, especially in the area of building construction by 7 percent (The building industry is in a decline for the third year, 2012).

The Altman model Z"EM-Score

The following Tab. II states the resulting values for individual active and bankrupted enterprises in the years 2008–2012.

The resulting value of the active enterprises can be included in the so-called safe zone with excellent rating. The monitored years had the AA+ rating, which is considered as the second highest. In the year 2012 there was even reached the best rating AAA. The monitored years 2008–2012 in case of the active enterprises can be, according to the Z"EM-Score, interpreted as the period, when the active enterprises prospered and the economic crisis did not affect them. The opposite is true for the bankrupted companies. The Altman Z"EM-Score value moved during the whole time in the zone of bankrupting enterprises, i.e. in the so-called distress zone, when measured values showed a decreasing tendency, which represents serious existential problems leading to bankruptcy. The rating in the years 2008–2010 was CCC and in the years 2011 and 2012 even D.

II: Development of the Altman Z"EM-Score in the years 2008–2012

Z"EM-Score	2008	2009	2010	2011	2012
Z"EM-Active companies	7.894847	7.501424	7.672018	8.018021	8.759039
Z'-Bankruptcy companies	2.830306	3.213623	2.595058	0.432044	0.399254

Source: Authors' calculations
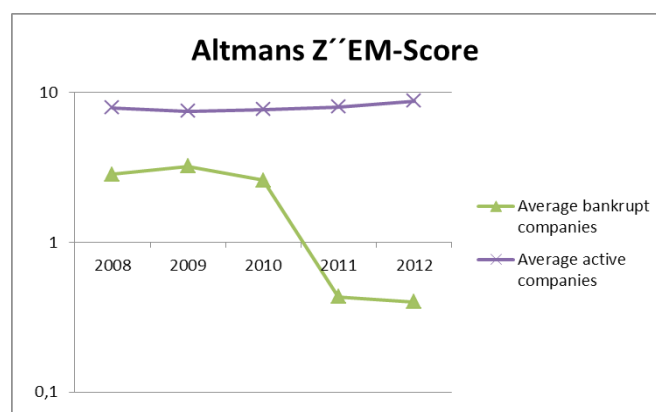
3: *Graphical representation of development of the Altman Z"EM-Score in the years 2008 - 2012*
Source: Authors' calculations

Thus, similarly as in case of the Z'-Score, we cannot talk only about the impact of the crisis, because the values of the Altman Z"EM-Score pointed out bankruptcy already at the beginning of the analysed period. Therefore, we can deduct, similarly as in the previous model, that the crisis perhaps only "supported" the critical financial situation of unsuccessful enterprises.

A slight decline in the growth rate of the active enterprises is obvious in the semilogarithmic graph no. 2 already since the year 2008. The active companies oscillated around the value 8, when changes in the growth rate in individual years are not very significant and therefore they belong to the safe zone. On the other hand, the bankrupted companies had in 2008 still an increasing tendency of the growth rate, nevertheless, since the year 2009 there occurs a sharp decline of the Z"EM-Score values in the years 2011 and 2012.

Statistical modelling with the use of Z'-Score

The following Tab. III shows data of explained and explanatory variables. They are average Altman Z'-Score values of the active and bankrupted enterprises, in the form of explained variables and furthermore indicators of return on equity (obtained according to the methodology INFA) within the industry and average ROE of bankrupted and active enterprises.

In case of the explained variables Average bankrup companies, a decreasing trend of the Altman Z'-Score can be seen in Tab. 1. Its average value in the time series from the year 2008 to 2011

corresponds with the so-called grey zone. However, in the year 2012 there arise significant financial problems leading to bankruptcy of the monitored companies.

On the other hand, the second explained variable Average active companies' shows an increasing trend in the individual years, except for the year 2008, when there occurred a decline of the Altman Z'-Score from an excellent financial situation to the edge of the grey zone. The indicator is at a good level in individual years. The development of the explained variables of the Altman Z'-Score in active and bankrupted enterprises is recorded in Fig. 2 (see above) by a semilogarithmic graph.

In Tab. III we can also see the development of return on equity in the bankrupted enterprises, which has a very sharp declining character intervening into negative values. The decreasing trend is also detected in ROE of the active enterprises with a break in the year 2010, when there was a very slight growth by 1.2% and subsequently a decline again. Fig. 4 clearly shows the growth rate of explanatory variables of the ROE indicator.

A declining growth rate of return on equity ROE is obvious in Fig. 6 in all monitored years. The sharpest decline in the growth rate of ROE occurred in the years 2011–2012 in the active companies, on contrary, in the bankrupted companies the sharp decline occurred already in the year 2010.

The bankruptcy model A verifies the dependence of the explained variable Average_bankrup on the individual explanatory variables ROE_bankrup and ROE_ind. Based on the sequential elimination

III: Overview of explanatory and explained variables within the regression modelling

	Average bankrup	Average active	ROE industry	ROE bankrup	ROE active
2008	1.9751	3.4413	19.39	18.1	29.4
2009	1.9304	2.8650	11.84	15.9	25
2010	1.4902	2.9609	9.2	13.9	14.3
2011	1.3906	3.1518	6.76	−0.4	15.5
2012	0.1501	3.0424	6.52	−11.9	6.4

Source: Authors' calculations
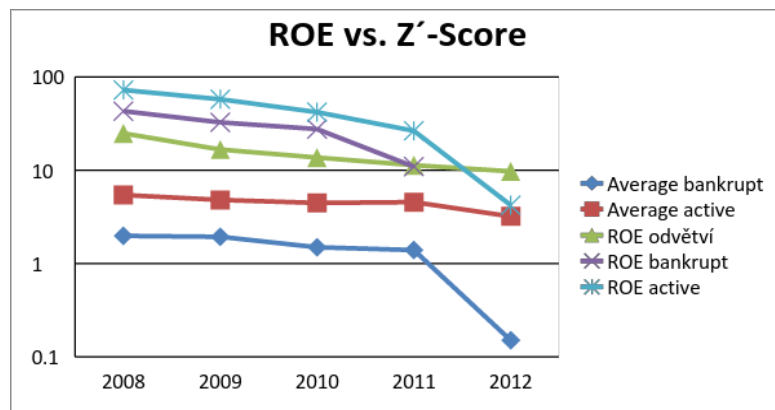
4: *Development of return on equity of solvent and bankrupted enterprises*
Source: Authors' calculations

there was excluded the variable ROE_ind in order to assure higher quality of the model. The following Tab. IV shows the calculated values of the resulting bankruptcy model A.

In case the bankruptcy situation would not be caused by poor financial management represented by return on equity of these bankrupted companies (ROE_bankrup), the average value of the Altman Z-Score would be 0.559374. This situation based on the interval division of the Altman Z'-Score means that an enterprise is in a very bad financial situation even without the impact of the variable ROE_bankrup representing poor financial management. Based on the found statistics it can be stated that there exist further influences impacting a value of the Altman Z'-Score and thus a financial side of an enterprise. If there was an increase of ROE-bankrup by one unit, this situation would have an influence on the bankrupting companies in the value of –0.0131313. Thus there would be a decline of the Altman Z'-Score to a lower value, what is from the perspective of financial health definitely an adverse state. Therefore, it can be stated that in case of bankrupted enterprises there is no direct correlation of the Altman Z'-Score with ROE_bankrup, because with an increase in ROE_bankrup there is a decrease of

a value of the Altmanova Z'-Score. The adjusted coefficient of determination is in the value of 23.24%, thus the model set up in this was explains the value only by 23%. The following XY graph 4 shows the relationship between the variables Average_bankrup and ROE_bankrup, which is shown with the linear functional relationship (the straight line).

Based on the testing of classic assumptions for the regression model it was found that almost no assumption was fulfilled and thus the model is not correctly explained and it does not work.

The bankruptcy model B verifies the dependence of the explained variable Average_active on the explanatory variables ROE_active and ROE_ind. Based on the sequential elimination there was excluded the variable ROE_ind in order to assure higher quality of the model. The following Tab. V shows the calculated values of the adjusted credit model B.

Based on the sequential elimination, there was determined the resulting model with one explanatory variable ROE_active, because it best explains, as a standalone variable, the Altman Z'-Score of the active enterprises. The adjusted coefficient of determination in the value of 94.43%, i.e. ROE_active explains exactly 94.43% of variability

IV: Impact of ROE on the Altman Z'-Score Average_bankrup

	Coefficient	Std. Error	t-ratio	p-value	
Const	0.559374	0.119477	4.682	0.0184	***
ROE_bankrup	−0.0131313	0.00883008	−1.487	0.2337	
Mean dependent var	0.465880		Standard deviation of dependent variable		0.259311
Sum squared resid	0.154832		Standard. error of regression		0.227180
R-squared	0.424349		Adjusted R-squared		0.232465
F(1, 14)	2.211492		P-value(F)		0.233701
Log-likelihood	1.592433		Akaike criterion		0.815133
Schwarz criterion	0.034009		Hannan-Quinn		−1.281327
Coef. autocorrelation	−0.316328		Durbin-Watson		2.410859

Source: Authors' calculations

Averagebankruptcompanies versus ROEbankrupt (with least squares fit)
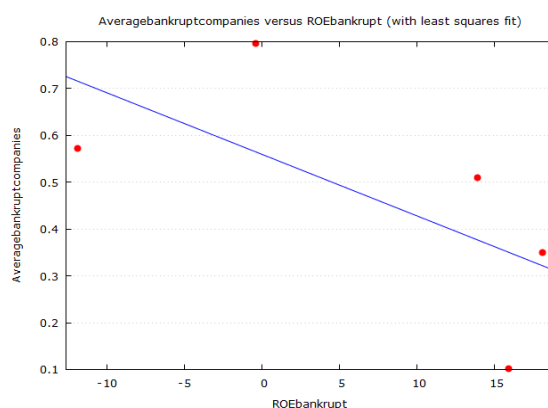
5: *XY diagram of the relationship between the variables Average_bankrupt and ROE_bankrupt*
Source: Authors' calculations

of Altman Z'-Score. Based on this data it is obvious that economic success of active companies is very closely related to return on equity, but there may be represented also other variables, which are a part of financial management. Therefore, the variable ROE_ind was eliminated because of quality of the model.

The following information can be read from the built model. In case the active situation of enterprises was not caused by average return on equity (ROE_active), the average value of the Altman Z'-Score would be 2.33414. This situation based on the interval division of the Altman Z'-Score means that an enterprise is on the edge of the grey zone and it is very close to an excellent financial situation (> 2.99) even without an influence of the independent variable ROE_active. If there was an increase in ROE_active by one unit, this situation would have an impact on the growth of the Altman Z'-Score in the value of 0.0222830. Therefore, it can be stated that in case of the active enterprises there exists the direct correlation of the Altman Z'-Score with ROE-active, because with an increasing explanatory value of ROE_active there is an increase in a value of the Altman Z'-Score. The assumption was the improvement of a financial situation and at the same time anticipation of a plus sign.

However, it is necessary to point out at the fact, that the explanatory variable ROE_active is significant at the 5% level of significance. The conclusion was deducted from this information, that success of the active companies can be seen in return on equity that represents proper financial management, nevertheless, there exist other facts influencing a resulting value of the Altman Z'-Score.

The following XY graph 5 shows the relationship between the variables Average_active and ROE_activ, which is shown with the linear functional relationship (the straight line). Very high explanation of the model is obvious from Fig. 8, which creates entire 94%.

## Statistical modelling with the use of Z''EM-Score

The following Tab. VI shows data of explained and explanatory variables. They include average of the Altman Z''EM-Score of the active and bankrupted enterprises in the form of explained variables and furthermore, the indicator of return on equity (obtained according to the methodology INFA) within the industry and the average ROE of the bankrupted and active enterprises.

In case of the explained variable *Average bankrupt companies*, a sharply decreasing trend of the Altman

V: Impact of ROE on Altman Z'-Score Average_active

	Coefficient	Std. Error	t-ratio	p-value	
Const	2.33414	0.0533451	43.76	2.63e-05	***
ROE_bankrup	0.0222830	0.00268404	8.302	0.0037	***
Mean dependent var	2.737906		Standard deviation of dependent variable		0.207812
Sum squared resid	0.007205		Standard. error of regression		0.049008
R-squared	0.958289		Adjusted R-squared		0.944385
F(1, 14)	68.92358		P-value(F)		0.003662
Log-likelihood	9.261262		Akaike criterion		–14.52252
Schwarz criterion	–15.30365		Hannan-Quinn		–16.61898
Coef. autocorrelation	–0.529740		Durbin-Watson		2.667440

Source: Authors' calculations
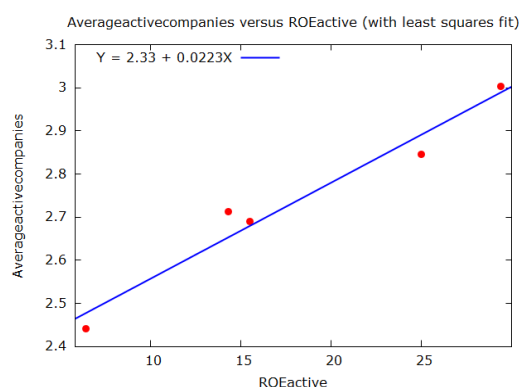
6: *Fig. 6: XY diagram of the relationship between the variables Average_active and ROE_ind*
Source: Authors' calculations

VI: Overview of explanatory and explained variables within the regression modelling

|	Average bankrup	Average active	ROE industry	ROE bankrup	ROE active
2008	2.830306	7.894847	19.39	18.1	29.4
2009	3.213623	7.501424	11.84	15.9	25
2010	2.595058	7.672018	9.2	13.9	14.3
2011	0.432044	8.018021	6.76	−0.4	15.5
2012	0.399254	8.759039	6.52	−11.9	6.4

Source: Authors' calculations

Z"EM-Score can be seen in Tab. VI, except for the year 2009 when there was a slight increase. Its average value in the time series from the year 2008 to 2011 corresponds with the so-called distress zone in the rating. Nevertheless, the year 2012 brought significant financial problems leading to bankruptcy of the monitored companies.

The second explained variable *Average active companies* shows an increasing trend in individual years, except for the year 2009 when there occurred a decrease of Altman Z"EM-Score to lower rating AA+. The indicator is at a very good level in individual years and during the whole time of its development it is included in the so-called safe zone. The development of explained variables of the Altman Z'-Score of the active and bankrupted enterprises is shown in Fig. 3 (see above) by a semilogarithmic graph.

Table 6 also shows the development of return on equity of the bankrupted enterprises, which has a very sharp decreasing character approaching zero. The decreasing trend is also detected in ROE of the active enterprises. Fig. 7 clearly shows the development of the growth rate of explanatory variables of the ROE indicator. The decreasing growth rate of return on equity ROE is obvious in all monitored years. The sharpest decline in the growth rate of ROE occurred in the year 2011–2012 in case of the active companies, on contrary, in case of the bankrupted companies the sharp decline occurred already in the year 2010.
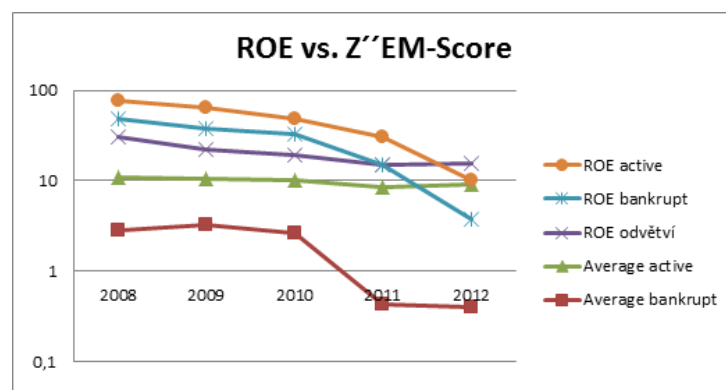
7: *Development of return on equity of solvent and bankrupted enterprises*
Source: Authors' calculations

The bankruptcy model A verifies the dependence of the explained variable Average_bankrup on the individual variables ROE_bankrup and ROE_ind. Based on the sequence elimination there was excluded the variable ROE_ind in order to achieve higher quality of the model. The following Tab. 7 shows the calculated values of the resulting bankruptcy model A.

In case the bankruptcy situation would not be caused by poor financial management represented by return on equity of these bankrupted companies (ROE_bankrup), the average value of the Altman Z"EM-Score would be 1.18366. This situation based on the rating Z"EM-Score means, that an enterprise is in a very bad financial situation with D rating even without the influence of the independent variable ROE_bankrup representing poor financial management. Based on the found statistics we can state that there are also other significant influences impacting a value of the Z"EM-Score indicator and thus also a financial side of an enterprise. If there was an increase of ROE_bankrup by one unit, this situation would have an influence on the bankrupting companies in the value of 0.0997753. There would be an increase of the Z"EM-Score

indicator to a higher value. Nevertheless, this fact would not influence the overall result of rating because the monitored companies would still be in the critical zone. Therefore, it may be stated that in case of the bankrupting companies there exist the direct correlation of the Altman Z"EM-Score with ROE_bankrup, because with an increase in ROE_bankrup there is an increase of the Z"EM-Score. The adjusted coefficient of determination has the value of 84.11%, i.e. the model set up in this way explains the value by 84%. The following XY graph shows the relationship between the variables Average_bankrupt and ROE_bankrupt, and there is shown the linear functional relationship (the straight line).

The bankruptcy model B verifies the dependence of the variable Average_active on the individual variables ROE_active, ROE_ind and ROE_bancrupt. Based on the sequence elimination there was not excluded any variable in order to maintain quality of the model. The following Tab. VIII shows the calculated values of the adjusted credit model B.

The use of the explanatory variable ROE_bankrup was kept by the authors due to competition in the industry. The importance of this variable proves the assumption that ROE of competing

VII: Impact of ROE on the Altman Z"EM-Score Average_bankrup

	Coefficient	Std. Error	t-ratio	p-value	
Const	1.18366	0.286703	4.129	0,0258	**
ROE_bankrup	0.0997753	4.709	4.709	0,0181	**
Mean dependent var	1.894057		Standard deviation of dependent variable		1.367583
Sum squared resid	0.891568		Standard. error of regression		0.545151
R-squared	0.880825		Adjusted R-squared		0.841099
F(1, 14)	22.17297		P-value(F)		0.018129
Log-likelihood	−2.784164		Akaike criterion		9.568328
Schwarz criterion	8.787204		Hannan-Quinn		7.471868
Coef. autocorrelation	−0.499146		Durbin-Watson		2.605961

Source: Authors' calculations

Average_bankrup versus ROE_bankrupt (pomocí nejmenších čtverců)

Y = 1,18 + 0,0998X
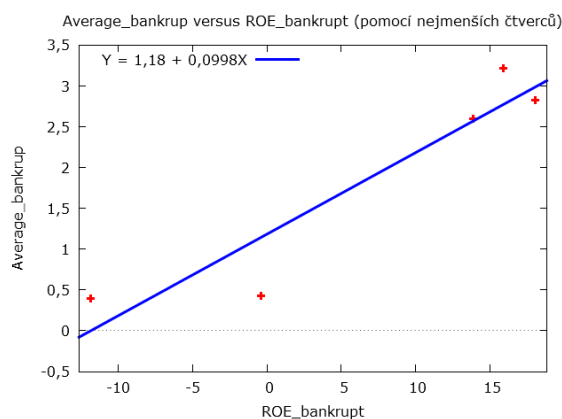
8: *XY diagram of the relationship between Average_bankrupt and ROE_bankrupt*
Source: Authors' calculations

companies influences efficiency of the monitored successful enterprises. The adjusted coefficient of determination is in the value of 99.91%, i.e. the model explains exactly 99.91% of variability of the Altman Z"EM-Score. Based on this data it is obvious that economic success of the active companies is very closely related to return on equity, but there can also be other variables, which are a part of financial management. Therefore, the variable ROE_bankrup was kept in order to keep quality of the model. Thus, the model proves that the development of performance of competing companies influences rating of the monitored creditworthy enterprises.

The following information can be seen in the created model. In case the creditworthy situation of enterprises was not caused by ROE_active, ROE_bankrupt and ROE_ind, the average value of the Altman Z"EM-Score would be 7.91029. This situation based on the rating evaluation of Z"EM-Score means that an enterprise is in a very good financial situation with AA+ rating even without the influence of independent variables, representing the influence of financial management.

According to the found statistics we can state that there exist also other important influences impacting a value of the Z"EM-Score indicator and thus a financial situation of an enterprise. If there was an increase of ROE_bankrup by one unit in the bankrupted companies, this situation would influence the creditworthy companies by the value of –0.0413525. Therefore, this situation leads to a decrease of the Z"EM-Score indicator to a lower value, because competing companies are better off and the creditworthy companies are worse off. Nevertheless, this fact does not influence the overall result of rating because the monitored companies will still be in the safe zone. Therefore, we can state that in case of the creditworthy companies there exists an indirect correlation of the Altman Z"EM-Score with ROE_bankrup, because with an increase in ROE_bankrup of the bankrupted companies there is a decrease of the Z"EM-Score of the creditworthy companies. An increase of ROE_active by one unit would have influence on the creditworthy companies by the value of –0.0298247. Thus, this situation leads to a decrease of the Z"EM-Score indicator to a lower value, what

VIII: Impact of ROE on the Altman Z"EM-Score Average_active

	Coefficient	Std. Error	t-ratio	p-value	
Const	7.91029	0.0225674	350.5	0,0018	***
ROE_active	–0.0298247	0.00214148	–13.93	0,0456	**
ROE_ind	0.0831909	0.00291180	28.57	0,0223	**
ROE_bankrup	–0.0413525	0.00107392	–38.51	0,0165	**
Mean dependent var	7.969070		Standard deviation of dependent variable		0.484481
Sum squared resid	0.000207		Standard. error of regression		0.014392
R-squared	0.999779		Adjusted R-squared		0.999118
F(1, 14)	1510.589		P-value(F)		0.018911
Log-likelihood	18.13427		Akaike criterion		–28.26853
Schwarz criterion	–29.83078		Hannan-Quinn		–32.46145
Coef. autocorrelation	–0.420823		Durbin-Watson		2.558617

Source: Authors' calculations
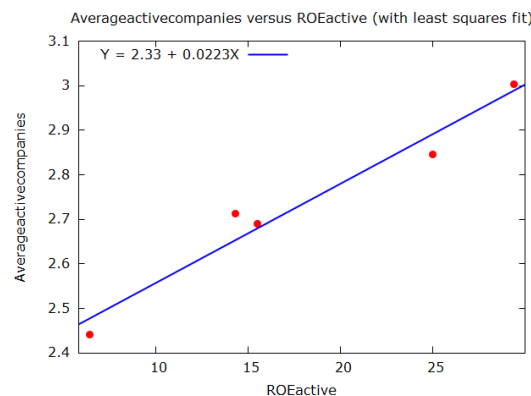
9: *XY diagram of the relationship between the variables Average_active and ROE_ind*
Source: Authors' calculations

corresponds with an adverse state of the indicator. The initial assumption about a positive dependence was not fulfilled. Considering excellent rating, it is not necessary to increase ROE, but to focus on the creation of a company value. If there is an increase of average ROE_ind by one unit, this situation will have an effect on the creditworthy companies by the value of 0.0831909. The resulting state would lead to an increase of the rating indicator Z"EM-Score to a higher value. However, the resulting state would not be influenced directly, because even after the change the creditworthy companies would be in the safe zone.

Fig. 9 shows the relationship between the variables Average_active and ROE_activ, which is interspersed by the linear functional relationship (the straight line).

A very high explanation of the model is obvious from Fig. 9, which makes entire 94%.

CONCLUSION

In case of modelling by the Z'-Score and Z"EM-Score in the bankrupted companies, there was, based on statistical testing, fulfilled the assumption about poor financial management of corporations in the building industry, which is in compliance with Špička (2013), which is also supported by the realized financial analysis. Average return on equity of the monitored enterprises had a significant influence on the resulting Altman Z'-Score and Z"EM-Score, because according to statistical modelling it explained ROE_bancrup by 82% of its overall variability in the Z'-Score and complete 99% of variability in the Z"EM-Score model. Poor financial management was represented by return on equity, because even in case of compliance with statistical principles between both variables there does not occur a hidden collinearity. None of the variables is a linear combination of another one. Therefore, within the bankruptcy modelling, the output is confirmation of the assumption about poor financial management of the monitored enterprises.

In case of the active companies, the observed assumption about poor financial management is disproved in both, the Z'-Score model as well as Z"EM-Score. Return on equity of the monitored active enterprises represented a significant variable, which represents a critical element of successful business and avoidance of bankruptcy. In the Z"EM-Score model there was intentionally left a significant explanatory variable ROE_bancrup, which specifically represents a competitive element in the industry and therefore it influences the overall rating. Based on the sequential elimination, it was decided to keep return on equity, which also significantly explained variability of the Z"EM-Score. Within modelling, there were used data from own calculation of the Z'-Score and Z"EM-Score per the set as a whole and at the same time there was carried out the comparison of results in calculations of the Z'-Score and Z"EM-Score per individual enterprises. The outputs of the comparison are almost identical results within the conducted modelling.

The answer for the first research questions, if the objective of entrepreneurship was to reach especially positive values of equity, is the fact that the active enterprises reported positive ROE with a decreasing rate of growth.

The bankrupted enterprises reported the same tendency, however, in absolute values they moved in negative results with a repeatedly decreasing trend. Therefore, it can be summarized that in the active companies there was confirmed the assumption about reaching of positive values of ROE. On contrary, in the bankrupted enterprises this assumption was not fulfilled.

Decisive factors, which had the greatest impact on bankruptcy of monitored companies are the ratio of net working capital and earnings before interest and taxation and furthermore, the share of sales on total assets. These factors most significantly influence the resulting value of the Z'-Score and Z"EM-Score and they signalized the occurrence of a problem.

In conclusion, after conducted tests we can state that for the monitored enterprises in the building industry it is very desirable to reach positive values of return on equity, because it significantly influences rating and it is an inseparable part of sound financial management.

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