THE THEORETICAL BASIS FOR PREDICTING BANKRUPTCY USING THE ALTMAN BANKRUPTCY MODEL IN THE CONDITIONS OF THE SLOVAK REPUBLIC

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ABSTRACT
In today's world of deepening globalization, especially in business, it is very important to be able to analyse the financial situation and to be more or less likely to be able to predict possible bankruptcy. Bankruptcy models are systems of financial indicators and can be seen as a tool for more advanced financial analysis, which is nowadays a necessary part of every competitive and prosperous enterprise. The paper is aimed at summarizing knowledge about bankruptcy prediction through Altman's bankruptcy models in conditions of the Slovak Republic. In our contribution, we focused on knowledge summarization of Altman´s model, in detail to calculation of individual approaches and especially the possibility of using this model in the conditions of the Slovak Republic.

KEYWORDS: *Financial analysis, Altman bankruptcy model, bankruptcy*.

1. INTRODUCTION

Bankruptcy models generally serve as indicators that can indicate the company's financial health and the probability of bankruptcy. These models are based on real data from companies that have already failed. Using accurately defined calculation methods, the firm finds itself prospering or prone to bankruptcy. Altman's model was published in 1968 by Professor of Finance at New York University Stern School of Business Edward Altman. The original model was based on the model of TWO groups of companies. Each group included 33 companies; the bankruptcy group included companies that were included in the so-called "bankruptcy petitions". The second, non-bankruptcy group consist of existing companies with assets ranging between one and twenty-five million US dollars. After selecting these groups, appropriate ratios have been searched to best reflect the situation in the company and then determine whether the company is heading for bankruptcy or prospering (Adamko et al., 2015; Altman, 2002). In 1968, the Altman's Z Score model was created, which is intended joint stock company traded at the capital markets. Further development was in the following years, when the model was modified and updated for companies that are not tradable on the capital markets. This model was called the ZETA model. Another modified variant was created for non-production companies, Z" Score. There is also a variant of the Altman model for Czech companies, the authors of this modification are Ivan and Inka Neumaier (Hasprova, 2002; Kristofik et al., 2019; Pawliczek and Zimmermannova, 2018).

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2. MODEL AND RESULTS

2.1 Z Score

Altman states that this variant of analysis can predict bankruptcy at 94% a year in advance. Two years in advance, the probability of a correct estimate is now down to 72%. For this reason, it would be very good to track the index over time (Altman, 2002). Algorithm for Z Score calculation is as follows:

$$Z=1,2 \cdot X1 + 1,4 \cdot X2 + 3,3 \cdot X3 + 0,6 \cdot X4 + 0,999 \cdot X5 \quad (1)$$

Table 1. Variable Altman's Z Score Model

X1	Net working capital / Assets
X2	Undistributed profit / Assets
X3	EBIT / Assets
X4	Market value of equity / The book value of the debt
X5	Sales / Assets

Source: Marek, 2009

- **Net working capital =** current assets - long-term receivables - short-term liabilities (Mrkvicka and Kolar, 2006).
- **Undistributed profit =** profit funds + the economy results of past years + the economy results for the current accounting period (Grünwald and Holeckova, 2006).
- **EBIT =** the economy results for the accounting period + income tax + interest expenses (Mrkvicka and Kolar, 2006).
- **The book value of the debt =** foreign capital – reserves (Knapkova et al., 2013).
- **Revenues =** Sales of goods + outputs + revenues from sales of DHM and material + other operating and financial revenues + revenues from sale of securities and deposits + revenues from DFM + interest income + extraordinary revenues + transfer of operating and financial revenues (Kislingerova and Hnilica, 2005).

Based on extensive testing, the thresholds for predicting the financial situation of the company were set. If an enterprise reach Z Spore less than 1.81, it is a bankrupt enterprise. By contrast, companies with a Z score higher than 2.99 are at prosperity levels. The range between 1.81 and 2.99 identifies so-called gray zone. This zone is specific because if, according to the achieved Z Score, the company is located in this zone, we cannot clearly determine where the company is heading (Marek, 2009; Valaskova et al., 2015).

2.2 Zeta

Based on the need to calculate this model for companies that are not publicly tradable, Altman modified the Z Score model and created the so-called ZETA model, which also made it possible for these companies. In this variant, the weights of the individual indicators were reduced and the importance of the individual indicators was reorganized (Vochozka, 2011). This variant is able to predict bankruptcy with 90.9% probability and with a 3% likelihood the prosperous enterprise will rank among bankruptcy (Altman and Hotchkiss, 2006). Algorithm for ZETA model calculation is as follows:

$$Z' = 0,717 \cdot X1 + 0,847 \cdot X2 + 3,107 \cdot X3 + 0,42 \cdot X4 + 0,998 \cdot X5 \quad (2)$$

Where the variables X1, X2, X3 and X5 remain the same as when calculating Z Score. The only changed variable is X4.

- **X4** = own capital / foreign capital,

Table 2. Company rating by ZETA Model

Results	Rating
$Z' \geq 2,9$	A creditworthy company
$1,23 \leq Z' < 2,9$	Gray zone
$Z' < 1,23$	Bankruptcy company

Source: Marek, 2009

The big advantage of this model for companies within the Slovak Republic is the fact that this model was created for companies that are not tradable on the stock market, which is the majority in Slovakia.

2.3 Z"Score

Another modification of the Altman model is the so-called Z"Score. The great advantage of this option is that it was created for non-productive companies in an attempt to minimize the impact of a potential industrial effect (Marek, 2009). There is a change in the weights of the individual coefficients and also the change of the coefficients themselves (Ivanova and Cepel, 2018; Valaskova et al., 2015). Algorithm for Z´´Score model calculation is as follows:

$$Z'' = 6,56 \cdot X1 + 3,26 \cdot X2 + 6,72 \cdot X3 + 1,05 \cdot X4 \quad (3)$$

Table 3. Altman's Z''Score Model variables

X1	Net working capital / Assets
X2	Undistributed profit / Assets
X3	EBIT / Assets
X4	Own capital / Foreign capital

Source: Marek, 2009

Consequently, based on the results of the Z" Score model, individual companies can be divided into three basic groups. The individual score ranges for identifying whether a creditworthy company, a gray zone company, or a company with a tendency to bankruptcy are as follows:

Table 4. Z''Score rating for non-production companies

Results	Rating
$Z'' > 2,6$	A creditworthy company
$1,1 < Z'' \leq 2,6$	Gray zone
$Z'' \leq 1,1$	Bankruptcy company

Source: Marek, 2009

2.4 Modification of the Altman´s Model for use in condition of Slovak Republic

Based on the available literature, we can assert that the use of Altman models can be quite complicated under certain circumstances. Therefore, if we want to effectively use the Altman analysis, the model must be modified for specific conditions that reflect the variability of the variables examined (Kliestik et al., 2015; Shpak et al., 2018; Siekelova et al., 2015; Spuchlakova and Michalkova, 2016). The first prediction model developed in Slovakia is the model of Zuzana Chrastinova. It is a model of discriminatory function that takes into account the specifics of

agricultural companies. Primarily, it is a modification of the Altman Z Score model and the Beerman's rating index. In total, 1 123 enterprises were tested for the needs of this model, the acquired knowledge confirmed the real utility of this model in assessing the financial health of enterprises in the agro-sector of the Slovak Republic. Based on the results of testing the suitability and significance of the individual indicators for the prediction analysis, Chrastinova chose 5 indicators for the compilation of its own index, to which it assigned the significance coefficients. It then transforms into scales whose sum is 1. And so, a discriminating function named CH-Index was created (Chrastinova, 1998). The Ch-Index model has the following form:

$$CH = 0{,}37X1 + 0{,}25X2 + 0{,}21X3 - 0{,}10X4 - 0{,}07X5 \quad (4)$$

Table 5. CH-Index variables

X1	The economy results for the accounting period / Total capital
X2	The economy results for the accounting period / Sales
X3	Cash Flow / payables
X4	Payables / Sales
X5	Foreign capital / Total Capital

Source: Chrastinova, 1998

Based on the results of the CH-Index calculation, enterprises can be divided into three basic groups, as in the previous cases. For the definition of a company as a creditworthy company, a gray-zone company, or a company with a tendency to bankruptcy, we use the following value ranges:

Table 5. Company rating by CH-Index

Results	Rating
$CH \geq 2{,}5$	A creditworthy company
$-5 < CH < 2{,}5$	Gray zone
$CH \leq -5$	Non-prosperous enterprise

Source: Chrastinova, 1998

3. CONCLUSION

In our contribution, we summarized the findings from the basic Altman model through its modifications to the specific modification suitable for use in the conditions of the Slovak Republic. Based on these findings and detailed descriptions of the calculations of the individual modifications of the Altman model, we can state that the Altman model and especially its use can be very problematic. Potential problems can arise from its generality. If we want to use this model, we need to know in detail all its calculation requirements. We can conclude that the creation of a significant number of Altman model modifications occurred precisely because the available variables did not correspond to the calculation needs and each modification corresponds to other, specific and individual needs.

ACKNOWLEDGMENT

The paper is an output of the science project VEGA 1/0428/17 Creation of New Paradigms of Financial Management at the Threshold of the 21st Century in Conditions of the Slovak Republic.

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