Analysis of foreign models for assessing the probability of bankruptcy and their application in Russian practice on the example of the public joint-stock company AVTOVAZ for the 2014-2016

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Abstract. There is an unstable economic growth in recent years, as well as unstable macroeconomic situation in general, so managers need to analyze not only the current financial condition of the enterprise, but also constantly to diagnose the probability of bankruptcy in the future. The paper carries out the analysis of foreign models for assessing the probability of bankruptcy, as well as Altman Z-Score and Altman-Sabato model which is based on logistic regression. Main attention is paid to application of models in Russian practice on the example of the public joint-stock company AVTOVAZ for the 2014-2016 years.

1. Introduction

Attempts to predict the probability of bankruptcy were made in the beginning of the 20th century. Such scientists as W.Low, R.Smith, P.Fitzpatrick, A.Winakor conducted researches in the 1920-1930s that were aimed at revealing effective tools for forecasting bankruptcy. However, serious interest in the development of effective techniques appeared in the 1960s with the development of computer technology. The main scientists of that decade were Edward Altman [1].

The Edward Altman model was constructed using discriminative analysis. He developed a linear equation with five factors that exerted a significant influence, and their amount was a Z-score, the number of which allowed to divide the enterprises into 2 categories: bankrupt enterprises and enterprises in a stable position. This model is still used by auditors, despite the fact that it was developed in 1968.

However, development of effective methods increased in the 1960s caused by development of computers. The main scientists in that decade were W.Beaver, E.Altman. W.Beaver created a quite simple method in 1966 which was based on indices of financial statements, particularly on comparing mid-points of prosperous companies with mid-points of bankrupt companies. It contributed to revealing of financial indicators that can forecast bankruptcy.

Research of bankruptcy forecast models, in which discriminative analysis was used, revealed a great number of drawbacks that didn’t allow to use the models for effective estimation of bankruptcy. For example, such models, cannot measure the probability of bankruptcy. Such models can produce qualitative evaluation, for instance, low high, extremely high. Moreover, all the models using discriminative analysis have “ambivalent zone” and if a total index gets there, it is impossible to be certain about probable bankruptcy.
All the drawbacks caused the tendency towards not using the models of bankruptcy estimation based on discriminative analysis but using modern econometric tools, mostly using logit-model made with the help of logistic regression.

Such models were used in the 1980-1990s. The first scientist, used logit-model for bankruptcy forecast, was J.Ohlon in 1980. Dependent variable in his model equaled from 0 to 1 that gave quantitative evidence of possible bankruptcy.

Another model was suggested by J.Fulmer in 1984. The accuracy of the model was 98% during a year and 81% during more than a year.

The British scientist R.Taffler used four-factor model in 1977 which was made for building and a manufacturing plants. The factors were: profitability, financial risk, concordance of circulate capital, liquidity.

In 1978 G.Springate made a model based on discriminative analysis. Unlike E.Altman he managed to select four main factors such as current asset to total asset ratio, profit share to total asset ratio, profit share to current engagements, current asset turnover to total asset ratio.

In spite of diversity of forecast bankruptcy models, the most famous one is Altman Z-score. The reason why this model is widely spread is that with the help of modern nonlinear methods we cannot get the real estimation of probable bankruptcy as an equation.

In 2007 E. Altman and D. Sabato presented a logit-model, developed on the basis of a sample of 120 bankrupts and 2010 non-bankrupts US.[2] This model takes values from 0 to 1 and allows you to accurately assess the risk of bankruptcy probability of the enterprise. In order to find out whether these models are applicable to Russian practice, let's give an estimate of the probability of bankruptcy on the example of the public joint-stock company AVTOVAZ.

2. Method
To begin with, consider the well-known 5-factor Altman model was used for manufacturing enterprises whose shares are traded on the exchange. The 5-factor Altman model implies a developed secondary market of shares, so it is more suitable for foreign enterprises.

Calculation of indicators is presented in the table below. All calculations were made based on accounting statements of PJSC "AVTOVAZ”.

| Table 1. Altman Five-Factor Model. Source: Balance Sheet and Income Statement of PJSC «AVTOVAZ».
| | 2014 | 2015 | 2016 |
|---|---|---|---|
| Z= 1.2*X1 + 1.4*X2 + 3.3*X3 + 0.6*X4 + X5 | 0,1308 | -0,5601 | -0,3452 |
| X1 = Working Capital / Total Assets | -0,22 | -0,45 | -0,38 |
| X2= Retained Earnings / Total Assets | -0,15 | -0,27 | -0,22 |
| X3 = Earnings Before Interest and Taxes / Total Assets | -0,16 | -0,21 | -0,23 |
| X4 = Market Value Equity / Book Value of Total Liabilities | 5,0E-05 | 4,6E-05 | 4,5E-05 |
| X5 = Sales / Total Assets | 1,1E+00 | 1,1E+00 | 1,2E+00 |

Made by the author basing on books of account of PJSC “AVTOVAZ” in 2016

The results of the Z value obtained must be compared in the normative values:

- If Z> 2.9 - the zone of financial stability (the "green" zone).
- If 1.8 <Z <2.9 - zone of uncertainty (the "grey" zone).
- If Z <1,8 - a zone of financial risk ("red" zone).

As it turned out, for all considered periods the values of Z were less than 1.8. This indicates a zone of financial risk, which means that the probability of bankruptcy of PJSC AVTOVAZ is very high. However, we cannot fully affirm that this estimate is correct. It is necessary to consider a model
applicable in Russian practice.

**Table 2.** Altman Four-Factor Model for Russian Economy. Source: Balance Sheet and Income Statement of PJSC «AVTOVAZ».

|          | 2014  | 2015  | 2016  |
|----------|-------|-------|-------|
| Z*** = 3.25+6.56*X1+3.26*X2+6.72*X3+1.05*X4 | 0.2647 | -2.2321 | -1.7626 |
| X1 = Working Capital / Total Assets | -0.22 | -0.45 | -0.38 |
| X2 = Retained Earnings / Total Assets | -0.15 | -0.27 | -0.22 |
| X3 = EBIT / Total Assets | -0.16 | -0.21 | -0.23 |
| X4 = Book Value of Equity / Total Liabilities | -0.0005 | -0.2118 | -0.2453 |

Made by the author basing on books of account of PJSC “AVTOVAZ” in 2016

For Altman model used in Russian economic situation, a constant 3.25 is added according to which it is possible to obtain a more accurate estimate of the financial state of the enterprise. Let's compare the received values Z * with the standart:

- If Z *> 2.6 - the zone of financial stability (the "green" zone).
- If 1.1 <Z * <2.6 - zone of uncertainty (the "grey" zone).
- If Z * <1.1 - the zone of financial risk (the "red" zone).

As it turned out, the estimates for the Russian model have changed slightly. In 2014, the value of Z * turned out to be at the boundary of the zone of uncertainty. Usually, the "grey zone" indicates that the company has taken measures to limit exports. In 2015, 2016, the Z values were less than 1.1, which means that the company had a high probability of bankruptcy. However, in 2016 the value increased by 0.47 points. According to this data we can claim that in 2016 measures for anti-crisis management were taken that resulted in risk of bankruptcy probability decrease.

Analyzing the Altman model, we can conclude that the enterprise was at a high risk of bankruptcy probability, and at least some trends were revealed that showed that the company had taken certain measures to overcome the crisis situation. However, we did not give an accurate quantitative estimate of the probability of bankruptcy. To do this, let us consider the Altman-Sabato model.

**Table 3.** Altman-Sabato model (logit-model). Source: Balance Sheet and Income Statement of PJSC «AVTOVAZ».

|          | 2014  | 2015  | 2016  |
|----------|-------|-------|-------|
| P=1/(1+e^(-Y)) | 1.0000 | 0.9950 | 0.9936 |
| Y = 4.28 + 0.18*X1 — 0.01*X2 + 0.08*X3 + 0.02*X4 + 0.19*X5 | 17.18 | 5.28 | 5.04 |
| X1 – EBITDA / Total Assets | -0.16 | -0.21 | -0.23 |
| X2 – Short Term Debt / Equity Book Value | -1143.26 | -2.60 | -2.24 |
| X3 – Retained Earnings / Total Assets | -0.15 | -0.27 | -0.22 |
| X4 – Cash / Total Assets | 0.05 | 0.02 | 0.10 |
| X5 – Profit before Tax/Payable Interest | 7.95 | 5.46 | 4.21 |

Made by the author basing on books of account of PJSC “AVTOVAZ” in 2016

In our case, PJSC AVTOVAZ can be classified as a bankrupt, since the P values for the period under review were close to 1. However, in the dynamics, the value of the P indicator tended to decrease. In 2016, the indicator fell by 0.0164 points compared to 2014, when the value of P was 1, which indicated a 100% probability of bankruptcy.
3. Conclusion
Predicted efficiency of foreign methods in Russian science are limited because they do not consider Russian specifics and based on different data. However, Russian models are mostly based on expert estimation but not on statistical technology. That is why it is important to select factors that correspond to Russian specifics. Including them will allow to get more accurate result. Considering Altman models, we found out that a constant 3.25 is added according to which it is possible to obtain a more accurate estimate of the financial state of the enterprise in Russian Economy.

The best combination for Russian economy is the combination of German and English models which directs towards both business maintenance and effective recourses allocation that can include partial sale of property. Effective foreign models can help produce effective Russian model. Taking into consideration both Russian specifics and international practices we can conclude that for “AVTOVAZ” we should use integrated system of risk management and pay attention to rehabilitation methods and get government support concerning bankruptcy.

According to analysis of foreign methods of anti-crisis management, we can name two types of management process: corporate and formal. Corporate anti-crisis management is carried out based on procedures regulated by national legislation or civil code.

Realisation of corporate anti-crisis management is carried out as anti-crisis consulting, individual anti-crisis management, anti-crisis management controlled by creditors, integrated system of corporate risks and crisis management.

Integrated system of risk management involves risk-management system according to which a company is capable to control risks at any level. Nowadays there is a tendency to combine methods of corporate risks management and methods of anti-crisis management of an enterprise. Methods of risks management used to be used by insurance, investment and credit organizations for predicting bankruptcy probability and neutralizing it. Nowadays all methods of domestic and outside environment analysis and anti-crisis planning are tend to be used in corporate risks management.

Methods of anti-crisis management includes: express-analysis of an enterprise (up to three weeks), evaluation of a short-term plan for an enterprise strengthening, analysis of domestic and outside enterprise environment (up to two months), anti-crisis plan evaluation (up to three months, anti-crisis management plan realization (up to three years). Consequently, the total period of anti-crisis management realization can be up to 3.5 years, but for small companies it can be limited up to six months.

Corporate risks management includes such methods as risks factors evaluation, risks probability and its consequence estimation, revealing methods for neutralizing risks, constant activity to decrease risks probability, monitoring of risks whose probability could be estimated, constant planning of enterprise activity concerning risks that are out of enterprise control.

The main differences of corporate management in different countries are state focus model on anti-crisis management at a macro level as well as at a micro level. The main idea of anti-crisis management is to save an enterprise but not to sell it out. In spite of the fact that the majority of cases results in bankruptcy proceeding, the most preferable methods are rehabilitation ones.

According to analysis, in foreign countries there are their own management models similar to Russian models. However, there are some foreign tools for anti-crisis management that are widely used in Russia for predicting bankruptcy probability and different factors.

Taking fluctuating economic growth and macroeconomic situation in general into consideration, managers should analyze current financial state of an enterprise as well as predict bankruptcy probability in the future.

References
[1] Altman E 1968 Financial ratios, discriminant analysis and the prediction of corporate bankruptcy J. Fin. 23 R 589-609
[2] Altman E 2006 Modeling credit risk for SMEs: Evidence from the US market Abacus 19
[3] Credit Suisse Credit risk: a credit risk management framework Credit Suisse Financial Products
New York NY 1997

[4] Falkenstein E, Boral A and Cartey L 2000 RiskCal- cTM for private companies: Moody’s default model M’s Invest. Serv.: Gl. Cr. Res. May 3-86

[5] Fulmer J, Moon J, Gavin T and Erwin M 1984 A bankruptcy classification model for small firms J. Com. Bank Lending July 25-37

[6] Nario L, Pfister T, Poppensieker T and Stegemann U 2016 The evolving role of credit portfolio management McKinsey&Company July

[7] Ohlson J 1980 Financial ratios and the probabilistic prediction of bankruptcy J. Acc. Res. 18 109-31