

MODELING AND FORECASTING OF INDICATORS OF THE HIDDEN BANKRUPTCY OF THE ENTERPRISES

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ABSTRACT

This article contains a statistical analysis of the hidden bankruptcy of the organizations, the existing principles and approaches to the identification of a hidden bankruptcy in the early stages for the purpose of commercial credit. A new approach in the analysis of concealed bankruptcy, using the three-dimensional model that combines the most adaptive forecasting models for the global and Russian terms of trade. The stages of development of models of forecasting of bankruptcy in different countries, as well as Russian experience in research of this issue. The author offers the classification of existing models identified their advantages and disadvantages. Systematization of the models are based on statistical methods used in solving the problem of bankruptcy forecasting organizations in the selected models. The definition of hidden bankruptcy should be, the state of the enterprise, in which there are predictive trends in the deterioration of financial performance, shortcomings in the management of the company are qualified as errors and failures, and lead to financial insolvency. However, that hidden bankruptcy is not legally defined and regulated, there are many methods for evaluating the effectiveness of the company's financial activity, which has as its basis a model for assessing hidden (unrecorded) bankruptcy. Also in the predictive models are calculated indicators of cash flow, cash from operations, costs for servicing loans (sales financing from funds raised - the price of borrowed capital), tangible assets or tangible total assets, salaries - the ratio of labour costs to the added value (cost price - the cost of raw materials, energy, services of third-party organizations) or remunerated staff ratio, profit before interest and taxes or gross operating profit, revenues - gross income from sales of products, works and services, extraordinary items - extraordinary consumption and financial expenses - financial costs, as well as GNP price-level index.

Keywords: commercial loans, bankruptcy risk assessment, credit policy, bankruptcy, forecasting models.

INTRODUCTION

The need to develop methodological approaches to identifying bankruptcy in the early stages is due to some trends occurring with the Russian economy at the present stage. The strong growth in the share of loss-making enterprises in Russia comes with the aggravation of crisis situations in the world markets, during the

world economic crisis, as well as in connection with the current currency crisis in Russia, when there is a sharp jump in the share of loss-making organizations.

The impact of operational and financial difficulties in the company is based on the traditional analysis of financial indicators (quantitative factors).

The first studies in the search for quantitative analytical coefficients to predict possible complications in the financial activities of companies were carried out in the United States in the early 30-IES.XX century. So in 1932, when Fitzpatrick published a study of 20 pairs of firms, among which were bankrupt firms and firms that were able to survive, were commensurate with the age of the company, size and industry, in Certified Public Accountant. At that time, he was unable to carry out a complete statistical analysis, as it is now possible, but intuitively interpret the values of indicators and their trends. His interpretation was effectively a complex multivariate analysis.

One of the first financial analysts, who used statistical techniques in combination with financial ratios to predict the likely bankruptcy of the enterprise, was W. H. beaver(W. N. Beaver) 1966. U. beaver on the basis of comparison of the influence of 30 financial indicators proposed five factors to assess the financial condition of the enterprise in order to diagnose bankruptcy. [2]

The most accurate in the conditions of modern market economy specificity are multi-factor models of bankruptcy prediction, which usually consist of five to seven financial indicators. In the practice of foreign financial institutions for assessing the probability of bankruptcy is often used "Z-account" E. Altman (creditworthiness index), which is a five-factor model, based on the data of successfully operating and bankrupt US industrial enterprises. [1]

As well as Altman (1968), discriminant analysis is used by many researchers by making changes in the choice of financial indicators, the study of different enterprises of different industries and different business cultures. Some of the known studies are dickin (1972), bloom (1974), Springate (1978) and Fulmer (1984).

The advantage of methods similar to the Altman model is the high probability with which bankruptcy is predicted approximately two years before the actual announcement of the competition, the disadvantage is the decrease in the statistical reliability of results in the preparation of strategic forecasts.

Limitations of discriminant analysis created a space for the development of the logit model. Olson (1980) presented the logit model in bankruptcy prediction. Assumptions of the logit models differed from the models Z-score. Olson identified nine independent variables (financial and non-financial) based on their frequent use in bankruptcy forecasting. This model was developed on the analysis of 2,163 companies (105 bankrupt and 2,058 non-bankrupt) for the period 1970-1976. According to the model of Olson, Abdullah et al. (2008), the applied logistic model foreshadows the corporate bankruptcy of Malaysian firms.

Despite the positive factors in the use of logistic regression and its logic models to assess the likelihood of bankruptcy of organizations, this model can be criticized. For example, a detailed analysis of the risk assessment of bankruptcy of domestic companies, obtained on the basis of this model, does not allow to draw a clear conclusion regarding the probability of bankruptcy of organizations included in the analyzed sample, the calculations give the opposite results.

Zmievskiy (1984) used a probit model using data from 40 8000 bankrupt and not bankrupt firms for the period 1970-1978. He conducted a comparative analysis of 13 models of the definition of bankruptcy and on their basis built his model. One of the criticisms of Zmievskiy's model is that other bankruptcy models for identifying problem firms were more accurate due to the completeness of financial data. [6]

Nonparametric models are highly computer-dependent and are mostly multidimensional (Andan and Dar, 2006). Some of the well – known nonparametric models are artificial neural network (Ann) models, hazard models, fuzzy models, genetic algorithms (GA) and hybrid models, or models in which some of the former models are combined.

The model of the artificial neural network can examine a particular dataset, and to adapt to it, they also have the ability to grasp the nonlinear relationship between the variables, what is the advantage of these models. The main disadvantage, however, is that they are unable to explain the cause-effect relationships between their variables, which limits their application to practical management problems (Lee and Choi, 2013). Kirkos (2015), in a credit risk review article that focuses mainly on artificial models of research published between 2009 and 2011, that is, during the information technology revolution, suggests that in the 1990s through the creation of artificial intelligence and management systems, these models were able to grow and develop. This led to the development of a new set of bankruptcy prediction models known as neural networks. Messier and Hansen's (1988) studies related to the use of neural networks in predicting bankruptcy are emerging. Followed by a large number of studies, such as Ragupathi (Raghupathi et al (1991), Fant (1993), Guan (1993), Tsukuda and Baba (1994), Altman, Marco and Barreto (1994). [4]

Artificial neural networks are a method that has been used in predicting bankruptcy, mostly over the past two decades. Neural network models include quality criteria and are in essence computer systems that make decisions based on established facts as well as the human brain operates, in addition, they aim to solve a specific problem, or used to create new models of governance.

Neural networks are also used for other tools of mathematical modeling, for example, to predict the corporate ratings of the company, share value and profitability. Neophytou, Charitou & Charalambous (2001) argues that by comparing the results of multiple discriminant analysis and neural network approach, it is proved that the artificial neural network model is more effective in classifying problem and successful companies. [5]

Neophytou (2001) identified some of the benefits of neural networks as their ability to induce algorithms in pattern recognition. Unlike traditional models, the approach of neural networks is considered to be more reliable due to the fact that it is not subject to statistical postulates, for example, linear coupling and multi-variability of the random variable. As such, it is adaptive and has the ability to Express non-linear relationships. Holi, Johnson, and Raina (1990) noted that the approach taken in neural networks could be most effectively used to solve problems such as classifications and clustering where environments are unstructured or with incomplete data. The disadvantages of the neural network can be attributed to the fact that they do not evaluate the contribution of each variable to the final classification, i.e. do not determine the value of this variable for the whole variation. Therefore, it is impossible for the researcher to select the most significant predictive variables to develop a model with a neural network approach.

In addition to the artificial neural network model, there are other nonparametric models, namely hybrid models. Hybrid models are a combination of two models, either parametric or nonparametric (Lee et al., 1996).

Genetic algorithm is also one of the most striking in the list of nonparametric models, which work as a method of stochastic search to find out will be the company bankrupt or not (Varreto, 1998). Other widely used non-parametric models: Etemadi (2009) genetic programming, the models based on the theory of "rough test" Dimitrios (1999), Bayesian, Fuzzy, models of hazards and analysis of data Data Envelopment Envelopment Analysis (DEA). [3]

In the case of nonparametric models, we are talking about modeling a huge amount of data that are not used in the realities of commercial lending, but are more often used in complex tasks of investment decision-making, ratings of companies, the value of shares and their profitability.

In the case of using some mathematical models, the influence of qualitative factors in identifying hidden bankruptcy is not taken into account. The next important stage in the development of hidden bankruptcy forecasting models is the creation of high-quality forecasting models. With them, it became possible to identify potential bankrupt even before financial performance began to deteriorate. Qualitative analysis is based on the use of information that cannot be expressed in quantitative terms. To carry out such an analysis, questionnaires and information about the borrower from various databases are used.

One of the most relevant models is the model j. Argenti (1976). Parametric models include discriminant models and conditional probability models (logit and probit), while nonparametric models include iterative sections, such as Argenti's hidden bankruptcy model. The model is based on the calculation of the company's assessment, which is based on three stages: the company's shortcomings, management errors and symptoms of bankruptcy. There are two important limitations of the model, first, there are no specific financial indicators used to describe the financial health of the company. As a result, the concept of financial health of the company is unclear and does not give the slightest idea of the

importance of financial indicators, such as profit, profitability, turnover and liquidity at various stages of bankruptcy, secondly, although Argenti emphasizes the importance of management shortcomings, the existence and importance of specific errors, as a consequence of the symptoms of hidden bankruptcy, without specifying the distinctive features, the definition of the stages of bankruptcy is not quite clear. As a result, the details of the definition of hidden bankruptcy are not obvious and there are too few differences between them. Moreover, they may not occur for a long time, and appear at the same time.

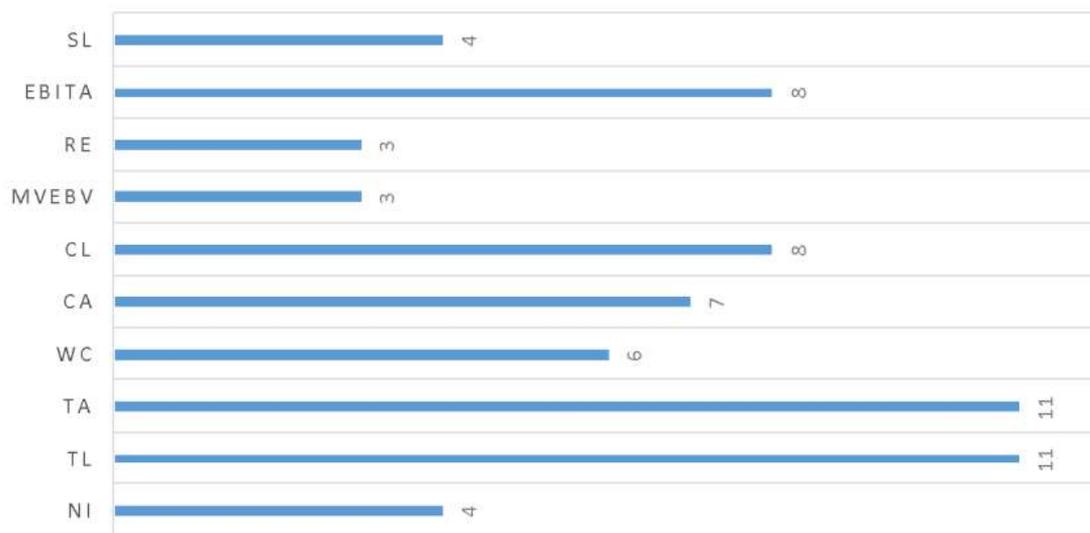


Figure 1 Study of indicators in forecasting models (compiled by the author based on the analysis of 11 forecasting models)

To implement commercial lending companies, it is advisable to include in the set of indicators characterizing the results, namely, sales Revenue (without VAT) – sales (SL) in accordance with IFRS or GAAP revenues (SL), Net profit, net income (NI) or in GAAP net profit in IFRS, the indicators characterizing the effectiveness of commercial lending is accounts receivable (AR – accounts receivable) and payables (AP – accounts payable), they are components of the CA and CL indices, which are often used by foreign authors in their bankruptcy forecasting models. And indicator stocks (Inventories) as characteristic of the influence of external factors on the operation of enterprises, namely the glut of products in the warehouse, because of the impossibility of its implementation (the complexity of the sale, nonpayment of contractors and improper strategic planning of production volume). Also in the set of features added quality measure, allocated A-score for the estimated model latent bankruptcy "of the company less than five years? the answer to which can be obtained by an indicator of the age of the enterprise.

According to the factor analysis of the indicators, based on a set of 629 agricultural enterprises, the importance of the selected factors SL (sales revenue), NI (net income) and AR (accounts receivable) is confirmed that they have the greatest impact on the model and are important for the community of the set.

From the matrix of the main components of table 1 it follows that, for example, the indicator age has a negative value, this suggests that in the model it is necessary to take the opposite indicator, too, with stocks, the first component is influenced by indicators such as revenue (SL), accounts payable and receivables (AP, AR), on the second component they have no impact, but has an impact on profit (NI).

Based on the results of the consolidated analysis of the selected models of bankruptcy prediction, it can be concluded that one of the priorities of statistical studies of hidden bankruptcy is the analysis of differentiation and identification of traits that distinguish enterprises prone to bankruptcy.

The combination of economic and statistical and qualitative analysis of the organization makes it possible to determine in advance the harbingers of hidden bankruptcy. The determination of the most significant influence factors based on the coefficients of Altman's multivariate analysis models, Olson's logit model and Zmieviskiy's probit model (X&Y&Z) and Argenti's qualitative model is likely to yield more accurate results in predicting the bankruptcy of organizations.

CONCLUSION

A new approach in the analysis of concealed bankruptcy, using the three-dimensional model that combines the most adaptive forecasting models for the global and Russian terms of trade. The stages of development of models of forecasting of bankruptcy in different countries, as well as Russian experience in research of this issue. The author offers the classification of existing models identified their advantages and disadvantages. Systematization of the models are based on statistical methods used in solving the problem of bankruptcy forecasting organizations in the selected models. The definition of hidden bankruptcy should be, the state of the enterprise, in which there are predictive trends in the deterioration of financial performance, shortcomings in the management of the company are qualified as errors and failures, and lead to financial insolvency. However, that hidden bankruptcy is not legally defined and regulated, there are many methods for evaluating the effectiveness of the company's financial activity, which has as its basis a model for assessing hidden (unrecorded) bankruptcy. Also in the predictive models are calculated indicators of cash flow, cash from operations, costs for servicing loans (sales financing from funds raised - the price of borrowed capital), tangible assets or tangible total assets, salaries - the ratio of labour costs to the added value (cost price - the cost of raw materials, energy, services of third-party organizations) or remunerated staff ratio, profit before interest and taxes or gross operating profit, revenues - gross income from sales of products, works and services, extraordinary items - extraordinary consumption and financial expenses - financial costs, as well as GNP price-level index.

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