SOFTWARE IMPLEMENTATION OF INTELLIGENT SYSTEMS FOR ASSESSING THE FINANCIAL CONDITION OF AN ENTERPRISE

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INTRODUCTION

Recent analytical reports on the state of entrepreneurship in Russia testify that the corporate bankruptcy cases tend to increase. Despite the large number of well-known models, methods and approaches to assessing the financial condition of business entities, there is no universal method of estimating the risk of bankruptcy and no universal practical tools for financial risk management nowadays. The aim of this paper is to develop a practical tool (software) that can provide accurate prediction of the bankruptcy risk level for Russian enterprises and at the same time can be easily used by the managerial staff of a company.

1. CURRENT SITUATION IN FINANICAL RISK MANAGEMENT

Due to global economic instability, a series of world economic crises, the deterioration of the domestic and foreign economy in the competitive environment of commercial structures, transition of economy from industrial to innovative, economic sanctions and the increasing number of bankruptcies in the Russian economy, the problem of financial risk management within enterprises and, in particular, prediction of bankruptcy, becomes especially vital.

Analytical review made by Center of macroeconomic research of Russian Federation shows [1] that by the end of the third quarter of 2017, the number of bankruptcies in the economy increased by 3.0% on the previous quarter and 12.4% – with respect to the third quarter of 2016. In addition, the level of bankruptcy in August-September 2017 slightly exceeded the high figure of March 2015 and appeared to be only 2% below the historic maximum in October 2009. The bankruptcy issue has affected almost all sectors of the economy, with the highest number of bankruptcies identified for enterprises in the construction industry. Data for the 3rd quarter of 2017 indicates that the number of bankrupt enterprises on the background of the economic stagnation continues to grow over the last four quarters.

The relevance of the research topic is determined by the necessity of doing business within the permanent effect of risk-causing factors. Every enterprise at any stage of its life cycle becomes aware of development and organizing of a risk-management system, whether using formalized tools and methodologies or performing intuitive risk management.

Many scientists, both domestic and foreign, studied the problem of modeling financial risk and the prediction of corporate bankruptcy in various periods. The first study devoted to the design of the mathematical approach to corporate insolvency forecasting refers to 1966 [2]. Since then, a large number of methods and approaches have been suggested to the solution of this problem. A review on approaches can be found in [3]. In accordance with [4] today there are over two hundred different models of predicting bankruptcy of enterprises. However, according to [5] 64% of models are based on statistical methods, 25% of models use methods of artificial intelligence, and 11% of models use other methods.

Despite the existing diversity of approaches to solving the problem of risk of corporate bankruptcy identification and assessment, the issue of designing an optimal tool for modeling and predicting the risk of bankruptcy is not completely determined. Russian entrepreneurship lacks a reliable and accurate tool for estimating the risk of bankruptcy that would be free of disadvantages of existing analogues and could accurately model the financial condition of Russian companies.

2. CLASSIFICATION OF APPROACHES TO FORECASTING CORPORATE BANKRUPTCY

Approaches to the prediction of bankruptcy are numerous; however, we can distinguish their two main classes – mathematical and empirical ones. The first class can include statistical models, methods and models of artificial intelligence and hybrid approaches. Among the empirical approaches, we can highlight the scoring and rating models and methods of strategic management and planning. The authors' classification of approaches is given in Figure 1.

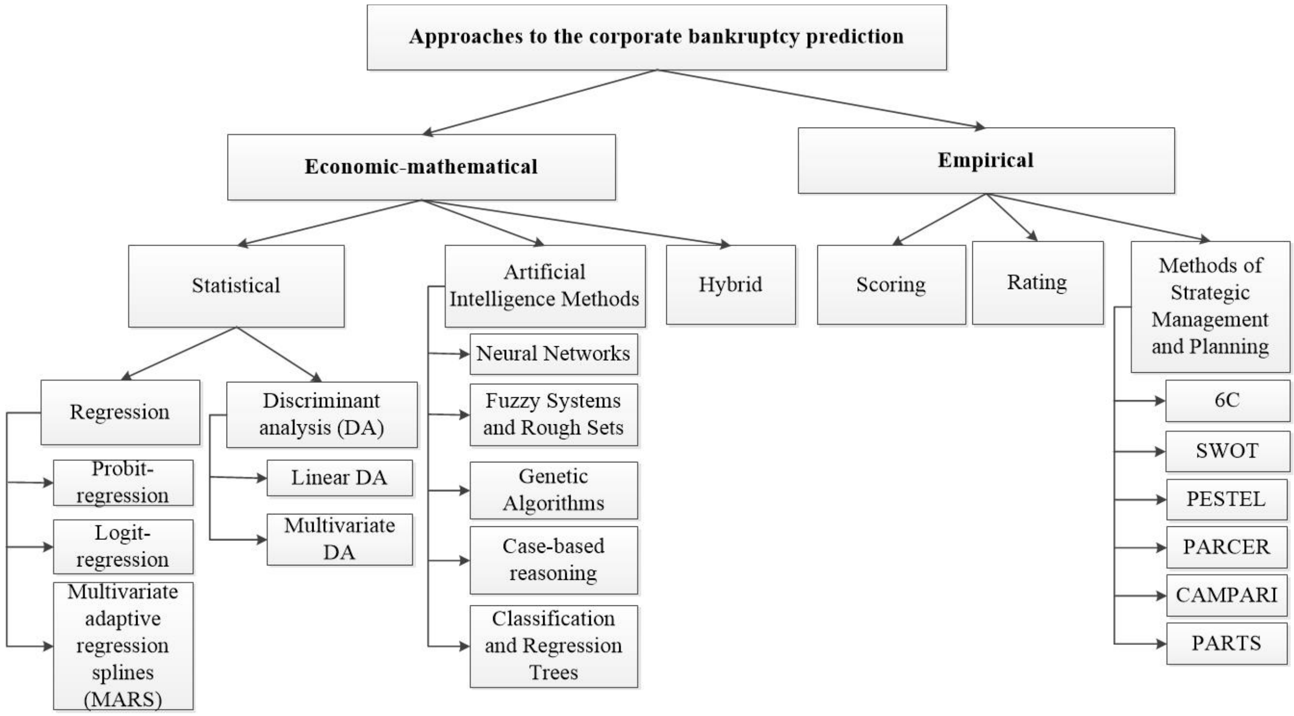

Figure 1. The authors' classification of approaches to forecasting corporate bankruptcy

Comparative analysis by the authors showed [6] that relatively recent studies in this area – hybrid models based on the technique of multivariate adaptive regression splines (MARS) – performed the most statistically accurate results and they were free of drawbacks of earlier analogues. However, hybrid approaches are hard to implement at enterprises that are the end users of the analysis results. Hardware requirements, bulkiness, complexity of interpretation are the factors that limit the application of hybrid models for the average small or medium enterprise.

Thus, despite numerous approaches, methods and models known, the issue of designing practical tools for bankruptcy forecasting remains vital. These tools should both provide the required level of statistical accuracy and meet the criteria of practical implementation.

3. THE AUTHORS' INTELLIGENT SYSTEM FOR ASSESSING THE FINANCIAL CONDITION OF AN ENTERPRISE

The problem of assessing the risk of corporate bankruptcy can be solved by performing a comprehensive analysis of risk's impact on the financial condition of an organization. In order to solve this problem, the authors' propose a tool for measuring and assessing the risk of bankruptcy within an enterprise, namely, a software application for Windows – an automated decision support system "Financial analyst" [7].

The software is developed in the IDE Microsoft Visual Studio 2012, using C# programming language, designed for the use on IBM PC and compatible computers. There is a calculation module for key financial indicators, a calculation module for traditional models calculation, the one for the MARS models, and a decision support system for financial analysis based on the authors' rule base.

The intelligent system consists of two modules:

- a module for express assessment of the bankruptcy risk using both traditional and the authors' models based on the multivariate adaptive regression splines (MARS) technique [8];
- a decision support system based on direct search on the basis of the rules. The rule base uses the authors' search algorithm on the adjacency matrix of a fuzzy metagraph.

The input data for the software is:

- an excel file of financial statements (balance sheet and statement of financial results);
- values of factors (tab "Work with DSS") that a user can choose from the drop down list;
- the truth level for each selected factor (tab "Work with DSS").

The output data is as follows:

- for the tab "Express-analysis of financial stability": the values of financial indicators, the results of the simulation (the traditional model and MARS models), the parameters' values for the traditional models;

- for the tab "Work with DSS": text results of financial analysis;

- diagrams "Structure of company's assets and liabilities".

Examples of user interface elements are shown in Figure 2.

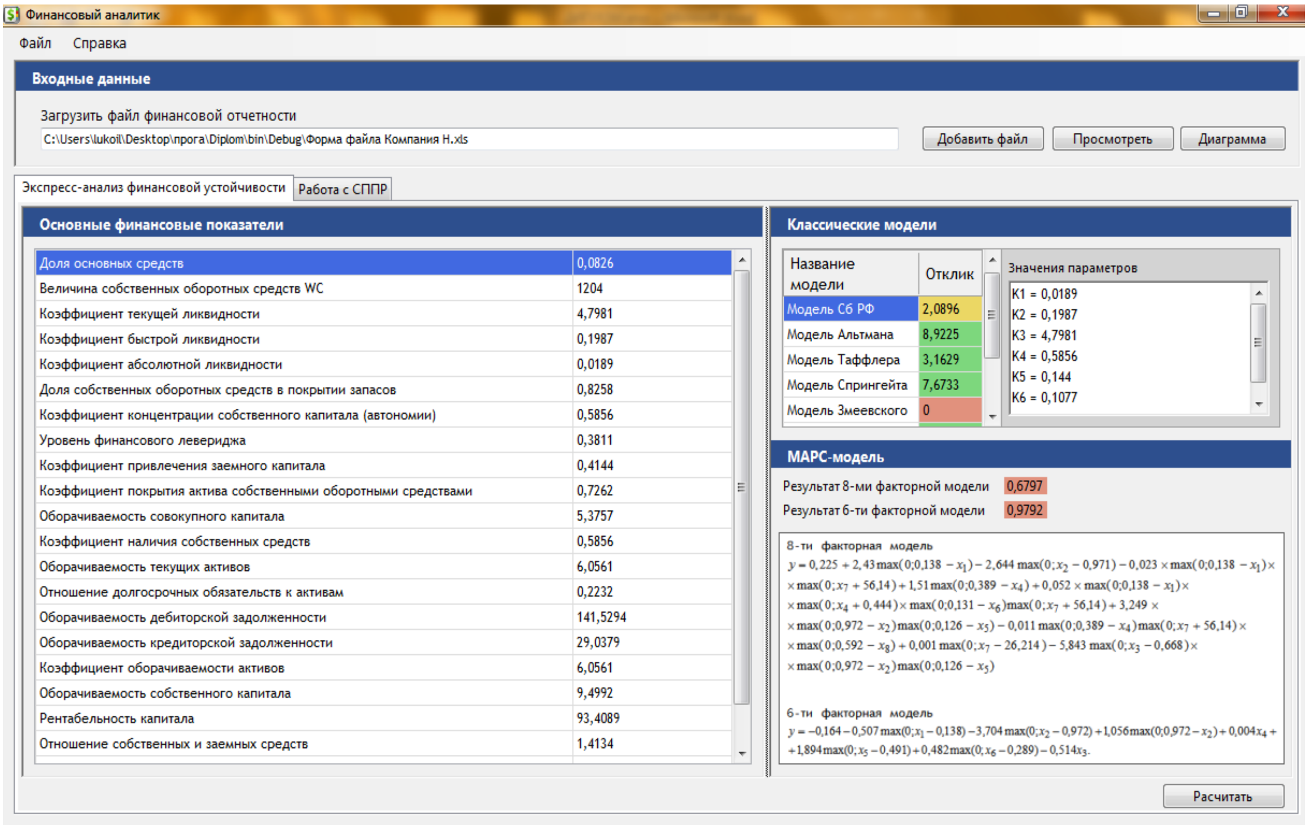

Figure 2. Module „*Express-analysis of financial stability*”.

However, this software implementation is only compatible with OS Windows and requires .Net Framework on a user's workstation. The authors' web-portal fa-online.info designed to assess the financial condition is free from these limitations. Basic functionality of the web-portal is as follows: vertical, horizontal financial analysis; calculation of net assets; calculation of EBITDA; profitability analysis; financial stability analysis; liquidity analysis; express-analysis of risk of bankruptcy; authors' MARS models analysis; maximum amount of loan estimation and Cash-flow model; financial reporting for small firms based on questionnaires.

The input data for the service is the data from a firm's accountant report: the balance sheet and the statement of financial results. It is possible to fill this data in the online mode, save it and edit later. The data is entered for two periods – current and previous. The section is provided with convenient navigation – the side menu. An example of a user interface of the product is shown in Figure 3.

CONCLUSIONS

The authors proposed two software products to solve the problem of assessing the financial condition and to create the information basis for management decisions – an application for OS Windows "Financial analyst" and a web portal fa-online.info. These apps are functional, easy to use; they do not require special skills from a user during operation. Each product has a module of quick assessment of the level of bankruptcy risk based on the authors' models, as well as a decision support system module that allows a user to generate reports describing the current financial situation at an enterprise and recommendations for further development.

The software is an integral result of the authors' research. It is a simple and practical tool aimed at solving the problem of estimating the current state of an enterprise, and at forming recommendations for further development and functioning using the algorithm of a decision support system.

Figure 3.Analysis results page.

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