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Analysis model and solvency risk assessment

Abstract. The article discusses methodological approaches to the development of a model for analyzing the optimization of the organization's capital structure, in which the main attention is paid to the principles of the concept, including the principle of effective use of equity capital, its profitability; the principle of efficient use of borrowed capital; the principle of balancing the sources of financing of the organization. Both vertical and horizontal analysis was carried out, as well as an assessment of the financial stability of the organization and a factor analysis of the return on equity. The factors influencing the optimization of leverage were considered, and the capital structure was optimized according to the criterion of maximizing the return on equity, which is becoming very relevant, especially in the context of the coronavirus pandemic and the post-pandemic period. In the process of choosing the optimal source of funding, both quantitative and qualitative indicators of the availability of resources were assessed, and a qualitative and quantitative analysis of funding channels was carried out, which was used to calculate the degree of their reliability. The capital structure was optimized according to the criterion of minimizing financial risks. In a pandemic and post-pandemic period, evidence schemes play a significant role for the practical application of a model that contributes to the growth of capital and an increase in its share in the overall structure of funding sources for the organization's activities. Procedures based on assessing changes in profitability, the structure of funding sources in a specific period of time.

The purpose of this work is to present a methodological approach to developing a model for analyzing the optimization of the capital structure of organizations in the context of the coronavirus pandemic and the post-pandemic period. As a measure of dependence, a factor analysis of the profitability of total capital is used. It is shown that the factor model takes into account various methodological approaches to the development of an assessment of the structure of funding sources for the organization's activities, the efficiency of using equity and debt capital in the context of the coronavirus pandemic and the post-pandemic period, as well as the development of management decisions aimed at capital optimization structure to increase capital intensity. This allows us to recommend these procedures for practical use.

In this article, we used regression analysis to predict the profitability of an organization's financial performance. The level of profitability of the aggregate, equity and debt capital of the organization in the planning period has been determined.

Keywords: the organization's capital structure, the factor model, regression analysis, level of profitability, solvency risk assessment.

Introduction

In modern economic conditions, the risk of insolvency is large enough and financial discipline "suffers". Therefore, great importance is paid to the analysis of solvency, liquidity assessment, risk assessment of insolvency and the likelihood of bankruptcy.

In this regard, the development of an analysis model and assessment of insolvency risk is increasing.

In addition to accounts receivable, the analysis of solvency focuses on stocks, since the formation of large stocks of goods, or raw materials for the production of products, negatively affects solvency, withdraws money from circulation. But at the same time, the main reporting form, in which the payment history of the enterprise is most informatively presented, is a cash flow statement. It is with the help of this reporting form that you can track in which areas the company made settlements and payments, what cash inflows were generated, how much all obligations were repaid, what cash balances the company had at its disposal after the settlements were made, what was the level liquidity and efficiency of its cash flows. Therefore, an analysis of cash flows will directly show what risks of insolvency can be in a modern economy.

In recent years, solvency assessment issues are becoming more widespread in the economic literature, and are also the subject of debate and discussion in various forums.

The relevance of our study is to develop a model for analysis and assessment of insolvency risk, which will comprehensively analyze the solvency and liquidity, liquidity and efficiency of its cash flows.

To achieve this goal, it is planned to solve a number of interrelated tasks:

- evaluate the various approaches of different authors to the basics of analysis and assessment of insolvency risk;

- substantiate the development of an analysis and risk model and determine the algorithm for its application;

- to develop a methodology for analysis and assessment of insolvency risk at Russian enterprises;

- develop the concept of a liquidity management model to reduce the risk of insolvency.

In our study, we proceeded from a number of hypotheses:

a. The indicators of the availability of receivables (both short-term and long-term) are growing and "inhibiting" liquidity. The violation of payment discipline by buyers and debtors is growing.

b. The activities of financial management in any field of activity cannot do without the sale of products (services or work, depending on the chosen line of business) with a deferred payment to the buyer, which leads to the formation of receivables. Under the agreement, the supplier of the goods represents the period during which the products shipped to the buyer (work performed or services rendered) are paid. In this case, the main point is the payment of products (works, services) on a specific date. If the payment deadlines have passed, and the buyer has not paid for the products (work, services), then the receivable goes into the category of doubtful, overdue. Therefore, it is important in the work of enterprises and organizations in the process of receivables management to prevent the moment when real receivables become overdue, to establish such relationships with customers that would prevent violation of payment discipline on their part.

in. In order to reduce risks, it is necessary to develop a new methodological toolkit, including an algorithm for applying the model for assessing and managing the risks of insolvency of production activities.

d. The need to develop the concept of a theoretical and methodological model for assessing the risk of enterprise insolvency management,

based on the introduction of innovative approaches to assessing cash flow liquidity.

As a result, they should study the experience of regions that successfully implement the efficient use of cash and current assets in general, which are positively reflected in the reduction of insolvency risks.

Materials and methods

The study was conducted based on materials from the Ural Federal District (hereinafter referred to as the Ural Federal District).

The most important industry and industry pride in the Urals District is engineering. In the Ural Federal District almost 10% of all engineering products of the country are produced. Enterprises of this industry produce up to 60.8% of freight railway cars of the Russian Federation, 21% of bridge structures. The equipment with the brand of the Ural enterprises, which is distinguished by its uniqueness and high quality, is installed at the leading petrochemical, metallurgical and engineering plants of Russia. Ural machine-building enterprises are the largest exporters of their products in world markets. Developed enterprises of the engineering industry are located in the south of the Tyumen region, in the Sverdlovsk, Chelyabinsk and Kurgan regions. Among the leading enterprises of the Tyumen region for the production of trailers, batteries and woodworking machines: OJSC Tyumen Motor Builders, CJSC Welding Electrodes Plant, OJSC Neftemash, OJSC Tyumen Battery Plant, OJSC Tyumen Shipbuilding Plant, etc.

The study was conducted on the basis of materials from Russian enterprises that produce and sell more than 50 types of mineral processing and mining equipment. Our study was conducted at joint-stock companies in the region.

The objective of the activity, which includes the release of quality products aimed at meeting the needs of customers, which are not only representatives of the Russian Federation, but also neighboring countries: enterprises of Kazakhstan, Belarus, Estonia, as well as foreign countries: China, Iran.

The analysis showed that for this group of enterprises the following dynamics of financial results is characteristic.

In general, for all enterprises in 2018-2019. there is a decrease in income and expenses from core activities:

a) revenue from sales decreased by 25.86% or 785 424 thousand rubles;

b) the cost price decreased by 20.27% or 445 255 thousand rubles;
c) gross profit decreased by 40.47% or 340 169 thousand rubles;
d) selling expenses decreased by 28.73% or 9853 thousand rubles;
e) management expenses decreased by 8.04% or 45 936 thousand rubles;
f) profit from sales in 2018 decreased to a loss in 2019 by 284,380 thousand rubles.

The excess of other expenses over the company's income in 2019, as well as the resulting loss from sales, did not allow them to work with a net profit. As a result, a loss of 71,280 thousand rubles was recognized. The deterioration of the economic situation in the country this year negatively affected the activities of many manufacturing enterprises.

For the period 2019-2020 the situation is changing for the better. Revenues and expenses from core activities grew, which led to a positive financial result of core activities - profit from sales.

The following changes have occurred in the composition of the assets of some joint stock companies:

a) in 2018-2019 non-current assets increase by 11.85% or 231 759 thousand rubles. The reason for this was the growth of fixed assets (an increase of 7.30%), other non-current assets (an increase of 150.03%). The cost of financial investments decreased by 12.34% or 4268 thousand rubles;

b) in 2018-2019 current assets are reduced by 2.06% or 21 559 thousand rubles, which was affected by a decrease in inventories (by 11.0% or 74 711 thousand rubles), as well as a decrease in cash (by 92.13% or 140 821 thousand roubles.);

c) in 2019-2020. the value of non-fixed assets increased: the increase was 45.24% or 989,284 thousand rubles. due to an increase in other non-current assets by 600.21% or 710 509 thousand rubles, deferred tax assets - by 4168.50% or 7525 thousand rubles. The cost of fixed assets also increased by updating them for new production: by 11.51% or 231,260 thousand rubles .;

d) the value of current assets in 2019-2020 increased by 37.26% or 381 350 thousand rubles. due to the strong increase in the provision of the enterprise with cash: by 579.47% or 68 686 thousand rubles, increase in the value of reserves - by 35.81% or 216 484 thousand rubles. At the same time, receivables decreased by 11.23% or 37 323 thousand rubles, which can be regarded as a positive phenomenon in the liquidity of KMZ JSC, which is associated with cash inflows in 2019-2020.

So, according to the results of the dynamics assessment, the total value of the assets of the enterprise increased as a whole in the analyzed period 2017-2020, while the growth in 2018-2019 amounted to 7.01% or 210,200 thousand rubles., in 2019-2020 - 42.70% or 1,370,634 thousand rubles.

General decrease in equity capital of KMZ JSC in 2018-2019 amounted to 71,155 thousand rubles. or 3.45% due to the resulting loss in 2019, in 2019-2020. equity increased by 0.07% or 1457 thousand rubles. for the capitalization of net profit in 2020.

Significant increase in the cost of sources of funds of KMZ JSC in 2019-2020 was associated with an increase in liabilities (both long-term and short-term ones): in 2020, a long-term loan (185,834 thousand rubles) and a short-term loan (262,022 thousand rubles) were received. In addition, accounts payable increased: by 10.98% or 42 035 thousand rubles. in 2018-2019, and by 17.99% or 76 392 thousand rubles. in 2019-2020. It should be noted that the growth of liabilities will negatively affect the financial condition of the enterprise.

Non-current assets account for the largest share in the structure of assets: 65.17% in 2018, 68.17% in 2019 and 69.34% in 2020, which fully justifies production activities, which are usually associated with a large diversion of capital to production security means of labor. The share of current assets in the analyzed period gradually decreased from 34.83% in 2018, to 31.88% in 2019 and to 30.66% in 2020.

Let us also analyze the structure of sources of financing the activities of the production enterprise KMZ JSC, highlighting the share of equity and the share of obligations (borrowed capital). The results of this assessment are presented in table 6.

As for the sources of financing the activities of KMZ JSC, in 2018 the enterprise had a high provision with its own capital, whose share was 68.72%. In 2019, the share of equity due to losses decreased to 62.0%, in 2020 - to 43.48%. Thus, the company's dependence on external sources of financing activities is increasing: the share of short-term liabilities increased from 12.76% in 2018 to 22.41% in 215 and a further increase to 24.50% in 2020; the share of long-term liabilities decreased from 18.52% in 2018 to 15.59% in 2019 and further doubled to 32.02% in 2020. Thus, the share of equity capital of KMZ JSC was at the level of 68.72% –43.48% in 2018–2020, the share of borrowed capital was 31.28% –56.52% in 2018–2020.

Thus, at present, the following conditions have been developed for the Ural region:

- loans, payables;
- solvency;
- financial instability;
- lack of equity.

Results

The study showed that there are various methods for assessing insolvency, which are used to calculate the probability of the occurrence of the risk of insolvency of enterprises, according to the developed criteria. In practice, today several types of techniques are used, which have their own distinctive features. The historical aspect of the occurrence is presented in table 1.

Initial use / Year of development	The name of the developed methodology for assessing solvency
1	2
1909 year to present	Rating Models Moody's
1916 year to present	Rating Models S&P
1924 year to present	Rating Models Fitch
1868	Z- Altman model
1977	Model Zeta
1999	The technique of Dontsova and Nikiforova
2000	Moody's KMV RiskCalc v1.0
2010	Moody's KMV RiskCalc v3.1 Russia
2011	Sinelnikova Model
2011	Interfax Business Intelligence Model
2013	Interfax Financial Risk Assessment Model

Tabl. 1. The evolution of methods for assessing solvency

One of the first models developed by Edward Altman, a professor of finance at New York University, the "Z-model", as the author called it, arose in 1968 and became really one of the most used in practice and successful for assessing the solvency of the enterprise. The "Z-model" allows you to assess the likelihood of a company default on the basis of calculated financial indicators. On its basis, other scientists began to develop new models based on the analysis of indicators, the informational basis for the calculation of which was represented by accounting data. The Altman model was developed using multiple linear discriminant analysis, which allowed the selection of significant variables. Its construction consists in the process of sequential inclusion and exclusion of variables in the model in order to improve its prognostic ability.

Initially, the model included 22 variables, 22 different financial factors. The choice of financial factors for the model was made on the basis of discriminant analysis of 33 "good" companies and 33 "bad" companies. The variables with the least statistical significance were excluded from the model, after which the analysis of the significance of the variables was repeated.

As a result, the model began to include only five significant variables, presented in Table 2.

Factor variable (x_n)	The average value of the group of insolvent companies, %	Sustainable Group Average, %	F-statistics
Equity / Total value of assets	- 6,1	41,4	32,60
Retained earnings / Total value of assets	- 62,6	35,5	58,86
Profit before tax / Total value of assets	- 31,8	15,4	26,56
Market value of capital / Балансовая стоимость обязательств	40,1	247,7	33,26
Выручка от продажи / Total value of assets	150	190	2,84

Tabl. 2. Assessment of factors used in the calculations of Altman

Elimination of the fifth variable has already led to a decrease in the predictive ability of the model. Based on this fact, it was concluded that the discriminant five-factor function has the greatest prognostic power. Imagine a general view of the model:

$$Z = 1{,}2x_1 + 1{,}4x_2 + 3{,}3x_3 + 0{,}6x_4 + 0{,}999x_5, \qquad (1)$$

where Z – solvency index;
xn – value n- factor.

According to the results of the analysis revealed that the critical values of the index solvency (Z) are set at 1.81 and 2.99. This means that those enterprises whose index value was determined to be less than 1.81 have a high probability of bankruptcy or default in the near future, such enterprises are categorically insolvent. For those enterprises for which the solvency index (Z) was determined to be more than 2.99, the probability of bankruptcy or default is low, such enterprises are classified as financially stable. If the solvency index assumes a value between 1.81 and 2.99, it is difficult to predict the likelihood of a default occurring.

The approach of the model is to classify companies into two groups: companies that are unconditionally insolvent, and companies that are financially stable.

The results of enterprise testing have led to the conclusion that Altman's "Z-model" provides a more accurate forecast of the likelihood of an organization defaulting in the course of one to two years. But it is possible to apply it only to large enterprises that compile a full set of financial statements (small enterprises submit a simplified version of the balance sheet and a report on financial results, and do not make an appendix to these reporting forms, due to which there is a difficulty in accessing data for analysis) . Therefore, it is advisable to supplement the solvency assessment with an analysis of cash flows, which will provide a real picture of the amounts received and spent cash, identify the risks of cash shortages by a certain date and allow you to develop a schedule of receipts and payments for cash flow management. Thus, the hypothesis that the analysis of cash flows will assess the risks of insolvency.

Let us evaluate the capabilities of the analysis and assessment model of insolvency risk in relation to a manufacturing enterprise, present the rationale for the goals of each direction in the proposed model, the coefficients used (table 3).

Direction of analysis and assessment of insolvency risk	Purpose of analysis	The composition of the coefficients
1	2	3
1. Assessment of balance sheet liquidity and calculation of liquidity ratios	Group assets by the rate of conversion into cash (and liabilities by the degree of urgency of repayment of obligations) to characterize the security of the most liquid assets, determine the possibility of repayment of the most urgent obligations	1.1. Grouping assets by liquidity: A1 – absolutely liquid assets; A2 – fast-selling assets; A3 – slow-moving assets; A4 – hard-to-sell assets. 1.2. Grouping of liabilities by the degree of urgency of repayment of obligations: П1 – most urgent obligations; П2 – current liabilities; П3 – long-term obligations; П4 – permanent liabilities. 1.3. Liquidity ratios: absolute liquidity; intermediate (urgent) liquidity; current liquidity.
2. Assessment of loss (recovery) of solvency	Determine the trend of decrease (increase) in current liquidity	2.1. Solvency loss ratio; 2.2. Solvency recovery ratio; 2.3. Factor analysis of current liquidity.
3. Assessment of current assets turnover	Determine the efficiency of resource use by the enterprise by calculating the duration of circulation of current assets	3.1. Current assets turnover ratio; 3.2. Cash turnover ratio; 3.3. Accounts receivable turnover ratio; 3.4. Accounts payable turnover ratio; 3.5. Inventory turnover ratio.
4. Cash flow liquidity assessment	Determine the sufficiency of the cash flow for all settlements and payments	Liquidity ratios: 4.1. Cash flow from current operations; 4.2. Cash flow from investing operations; 4.3. Cash flow from financial transactions; 4.4. Total cash flow; 4.5. The total cash flow, taking into account the cash balance at the beginning of the period.

5. Cash Flow Evaluation	Determine the possibility of forming an enterprise free stock of cash on a certain date after all settlements and payments	Performance ratios: 5.1 Cash flow from current operations; 5.2. Cash flow from investing operations; 5.3. Cash flow from financial transactions; 5.4. Total cash flow.
6. SWOT analysis in terms of insolvency risk	Determine the company's ability to repay existing obligations, identify threats, insolvency risks and outline ways to reduce them	6.1. Strengths based on solvency analysis; 6.2. Weaknesses; 6.3. Possibilities of the enterprise regarding timely repayment of obligations; 6.4. Threats to insolvency.

Tabl. 3. Model analysis and assessment of the risk of insolvency of the enterprise

Perhaps the most important in the proposed assessment model is the analysis of cash flows, and its relationship with the balance sheet in terms of assessing the sufficiency of liquid assets to repay liabilities. Therefore, it is proposed to analyze and assess insolvency risk not only according to the account balances on which the balance sheet was drawn up, but also using a cash flow statement that details the sources of cash inflows and the calculations made with their help.

The liquidity of assets and the urgency of repayment of obligations according to the balance sheet of the enterprise is determined approximately (after all, the balance is drawn up at a certain date and the level of liquidity may change depending on the duration of the analyzed periods). So, the liquidity of stocks depends on the turnover of each element in the structure of stocks, on the share of stale materials and finished products. The liquidity of receivables depends on the share of overdue payments in the general structure of receivables, the rate of repayment of debts, and the share of buyers unrealistic for collecting debts in the total debtors' debt structure. An increase in the share of overdue receivables and illiquid stocks indicates a decrease in the liquidity of current assets. For these reasons, an enterprise may have a high level of liquidity ratios, but in reality be insolvent. Therefore, it is very important to supplement the balance sheet liquidity assessment and the calculation of liquidity ratios with an analysis of current assets turnover.

Conclusions

According to the results of the study, we can draw conclusions about the achievement of its goals and objectives, namely:

1) the approaches of various authors to the basics of analysis and assessment of the risk of insolvency of an enterprise are disclosed.

Solvency of an enterprise is its financial ability to meet the payment requirements of suppliers of equipment and materials in full and in full in accordance with contractual obligations, repay bank loans, pay salaries to staff, and make obligatory payments to the budget and extra-budgetary funds. Thus, insolvency is a failure to fulfill the above obligations. The causes of the risk of insolvency or financial insolvency can be divided into three groups:

a) lack of desire to fulfill current obligations;

b) the lack of cash or liquid assets by which these obligations can be repaid;

c) improper use of working capital (the formation of large amounts of receivables, which increases the risks of its transition to overdue debts, the overstatement of the usual need for stocks and the formation of stocks of raw materials in stock, etc.);

Analysis and assessment of business risks, including the study of insolvency risk, are considered in the work of many scientists. But a complete analysis technique was presented only by D.S. Kudryavtsev, and only on the example of small businesses and from the standpoint of assessing the solvency of counterparties, and not the enterprise itself.

The author of this study concluded that it is advisable to supplement the solvency assessment with an analysis of cash flows, which will provide a real picture of the amounts of cash received and spent, will identify the risks of cash shortages by a certain date and develop a schedule of receipts and payments in order to manage cash flows;

2) the necessity of developing a model for analyzing and assessing the risk of insolvency of an enterprise, an algorithm for its application, is substantiated.

An analysis of the theoretical approaches of various authors, presented in the work earlier, made it possible to formulate the author's own position regarding the methodology for analysis and assessment of insolvency risks, and to develop a model of this area of financial analysis in relation to a manufacturing enterprise. The proposed model includes the following areas of analysis and evaluation:

a) assessment of liquidity balance and calculation of liquidity ratios;

b) an assessment of the turnover of current assets;

c) assessment of liquidity and cash flow efficiency;

d) assessment of loss (restoration) of solvency;

e) SWOT analysis, identifying risks of a decrease in the liquidity of the enterprise;

3) testing of an improved methodology for the analysis and assessment of the risk of insolvency of the enterprise on the example of JSC "KMZ"

The adoption of this Concept is designed to achieve the following results:

a) timely analysis of the solvency of the enterprise and the identification of threats to reduce it;

b) the development of managerial decisions aimed at restoring solvency or increasing it upon reaching established liquidity standards, as well as increasing asset turnover and financial performance on this basis.

Assessment of the financial condition of JSC "KMZ" according to the financial statements for 2014-2016. showed the following:

a) increases the security of both non-current and current assets necessary for the production activities of the enterprise;

b) the main source of financing assets became liabilities (loans, payables), the share of equity for the period 2014-2016 decreased almost twice, which negatively affects the financial stability of KMZ JSC;

c) the situation with absolute and intermediate liquidity is extremely difficult, only in the long term will KMZ JSC be able to repay its short-term liabilities (it is also taken into account that the balance sheet drawn up at the end of the year may not include large cash balances on the company's accounts)

The main problems in the activities of KMZ JSC, to which management impact should be directed, were identified as follows: a high share of stocks (in particular, finished goods in stock) and receivables in the assets structure of KMZ JSC and a low level of absolute and intermediate liquidity . The solution to these problems within the framework of the liquidity management concept was proposed in two ways:

a) a reduction in inventories in terms of the sale of 50% of finished product balances in the warehouse (at the same time, 50% of finished products in the production program are included with an advance payment of 50%);

b) the use of factoring to repay short-term receivables and change the terms of circulation of receivables.

The reduction of the part of the finished product balances in the warehouse will change the asset structure of the production plant of KMZ JSC, increase the cash supply, the level of absolute liquidity of KMZ JSC and the liquidity of its balance sheet.

Selling accounts receivable into factoring of PJSC Promsvyazbank in the amount of 70% of the amount of available receivables of KMZ JSC with a commission of 9.5% will increase the turnover of accounts receivable from 46 days to 13 days in the 2025 plan.

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