Economic-Mathematical Modeling of the Enterprise Solvency Risk Assessment

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ABSTRACT

This article describes the methodological approaches to the development of a model of capital structure optimization analysis taking into account the factors affecting the ratio of capital structure optimization: The criterion of return on equity maximization with a minimum level of financial risks. In the process of selecting the optimal source of funding, both quantitative and qualitative indicators of the availability of funding channels were evaluated. A significant role is played by the evidence schemes of the practical application of the model, which contributes to the growth of capital, and increase its share in the overall structure of sources of financing. The purpose of this paper is to present a methodological approach to the development of capital structure optimization analysis model. As a measure of dependence factor analysis of return on equity is used. It is shown that the factor model takes into account various methodological approaches to the development of evaluation of the structure of sources of financing activities, the efficiency of use of equity and debt capital, the development of management decisions aimed at optimizing the capital structure to increase capital productivity. This article uses regression analysis to predict the profitability of financial activities.

Keywords: Solvency, Cash Flows, Analysis Model, Risk Assessment, Balance Liquidity, Finance, Comparative Analysis, Liabilities
JEL Classifications: Q12, O18, R51

1. INTRODUCTION

In modern economic conditions, the risk of insolvency is large enough and "financial discipline" suffers. Therefore, great importance is attached to analyzing solvency, assessing liquidity, assessing the risks of insolvency and the likelihood of bankruptcy.

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

In addition to accounts receivable, the analysis of solvency pays attention to reserves, since the formation of large stocks of goods or raw materials for the production of products adversely affects solvency, and withdraws money from circulation. But the main form of reporting, in which the company's payment history is most informative, is a cash flow statement. It is through this form of reporting that it is possible to track which lines of activity the company made settlements and payments, what cash inflows were formed, to what extent all liabilities were discharged, what balances of cash are available to the enterprise after the calculations, what was the level liquidity and efficiency of its cash flows. Therefore, the analysis of cash flows will directly show what insolvency risks can be in the modern economy.

In recent years, solvency assessment issues have become increasingly widespread in the economic literature, and are also the subject of discussions and discussions in various forums.

The relevance of our study is to develop a model for analyzing and assessing the risk of insolvency, which will combine to 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 different approaches of different authors to the basics of analysis and assessment of insolvency risk;
- Justify the development of the analysis and risk model and determine the algorithm for its application;
- Develop a methodology for analyzing and assessing the risk of insolvency at Russian enterprises;
- Develop a concept of a liquidity management model to reduce the risk of insolvency.

In our study, we proceeded from a number of hypotheses:
- Indicators of the presence of receivables (both short-term and long-term) contribute to growth and "brake" liquidity. There is a growing violation of payment discipline from buyers and debtors.
- The activity of financial management in any field of activity can not do without the realization of the products manufactured (rendering services or performing work depending on the chosen line of business) with a deferred payment to the buyer, which leads to the formation of accounts receivable. Under the contract, the supplier of the goods represents the period during which the products shipped to the buyer (works performed or services rendered) are paid. In this case, the main point is the payment of products (works, services) at a specific time. If the payment terms have passed, and the buyer has not paid for the products (works, services), then the receivables go into the category of doubtful, overdue. Therefore, important in the work of enterprises and organizations in the process of managing accounts receivable is the prevention of the moment when real receivables become overdue, establishing such relationships with buyers that would prevent a breach of payment discipline on their part.

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

The need to develop a concept of a theoretical and methodological model for assessing enterprise insolvency risk management, based on the introduction of innovative approaches to assessing the liquidity of cash flows.

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

2. LITERATURE REVIEW

According to the statements of Gladkovskaya (2015) and Gradov (2014), the main indicator of the approaching bankruptcy of the organization is the suspension of all currently available payments, as well as the lack of the possibility of paying settlements with creditors within the next three months, starting from the date of

payment under the contracts. In the author's opinion, the failure to fulfill the production plan and the sale of goods, the increase in the cost of production, the failure to meet the profit plan and, as a result, the deficit of the organization's own funds, as a cause of insolvency, can be identified as the reason for insolvency.

However, according to Savitskaya and Volosevich (2015), Duisenbaeva (2016), Ilyina (2017). Lyagoshina (2017), Nagapetyan and Tronin (2017), the reason for the deteriorating solvency - unreasonable and inappropriate management of the company's current assets, for example, the formation of accounts receivable, which expired the payment period, the excessive acquisition of stocks and materials, Dontsova and Nikiforova (2015) believe that the reason for the insolvency of the enterprise may be covered in non-payment of taxes in a timely manner, thereby leading to unnecessary costs for the payment of fines, penalties.

According to Smirnov (2015), Baranov and Karsaev (2017). the solvency of the enterprise is extremely variable. For example, when the maturity of accounts payable and the absence of funds in the bank come due to late payment of goods for goods previously delivered to customers, the enterprise will become insolvent due to the financial indiscipline of its debtors. Even though the company has a liquid balance in terms of its assets and has the ability to raise borrowed funds.

According to Kudryavtseva (2015), Babintseva (2014), Gubarenko (2016). the definition of solvency as the ability of the debtor to fulfill obligations at the approach of the term corresponds to reality, but none of the researchers presented above believed that not only the ability to fulfill obligations, but also the desire is needed. Zotova, Faschevsky and Hadieva (2017). Thus, failure is the impossibility and/or unwillingness of the debtor to fulfill obligations when the time comes. In practice, an assessment of the risk of insolvency should be made before the conclusion of the transaction. An insolvency risk assessment should be conducted using the same methods that creditors use. Thus, when granting a loan, the creditor assesses the risk of insolvency of the borrower. A positive assessment of the insolvency risk allows the lender to lend. The borrower's assessment of his own insolvency is necessary to appeal of a loan lender. A similar situation is repeated in such a sphere of trade and services, in the process of buyer-seller relations. Thus, the reasons for the risk of insolvency in accordance with Kudryavtsev (2015):
a. Lack of desire to fulfill current obligations;
b. The lack of cash or liquid assets through which these obligations can be repaid. It is most interesting to study the experience of regions successfully implementing projects in assessing the risks of insolvency.

3. RESEARCH MATERIALS

3.1. General Characteristics of Research Facilities
The study was conducted on materials of the Urals Federal District (hereinafter Ural Federal District).

The most important branch and pride of the industry on the Urals District is engineering. In the UFO almost 10% of the country's

machine-building production is produced. Enterprises of this industry produce up to 60.8% of freight railcars of the Russian Federation, 21% of bridge structures. The equipment with the brand of the Ural enterprises, distinguished by uniqueness and high quality, is installed at the leading petrochemical, metallurgical and machine-building plants in Russia. Ural machine-building enterprises are the largest exporters of their products on world markets. The developed enterprises of the machine-building 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 Constructors, ZAO Welding Electrode Plant, Neftemash OJSC, Tyumen Battery Plant, Tyumen Shipyard, and others.

The study was conducted on the basis of materials from Russian enterprises that produce and sell more than 50 types of dressing and mining equipment. Our research was conducted at the regional joint-stock companies, whose task is to produce quality products aimed at meeting the needs of buyers, which are not only the representatives of the Russian Federation, but also the near abroad: 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 2014–2015 gg.there is a decrease income and expenses from operating activities:
a. Sales revenue decreased by 25.86%, or 785,424 thousand rubles;
b. The cost of production decreased by 20.27%, or 445,255 thousand rubles;
c. Gross profit decreased by 40.47%, or 340,169 thousand rubles;
d. Commercial 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 2014 decreased to a loss in 2015 by 284,380 thousand rubles.

The excess of other expenses over the company's revenues in 2015, as well as the loss from sales, did not allow them to work with a net profit. As a result, a loss of RUR 71,280 thousand was recognized. The deterioration of the economic situation in the country this year had a negative impact on the activities of many manufacturing enterprises.

For the period 2015–2016 years the situation is changing for the better. Revenues and expenses from core activities increased, which led to a positive financial result of core business - sales profit.

3.2. Characteristics of Financial Activities of Enterprises
As part of the assets of some joint-stock companies the following changes occurred:
a. In 2014–2015 g. 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 2014–2015 year the current assets decrease by 2.06%, or 21,559 thousand rubles, which was due to a decrease in inventories (by 11.0%, or 74,711 thousand rubles), and a decrease in cash (by 92.13% or 140,821 thousand rubles);
c. In 2015–2016 years the value of non-current assets increased: The increase was 45.24%, or 989,284 thousand rubles. Due to the increase in other non-current assets by 600.21%, or 710,509 thousand rubles, deferred tax assets - by 4,168.50%, or 7525 thousand rubles. The value of fixed assets also increased due to their renewal for a new production: by 11.51%, or 231,260 thousand rubles;
d. At the same time, accounts receivable decreased by 11.23%, or 37,323 thousand rubles, which can be regarded as a positive phenomenon in the liquidity of JSC "KMZ," which is connected with the inflow of cash in 2015–2016.

So, based on the results of the assessment of the dynamics of the total value of assets the enterprise has increased in the whole in the analyzed period of 2013–2016, while the growth in 2014–2015 amounted to 7.01%, or 210,200 thousand rubles, in 2015–2016– 42.70%, or 1,370,634 thousand rubles.

General decrease in equity capital of JSC "KMZ" in 2014–2015 amounted to 71,155 thousand rubles, or 3.45% due to the loss in 2015, in 2015–2016 own capital increased by 0.07%, or 1457 thousand rubles. The capitalization of the net profit of 2016.

Significant increase in the cost of the sources of funds of JSC "KMZ" in 2015–2016. It was associated with an increase in liabilities (both long-term and short-term) Long-term loans were obtained in 2016 (185,834 thousand rubles.) and short-term loan (262 022 thousand rubles..). In addition, accounts payable grew by 10.98%, or 42,035 thousand rubles in 2014–2015, and by 17.99%, or 76,392 thousand rublesin 2015–2016 years. At the same time, it should be noted that the growth of liabilities will negatively affect the financial condition of the enterprise.

In the structure of assets largest share of non-current assets: 65.17% in 2014, 68.17% in 2015 and 69.34% in 2016, which justifies production activity, which is usually associated with a large diversion of capital the availability of means of labor. The share of current assets in the analyzed period gradually decreased from 34.83% in 2014, to 31.88% in 2015 and to 30.66% in 2016.

We will also analyze the structure of sources of financing the activities of the production enterprise of JSC "KMZ," by allocating a share of own capital and a share of liabilities (borrowed capital). The results of this evaluation are presented in Table 1.

As for the sources of financing activities of JSC "KMZ," in 2014 the enterprise had a high level of its own capital, the share of which was 68.72%. In 2015, the share of own funds due to losses decreased to 62.0%, in 2016–43.48%. Thus, the increased dependence of the enterprise from external funding sources: The share of short-term liabilities increased from 12.76% in 2014 to 22.41% in the year 215, and a further increase to 24.50% in 2016;

the share of long-term liabilities decreased from 18.52% in 2014 to 15.59% in 2015 and subsequently doubled to 32.02% in 2016. Thus, the share of equity capital of JSC "KMZ" has been at the level of 68.72–43.48% in 2014–2016, the proportion of debt capital - 31.28–56.52% in 2014–2016.

Thus, at the present time for the Ural region the following conditions have been developed:
- Loans, accounts payable;
- Solvency;
- Financial instability;
- Lack of equity.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. World Trends in Models of Analysis and Assessment of Insolvency Risks

The study showed that there are different methods of assessing insolvency, which are used to calculate the probability of occurrence of insolvency risk of enterprises, according to the criteria worked out. In practice today, several types of techniques are used, which have their own distinctive features. The historical aspect of their occurrence is presented in Table 2 Kolesnik (2017).

One of the first models developed by Edward Altman, a finance professor at New York University, the "Z-model," as the author called it, arose in 1968 and became truly one of the most applied practically and successfully for assessing the solvency of an enterprise. "Z-model" allows you to assess the probability of default of a company based on calculated financial indicators. On its basis, other scientists began to develop new models based on the analysis of indicators, the information basis for the calculation of which was represented by accounting data. The Altman model was developed using multiple linear discriminant analysis, which allowed selecting significant variables. Its construction consists in the process of sequential inclusion and exclusion of variables in the model in order to improve its predictive 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 a discriminant analysis of 33 "good" companies and 33 "bad" ones (Kovalenko, 2016). Variables with the least statistical significance were excluded from the model, after which the analysis of the importance of the variables was repeated (Luneva 2017).

As a result, the model began to include only five significant variables presented in Table 3.

Table 1: Estimation of the change in the value of the current assets of JSC "KMZ" after the reduction of inventories

Indicator name	Indicator value			Economic effect
	On 31.12.2016	Change in the entered event 1	Plan 2018	
1	2	3	4	5
1. Cash assets, thousand rubles	81,713	+197,576	279,289	+197,576
2. Financial investments are short-term, thousand rubles	11,035	-	11,035	-
3. Receivables, thousand rubles	294,898	-	294,898	-
4. Stocks, total	821,090	-197,576	623,514	-197,576
Iincluding finished products in stock	395,151	-197,576	197,575	−197,576
5. Short-term liabilities, thousand rubles	1,122,175	-	1,122,175	

Table 2: Evolution of solvency assessment techniques

Initial application/year of development	The name of the developed methodology for assessing solvency
1	2
1909 year to the present	Rating Models Moody's
1916 year to the present	Rating Models S&P
1924 year to the present	Rating Models Fitch
1868	Z-model of Altman
1977	Model Zeta
1999	The methodology of Dontsova and Nikiforova
2000	Moody's KMV RiskCalc v1.0
2010	Moody's KMV RiskCalc v3.1 Russia
2011	Model Sinelnikova
2011	The model of business diligence of the company Interfax
2013	The model of financial risk assessment of Interfax

Table 3: Assessment of the factors used in Altman's calculations

The factor variable (X_n)	The average value for a group of insolvent companies, %	The average value for a group of sustainable companies, %	F - statistics
Own working capital/total value of assets	−6.1	41.4	32.60
Retained earnings/total value of assets	−62.6	35.5	58.86
Profit before taxation/total value of assets	−31.8	15.4	26.56
The market value of capital/carrying amount of liabilities	40.1	247.7	33.26
Sales revenue/total value of assets	150	190	2.84

Elimination of the fifth variable has already led to a decrease in the predictive ability of the model. Proceeding from this fact, it was concluded that the most predictive force is the discriminant five-factor function. Let's represent the 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 - index of solvency;
x_n - value n-factor a.

Based on the results of the analysis, it was 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 <1.81, there is a high probability of bankruptcy or default in the near future, such enterprises are among the group of unconditionally insolvent. For those enterprises for which the value of the solvency index (Z) was determined to be greater than 2.99, the probability of bankruptcy or default is low, such enterprises are classified as financially stable. In the event that the solvency index takes a value between 1.81 and 2.99, it is difficult to forecast the probability of default.

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 the enterprise testing made it possible to conclude that Altman's "Z-model" represents a more accurate prediction of the likelihood of an organization defaulting in the interval of one to two years. But it can only be applied to large enterprises that make up a complete set of accounting records (small businesses give a simplified version of the balance sheet and the financial results report, and do not form an appendix to these forms of reporting, which makes it difficult to access the data for analysis. Therefore, it is advisable to supplement the solvency assessment with an analysis of cash flows, which will present a real picture of the amounts received and spent money, identify the risks of insufficiency of funds by a certain date and allow the development of a schedule of receipts and payments to manage cash flows. Thus, the hypothesis is confirmed that it is the analysis of cash flows that will allow us to assess the risks of insolvency.

4.3. Opportunities and Experiences of Applying the Model of Analysis and Assessment of Insolvency Risk

We will assess the possibilities of the model for analyzing and assessing the insolvency risk applied to manufacturing enterprises, present the rationale for the objectives of each direction in the proposed model, and the coefficients used (Table 4).

Perhaps the most important in the proposed valuation model is the analysis of cash flows and its relationship with the balance sheet in terms of assessing the adequacy of liquid assets to pay off liabilities. Therefore, it is proposed to analyze and assess the insolvency risk not only from the balances on the accounts for which the balance sheet was compiled, but also using a cash flow statement that details the sources of cash inflows and calculations made with their help.

Liquidity of assets and maturity of liabilities according to the balance sheet of the enterprise are determined approximately (after all, the balance is made on a certain date and depending on the duration of the analyzed periods, the liquidity level may change). So, the liquidity of reserves depends on the turnover of each element in the structure of stocks, on the share of stale materials and finished products. Liquidity of accounts receivable depends on the share of overdue payments in the overall structure of accounts receivable, the speed of debt repayment, the share of buyers unrealistic in collecting debt in the overall debt structure of debtors. The 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 assess the liquidity of the balance sheet and calculate the liquidity ratios to be supplemented by an analysis of the turnover of current assets.

5. ESTIMATION OF LIQUIDITY AND EFFICIENCY OF CASH FLOWS

The estimation of cash flows will begin with an assessment of the dynamics and structure of cash flows by types of operations of JSC "KMZ," presented in the Cash Flow Statement (Form #4): Current, financial and investment. The results of calculating the increment in the value of inflows and outflows of cash, as well as their structure, are presented in Table 5.

Based on the results of the assessment, cash inflow from the current operations of JSC "KMZ" for the period 2015–2016 decreased by 17.00%, spending money - by 26.55%, which led to the formation of excess cash flow (the difference between inflow and outflow) of cash in 2016 against the deficit in 2015. The largest share in the structure of cash flows from current operations is taken by proceeds from the sale of products - 99.90% in 2015 and 84.51% in 2016, which is quite consistent with the activities of the manufacturing enterprise.

The inflow of cash from investment operations of JSC "KMZ" increased by 210.31% mainly due to the sale of non-current assets (fixed assets), the outflow of funds also increased, but more significantly - by 1217.26% due to the acquisition of new and modernization of existing basic facilities means. At the same time, the deficit of cash from investment operations (cash flow balance) increased in 2015–2016 very considerably.

The inflow of cash from financial transactions increased by 83.18% due to the receipt of a new loan, the outflow of funds also increased - by 56.29% in connection with the repayment of the principal debt on credit obligations. Nevertheless, the balance of cash flows from financial transactions in 2015–2016 remained positive, and there was a positive trend - by 391.58%.

Thus, the main problem in the cash flow of JSC "KMZ" was the decrease in sales volumes, and as a result, revenues from current operations decreased. JSC "KMZ" in 2016 carried out the modernization of fixed assets, so the time spent on installing new

Table 4: Model of analysis and assessment of insolvency risk of the enterprise

Direction of analysis and assessment of insolvency risk	Purpose of analysis	Composition of coefficients
1	2	3
1. Estimation of liquidity of balance sheet and calculation of liquidity ratios	Group assets by the rate of conversion into cash (and liabilities by the degree of maturity of obligations) to characterize the provision of the most liquid assets, determine the possibility of repayment of the most urgent obligations	1.1. Grouping of assets by liquidity: A1 - absolutely liquid assets; A2 - quickly sold assets; A3 - slowly sold assets; A4 - hard-to-sell assets. 1.2. Grouping of liabilities by the degree of maturity of obligations: P1 - the most urgent obligations; P2 - short-term liabilities; P3 - long-term liabilities; P4 - constant liabilities. 1.3. Coefficients of liquidity: absolute liquidity; intermediate (urgent) liquidity; current liquidity
2. Estimation of loss (restoration) of solvency	Determine the trend of decrease (increase) in current liquidity	2.1. Coefficient of loss of solvency; 2.2. Coefficient of restoration of solvency; 2.3. Factor analysis of current liquidity
3. Estimation of turnover of current assets	Determine the efficiency of resource use by the enterprise by calculating the duration of circulation of current assets	3.1. Coefficient of turnover of current assets; 3.2. Coefficient of turnover of funds; 3.3. Coefficient of turnover of accounts receivable; 3.4. The coefficient of turnover of accounts payable; 3.5. Inventory turnover ratio
4. Estimation of liquidity of cash flows	Determine the adequacy of the inflow of funds to make all payments and payments	Coefficients of liquidity: 4.1. Cash flow from current operations; 4.2. Cash flow from investment operations; 4.3. Cash flow from financial transactions; 4.4. Aggregate cash flow; 4.5. Total cash flow taking into account the balance of cash at the beginning of the period
5. Estimation of the efficiency of cash flows	Determine the possibility of the enterprise forming a free stock of cash on a certain date after the completion of all payments and payments	Coefficient of effectiveness: 5.1 Cash flow from current operations; 5.2. Cash flow from investment operations; 5.3. Cash flow from financial transactions; 5.4. Total cash flow
6. SWOT-analysis from the point of view of occurrence of insolvency risk	Identify the enterprise's ability to pay off existing liabilities, Identify threats, risks of insolvency and outline ways to reduce them	6.1. Strengths based on the analysis of solvency; 6.2. Weak sides; 6.3. Opportunities of the enterprise in terms of timely repayment of obligations; 6.4. Threats to insolvency

equipment and modernizing the existing one, led to the idle time of the existing equipment park, and as a result, fewer products were manufactured, which reduced the sales proceeds.

We will assess the liquidity and efficiency of cash flows of JSC "KMZ" according to Table 5, using formulas (1)–(8), according to the first chapter of this study (Table 6).

Based on the results of the calculations in 2015, there were indeed problems with the level of solvency, there was insufficient funds received to pay off existing obligations. Thus, the value of the liquidity ratio of the aggregate cash flow is <1 (0.972) at the rate of 1000. Therefore, all settlements and payments were made at the expense of available cash balances at the beginning of 2015, which is confirmed by the calculation of the liquidity ratio of the

aggregate cash flow taking into account the cash balances at the beginning of the period.

In 2016, the situation improves: The value of the liquidity ratio of the aggregate cash flow was 1.013, while the cash at the beginning of the year was sufficient, the liquidity ratio, including cash balances at the beginning of 2016, was 1.016.

Very low level of liquidity of cash flows from investment operations - 0.223 in 2015, with a decrease to 0.053 in 2016, which is due to excess cash outflows over the inflow.

Concerning the efficiency of cash flows, one can see a situation similar to their liquidity: In 2015, a shortage of funds led to the formation of inefficient cash flows, in 2016 the situation improves,

Table 5: Assessment of the dynamics and structure of cash flows of JSC "KMZ"

Indicator name	Value, thousand roubles		Growth	Specific gravity, %	
	2015	2016	2015–2016, %	2015	2016
1	2	3	4	5	6
1. Cash flows from current operations					
1.1. Cash inflow, total	3,597,384	2,985,771	−17.00	100.00	100.00
From the sale of products	3,593,738	2,523,280	−29.79	99.90	84.51
Lease payments	0	489	-	0.00	0.02
Other supply	3646	462,002	12,571.48	0.10	15.47
1.2. Expenditure of funds, total	3,800,468	2,791,545	−26.55	100	100
Suppliers (contractors) for raw materials, materials, works and services	1,936,988	951,507	−50.88	50.97	34.09
Interest on debt	21,560	36,932	71.30	0.57	1.32
Remuneration of employees	828,856	874,325	5.49	21.81	31.32
other payments	1,013,064	928,781	−8.32	26.66	33.27
1.3. Cash flow from current operations	−203,084	194,226	195.64	-	-
2. Cash flows from investment operations					
2.1. Cash inflow, total	11,096	34,432	210.31	100.00	100.00
Sale of non-current assets	385	3499	808.83	3.47	10.16
Dividends, interest on debt financial investments, income from equity participation in other organizations	10,710	30,556	185.30	96.52	88.74
Repayment of loans granted	0	4	-	0.00	0.01
Other supply	1	373	37200.00	0.01	1.08
2.2. Expenditure of funds, total	49,712	654,836	1217.26	100.00	100.00
Acquisition, creation, reconstruction of non-current assets	49,712	550,904	1008.19	100.00	84.13
Interest on debt obligations included in the value of an investment asse	0	4769	-	0.00	0.73
Other payments	0	99163	-	0.00	15.14
2.3. Balance of cash flows from investment operations	−38,616	−620,404	−1506.60		
3. Cash flows from financial transactions					
3.1. Cash inflow, total	1,257,610	2,303,738	83.18	100.00	100.00
Obtaining loans and borrowings	1,237,351	2253568	82.13	98.39	97.82
Other supply	20,259	50,170	147.64	1.61	2.18
3.2. Expenditure of funds, total	1,156,731	1,807,840	56.29	100.00	100.00
Redemption (redemption) of bills and other debt securities, repayment of loans and borrowings	1,156,731	1807840	56.29	100.00	100.00
3.3. Balance of cash flows from financial operations	100,879	495,898	391,58	-	-
The balance of cash and cash equivalents at the beginning of the year	152,847	11,993	−92.15	-	-
Cash flow balance for the year	−140,821	69,720	−149.51	-	-
Balance of cash and cash equivalents at the end of the year	12,026	81,713	579.47	-	-

and flows are only inefficient from the investment operations of the enterprise. Nevertheless, the enterprise can not finance current activities without loans, loans are attracted, which means that problems with solvency take place.

Thus, JSC "KMZ" is not able to pay off its short-term obligations at the current moment, as well as after the repayment of debts by buyers. Only in the long term, the solvency situation can change positively, speaking about the results of calculating the current liquidity ratio. The liquidity assessment showed a low level of absolute and intermediate liquidity, which means that the funds are insufficient to pay off the most urgent obligations at the balance sheet date, as well as the receivables after its repayment by the buyers is not enough to pay off the obligations. Therefore, it is necessary to develop activities to manage accounts receivable and its turnover.

6. DISCUSSION AND RECOMMENDATIONS

We will determine the economic efficiency of the two proposed measures, which should positively affect the level of liquidity of JSC "KMZ:"

a. Sale of finished goods in the warehouse. The cost of finished goods at the end of 2016 amounted to 395,151 thousand rubles. It should be noted that basically JSC "KMZ" works on 100% prepayment for the equipment produced, except that spare parts are usually paid for by 50% when ordering. Therefore, suppose that finished goods in the warehouse after its sale will be reduced by 50%;

b. The use of factoring to pay off receivables and change the terms of circulation of receivables. At the same time, analysis of the factoring market in Chelyabinsk showed that it would be more convenient for JSC "KMZ" to apply for factoring in PJSC "Promsvyazbank," with which the enterprise has been working for several years, is serviced and takes loans.

So, for the first measure the amount of finished goods for sale will be 197,576 thousand rubles. This amount will reduce the cost of stocks, increase the level of current liquidity and increase the amount of cash, increase the level of absolute liquidity in 2018 plan. Calculations of changes in the liquidity level of JSC "KMZ" after the reduction of stocks and increase of liquidity will be presented in Table 1.

Based on the regression analysis, we will forecast the absolute, intermediate and current liquidity of the enterprise and determine the regression equation by performing the corresponding calculations in the "Statistic 6.0" program using statistical functions. The results of the analysis are presented in Table 7.

It turns out that with the reduction of finished products in the warehouse of JSC "KMZ" will receive an inflow of cash in the amount of 197,576 thousand rubles. Due to this influx, the availability of cash will increase, and this will lead to the result of the absolute liquidity ratio in terms of 2018 within the established standard of 0.2–0.25.

If the level of absolute liquidity reaches a standard of 0.2 in the plan of 2018, then for intermediate liquidity the standard (0.7–1.0) is not met even in terms of 2018.

Therefore, in order to increase the level of intermediate liquidity, it is necessary to take advantage of the factoring of PJSC "Promsvyazbank," the reduction of accounts receivable will lead

to an increase in the provision of cash and reduction of short-term obligations on this basis.

We evaluate the application of factoring in the activities of JSC "KMZ" and the sale of a factoring company 70% of the total amount of accounts receivable (since this is the percentage of buyers' debt that has a real redemption period within 55 days from the date of shipment). As a factoring company, PJSC "Promsvyazbank" was chosen, in which JSC "KMZ" is serviced, in addition, a loan was taken from this bank. When buying receivables, this company repays immediately 100% of the amount owed to customers. The commission for factoring services of this company is 9.5% of the transaction amount. In Table 8, we present the business case for this activity.

Sale by factoring PJSC "Promsvyazbank" 70% of accounts receivable of JSC "KMZ" with a commission of 9.5% of the amount of accounts receivable sold will increase the turnover of receivables from 46 days in 2016 to 13 days in 2018 plan.

Thus, the assessment of the economic efficiency of the proposed measures showed an improvement in the level of absolute liquidity and turnover of accounts receivable of the production enterprise of JSC "KMZ."

7. CONCLUSION

Based on the results of the study, it is possible to draw conclusions about the achievement of its purpose and objectives, namely:
1. The approaches of different authors to the basics of analysis and assessment of the risk of insolvency of the enterprise are disclosed.

The solvency of an enterprise is its financial capacity at a certain time and in full extent to satisfy the payment requirements of equipment suppliers and materials, repay bank loans, pay salaries to staff, make mandatory payments to the budget and extra-budgetary funds in accordance with contractual obligations. Thus, insolvency is a failure to fulfill the obligations stated above. The reasons for 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 through which these obligations can be repaid;
c. Misuse of working capital (the formation of large amounts of accounts receivable, which increases the risk of its transition to overdue debt, overstating the normal need for inventories and the formation of stocks of stale raw materials in the warehouse, etc.);

Analysis and assessment of business risks, including the study of the risk of insolvency, are considered in the works of many scientists. But the holistic method of analysis was presented only by Kudryavtsev, and only on the example of small businesses and from the position of assessing the solvency of counterparties, and not the enterprise itself.

The author of this study concluded that the solvency assessment is expediently supplemented by a cash flow analysis that will present

Table 6: Assessment of liquidity and efficiency of cash flows of JSC "KMZ"

Indicator name	Value, thousand roubles	
	2015	2016
1	2	3
PDPTC	3,597,384	2,985,771
PDDPID	11,096	34,432
DFDD	1,257,610	2,303,738
TPDTD	3,800,468	2,791,545
ODPID	49,712	654,836
FFDD	1,156,731	1,807,840
CHDPDD	(203,084)	194,226
CHPDID	(38,616)	(620,404)
CHDFD	100,879	495,898
Aggregate RAP	4,866,090	5,323,941
Aggregate CBP	5,006,911	5,254,221
Aggregate NDP	(140,821)	69,720
Liquidity of the DPTD	0.947	1.070
Liquidity of DPID	0.223	0.053
Liquidity of the DFDD	1.087	1.274
Liquidity of the cumulative DP	0.972	1.013
Liquidity of the aggregate DP taking into account the cash balance at the beginning of the period	1.002	1.016
Efficiency of DPTD	−0.176	0.107
Efficiency of DPID	−0.777	−0.947
Efficiency of DFDD	0.087	0.274
Efficiency of the cumulative DP	−0.028	0.013

Table 7: Results of regression analysis of liquidity indicators of JSC "KMZ"

Indicator name	The regression equation	The value of the reliability of the approximation (R^3)
1	2	3
Absolute liquidity ratio	y=0.002x+0.088	0.259
Intermediate liquidity ratio	y=0.012x+0.096	0.522
Coefficient of current liquidity	y=0.023x+0.123	1.077

Table 8: Evaluation of the effectiveness of factoring in the liquidity management of JSC "KMZ"

Наименование показателя	On 31.12.2016	Change in the entered event 2	Plan 2018	Economic effect
1	2	3	4	5
1. Accounts receivable total, thousand roubles	294,898	−206,429	88,469	−206,429
2. Sale of accounts receivable of the factoring company PJSC "Promsvyazbank" thousand roubles (п.1 х 0,7)	-	+206,429	206,429	+206,429
3. Cash (item 2 minus commission 9.5% of the amount of accounts receivable sold in factoring), thousand rubles	-	+186,818	186,818	+186,818
4. Short-term liabilities, thousand roubles	1,122,175	-	1,122,175	-
Revenues, thousand rubles	2430094	-	2,430,094	-
Turnover of accounts receivable, in revolutions	8.24	+19.23	27.47	+19.23
In days	46	-33	13	-33

a real picture of the amounts received and spent funds, will identify the risks of insufficiency of funds by a certain date and develop a schedule of receipts and payments 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.

The analysis of theoretical approaches of different authors, presented in the work earlier, allowed to formulate the author's own position on the methodology for analyzing and assessing insolvency risks, and to develop a model for this direction of financial analysis applied to a manufacturing enterprise. The proposed model includes the following areas of analysis and evaluation:

a. Assessment of liquidity of the balance sheet and calculation of liquidity ratios;
b. Estimation of turnover of current assets;
c. Assessment of liquidity and efficiency of cash flows;
d. Assessment of loss (recovery) of solvency;
e. SWOT-analysis, which identifies the risks of reducing the liquidity of the enterprise;

3. Approbation of the improved methodology for analysis and assessment of the insolvency risk of the enterprise on the example of JSC "KMZ."

Approbation of this model of analysis on the example of the production enterprise of JSC "KMZ" allowed to make a conclusion regarding the risks of decreasing solvency. Thus, according to the results of the valuation, JSC "KMZ" is not able to pay off its short-term obligations at the current moment, as well as after the customers pay off their debts. Only in the long term, the solvency situation can change positively, speaking about the results of calculating the current liquidity ratio. The liquidity assessment showed a low level of absolute and intermediate liquidity, which means that the funds are not sufficient to pay off the most urgent obligations at the balance sheet date, as well as the receivables after it has been repaid by the buyers is not enough to repay the obligations. Therefore, JSC "KMZ" developed a concept of liquidity management;

4. Developed the concept of liquidity management of JSC "KMZ" to reduce the risk of insolvency, the economic efficiency of the proposed recommendations is evaluated.

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

a. Timely analysis of the company's solvency and identification of threats to the risks of its reduction;

b. Development of management decisions aimed at restoring solvency or raising it when liquidity standards are met, as well as increasing asset turnover and financial performance on this basis.

Carrying out of an estimation of a financial condition of joint-stock company "KMZ" according to the reporting for 2014–2016. Showed the following:

a. The security of both non-current and circulating assets, which are necessary for the production activity of the enterprise, is increased;

b. The main source of financing assets became liabilities (loans, accounts payable), the share of equity capital almost doubled for the period 2014-2016, which negatively affects the financial stability of JSC "KMZ;"

c. The situation with absolute and intermediate liquidity is extremely difficult, only in the long term JSC "KMZ" will be able to pay off its short-term obligations (it also takes into account that the balance made at the end of the year may not include large cash balances on the company's accounts).

The main problems in the activities of JSC "KMZ," which should be managed, the following were determined: A high share of stocks (in particular, finished goods in the warehouse) and accounts receivable in the structure of assets of JSC "KMZ" and a low level of absolute and intermediate liquidity. The solution of these problems within the framework of the liquidity management concept was proposed in two ways:

a. Reduction in the volume of stocks in terms of selling 50% of finished products in the warehouse (50% of the finished goods in the production program are pledged with an advance payment of 50%);

b. The use of factoring to pay off short-term receivables and change the terms of circulation of receivables.

The reduction of the remainder of finished goods in the warehouse will change the structure of the assets of the production enterprise of JSC "KMZ," increase the availability of cash, the level of absolute liquidity of JSC "KMZ" and the liquidity of its balance.

Sale of accounts receivable in factoring PJSC "Promsvyazbank" in the amount of 70% of the existing accounts receivable of JSC "KMZ" under the commission of 9.5% will increase the turnover of the accounts receivable of the enterprise from 46 days to 13 days in terms of 2018.

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