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Methods of Rating IT-Sector Companies by Level of Risks of Creditworthiness

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ABSTRACT

The subject of the research are the companies of the IT sector, as a strategically important sector in the information age. Their development of companies in the IT sector is associated with high risks and requires large volumes of investments, including attracting bank loans. In this regard, **the purpose of the study** was to develop an adequate sectoral methodology for rating companies in the IT sector by the level of creditworthiness risks using mathematical and statistical tools that make it possible to reliably assess the potential risks of investors. To achieve this goal, the study proposes a methodology for assessing the creditworthiness of IT companies based on a system of risk factors, which makes it possible to quantify the exposure of companies to two generalized risk groups: financial risk and business risks. Based on the cluster analysis, a rating table has been developed, according to which, depending on the calculated score, the category of the company's creditworthiness is determined. The **study concluded** that the key factors affecting the creditworthiness of companies are: indicators of financial stability, return on assets, liquidity ratio, online advertising market size, as well as the share of intangible assets in the structure of assets and the amount of research costs. development and capital investments. The constructed scoring model was tested on the Mail.ru Group company (from 12.10.2021 — VK). **Practical significance of the research results** includes in the fact that the developed model can be applied not only for assessing creditworthiness, but also as one of the express methods of risk management in an organization.
Keywords: creditworthiness; risk factors; financial risk; business risk; rating model; IT companies

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INTRODUCTION

IT-sector provides economic security of the country, as Russia's dependence on imported supplies of equipment and software is one of the key threats to national security.[1] Western experts consider that "not fully covered by statistics, but quite powerful IT-sector, especially in the field of contract software" would give Russia a chance to accelerate economic growth.[2] According to the Digital Evolution Scorecard rating, Russia is assigned to the group of "perspective countries" by criteria "level and pace of digital development", which indicates that there is a possibility of significant progress in these areas.[3] Indeed, the information technology sector in Russia is one of the fastest growing and developing in the current realities of the Russian economy [1], but its rapid development is associated with high risks and requires large volumes of investments, and in attracting bank loans [2]. In this regard, in the context of the large-scale growth of digitalization, it becomes extremely important to develop a model for assessing the creditworthiness of IT-companies with their industry-specific features [3].

The purpose of our research consisted in developing a complex method of rating companies in the IT-sector by the level of credit risk, with their specific industry, using mathematical and statistical tools. To achieve this goal, a number of objectives have been set:

- develop an algorithm for building a model of complex assessment of creditworthiness, justifying the inclusion of risk factors in the assessment system;
- conduct a regression analysis to assess the impact of risk factors on the creditworthiness of IT-companies;
- develop a creditworthiness rating scale based on the cluster approach;
- conduct an approbation of the developed method of assessing creditworthiness on the example of Mail.ru Group (from 12.10.2021 — VK).

The scientific novelty of the research consists in the development of a method of rating companies IT-industry, allowing to improve the tools of assessment of creditworthiness of companies taking into account their industry characteristics.

Assessing the creditworthiness of companies' means to determine the appropriateness of interaction with a potential borrower based on an analysis of the organization's ability to repay the creditor's debts in full and within the deadline set in the contract. In fact, the creditworthiness involves an analysis of the impact of different risk groups on the company's activities, i.e. is some forecast of the financial state of the organization for the expected crediting period under conditions of volatility of external and internal factors. On this basis, it is advisable to include several risk groups as basic indicators of the creditworthiness assessment methodology, which are likely to have a significant impact on the activities of the borrower companies under analysis [4]. Credit risk — factors affecting the company's ability to generate cash flow, the ability to meet its obligations to the credit institution in a timely manner, i.e. to repay the full amount of principal and accrued interest [5]. Credit rating — formed opinion on the level of the borrower's overall creditworthiness or its ability to service a specific credit product derived from risk assessment [6].

According to Basel III, new approach is being introduced based on banks' internal ratings to calculate credit risk. The IRB-approach is based on the assessment of credit risk by calculating the expected losses of the Bank in the event of the borrower defaulting on loan obligations (default) under the following formula:

$$EL = PD \times EAD \times LGD, \quad (1)$$

where: EL — Bank's expected losses;

[1] From the statement of D. Rogozin, according to the press service of GC "Roskosmos". URL: https://news.mail.ru/politics/45808571/?frommail=1 (accessed on 01.08.2021).

[2] MACROECONOMIC FORECASTING. URL: https://cebr.com/service/macroeconomic-forecasting (accessed on 01.08.2021).

[3] The world's most digital countries: rating of 2020. URL: https://hbr-russia.ru/innovatsii/trendy/853688 (accessed on 01.08.2021).

PD — probability of default of the Borrower;

EAD — amount at risk of default by the Borrower;

LGD — Bank's share of economic losses at the time of Borrower's default.

In turn, the probability of default of the Borrower (value of indicator *PD*) means the probability that due to the Borrower's financial problems there will be no sources of repayment of loan obligations to the Bank [7].

In particular, for the application of IRB-approach, credit organizations need to build a model of credit rating (scoring), which allows to assess the level of creditworthiness of the borrower and to determine the level of probability of its default (indicator *PD*), i.e. ability to meet obligations on time and in full.

In order to minimize credit risk, existing multi-factor models should be modified, which will mitigate the risk of decline in corporate loan portfolio of Russian commercial banks, taking into account the influence of various external macroeconomic factors [8].

Typically, a credit analysis involves a study of the impact of two groups of factors on credit risk — financial risks and business risks. Business risks include risk factors at the level of the economy, the sector in which the borrower operates, the business environment of the company. Financial risks — it's a risks of violation of the repayment terms envisaged by the Borrower, repayment in full of the indebtedness or full loan default.

The research of foreign authors also notes the need to update and improve the methods used to assess the creditworthiness of companies in the IT-sector in modern conditions.

According to V. Munguti and R. Ngali, developing technology companies are faced with difficulties in obtaining credit facilities, as standard creditworthiness assessment procedures do not apply to organizations in the industry, which are often characterized by a lack of liquidity, instability of cash flows, high mobility of business, etc. [9]. Accordingly, the authors confirm the need for a correct assessment of the level of creditworthiness of IT-sector companies, with their specifics. To solve this problem, analysts recommend to develop a platform of end-to-end assessment of creditworthiness with an available credit rating model based on forecasting and data aggregation to assess the state of the business at the 4th stage of the Industrial Revolution (Industry 4.0) [9].

According to research by R. Safi and Z. Lin in the context of economy digitalization, it is advisable to move to transaction models that use quality statistics to assess the creditworthiness of companies. The authors classify indicators reflecting the creditworthiness of technology companies into three groups: internal factors, external factors, B 2B- or B 2C-Platform factors [10]. Internal and external factors are classic and applicable in most assessment methodologies, including financial indicators, basic characteristics of companies (business ownership structure, litigation, etc.), and general economic factors. Proposed by scientists R. Safi and Z. Lin the group of factors B 2B/B 2C-Platform consists of three categories: presence on the platform (including the duration of the company's presence in online channels, its awareness), activity on the platform (degree of customization of the online-platform, the scope of activity in the Internet, etc.), customer base (number of users, including permanent and potential). Scientists used logistic regression to confirm their hypothesis about the impact of qualitative factors on the creditworthiness of technology companies [10].

The practical significance of the research is consist on the basis of the proposed model, that possible to assess the impact of risk groups on the level of creditworthiness of IT-industry companies. The developed model is an additional tool in the assessment of credit risk, as well as one of the express methods of risk management in the organization, allows to prevent the occurrence of financial problems of the company in the future. Accordingly, the developed methodology is

applicable not only in credit organizations, but also in the corporate sector.

DESCRIPTION OF THE AUTHOR'S ALGORITHM AND METHODS FOR RATING OF IT-SECTOR COMPANIES BY THE LEVEL OF CREDIT RISK

The main prerequisite for the transition to rating models of creditworthiness is the objective need to replace the expert assessment by automation and algorithmic of this process, which will increase its transparency [11, 12].

The author's algorithm of development of the method of rating of IT-sector companies by the level of creditworthiness risk (credit scoring) consists of the following stages:

1. Selection of risk factors affecting the creditworthiness of companies, their systematization by generalized groups.

2. Substantiation of indicator are included in the factors system and allow for the quantification of each of the risk groups; selection and substantiation of the result indicator of creditworthiness.

3. Selection of IT-sector companies based on public financial statements and industry reviews.

4. Construction of a regression model allowing assigning weights to each group of risk factors to take into account in the assessment of the force of the influence of the indicators of factors on the resulting indicator, as well as sensitivity when changing the factor variables.

5. Development of the final system (model) of assessment of creditworthiness of IT- sector companies on the results of construction of regression models.

6. Development of the rating system and its scale reflecting the rating of the IT- sector company by the level of creditworthiness risks, formed on the basis of a comprehensive risk assessment.

The author's development of an algorithm for the IT-sector companies rating is development of the methodology of assigning credit ratings to the companies of the largest credit rating agency in Russia (Expert RA JSC). According to the methodology of RA Expert the rating of the company is based on the analysis of block factors: independent creditworthiness of the company [taking into account internal factors of support (financial risks, business risks, corporate risks) and exposure to internal stress factors] and importance of external factors of support and stress factors. As a result of the assessment of the company is assigned one of 8 categories of creditworthiness from AAA (maximum level) to C (default).[4]

The first stage of construction of the proposed rating model of assessment of creditworthiness is formation of the system of risk factors that influence the level of credit risk for each borrower. Within the developed methodology will focus on two main risk groups: financial risks and business risks.

It is reasonable to be included business risk group in risk assessment model — risks due to the specifics and dynamics of the market or industry in which the analyzed companies operate. Each assessment area combines a set of factors that can influence development trends, position in the industry sector and the overall state of the borrower company. In addition, the researches note that in terms of increasing competition in financial markets, it is recommended to assess the quality of the commercial bank loan portfolio for each industry segmentation of the customer base [13].

The final set of factors and indicators that allow to quantify business risks inherent in the activities of IT-industry companies is presented in *Table 1*.

Financial risks are included in the model as the main stage of credit analysis is to assess the financial condition of borrowers [14]. Standard coefficient analysis indicators are proposed for assessment of financial risks: liquidity, financial sustainability, profitability and business activity. For the construction of the model it is important to use the values of these indicators in absolute values, as

[4] Methodology of creditworthiness ratings to non-financial companies of Expert RA JSC. Official site Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

Table 1

The system of factors assessing business risks

Group of risk	Subgroup of risk	Justification for inclusion in the model	Indicators	Calculation formula
Business risks	Industry risk	Assessment of the stability of the company's activity directly depends on the state and inherent trends in the industry and the market, which is the main platform for doing business. Favorable structural changes in the industry have a significant impact on the growth of the company (including internet penetration, digital growth, and digital services popularity). Also at present, the main channel of sales of companies IT-industry becomes the advertising market (mainly in the online-segment). In addition, it is important to assess the industry-specific level of arrears to credit institutions	Number of active Internet users, per.	Statistical data
			Level of arrears to credit organizations, %	Statistical data
			Volume of the online- advertising market, bln rub.	Statistical data
	Market risk	The IT-sector is characterized by continuous development and continuous improvement, implementation of technological changes in all processes. This specificity is due to the rapid technology update, consumer preferences variability, nature of services offered The inability to innovate, provide popular products and services or respond quickly to market developments has a direct impact on the attractiveness of the company, as well as its profitability. The ability to adapt flexibly and effectively to the changing external market environment and offer the consumer innovative advanced product at the end of its own development — the main factor of sustainability of companies in the IT-sector	Share of intangible assets (IA) in balance sheet structure, %	IA/assets
			Cost on research or capital investment, mln rub.	Expenditure on IA
			Revenue growth rate, %	Revenue of the reporting period / Revenue of the same period last year
	Business reputational risk	Business reputation risk reflects the risk of losses to the company as a result of the formation of a negative image of the activity or as a result of the formation of significant claims on the part of government authorities (for example, enforcement proceedings for tax arrears), and from counterparty partners (various arbitration cases). It is also important to assess this risk in the course of the creditworthiness analysis due to possible deterioration of the financial condition of the company due to the performance of significant claims (claims, etc.). To be able to quantify this risk, it is proposed to use dummy variables (qualitative indicators are assigned a certain value depending on the specific level)	Share of active actions in net assets, %	Dummy variable: less 5% — 0, from 5 to 30% — 1, from 30 to 50% — 2, more than 50% — 3
			Share of value of enforcement proceedings in net assets, %	Dummy variable: less 5% — 0, from 5 to 30% — 1, from 30 to 50% — 2, more than 50% — 3

Source: compiled by the authors.

it is advisable to use the initial values for the correct assessment of creditworthiness, because the level of the assessed financial position of a company depends on the specific value of the estimate (for example, than higher the value of financial sustainability indicators, those higher the level of creditworthiness). The model construction algorithm does not provide a stage for converting the values of the indicators into single scores due to the above-mentioned problems, as well as the need to exclude subjectivity from the model (including business risk indicators, it is difficult to determine the required industry averages and the translation scale for them).

The totality of risk factors in the group of financial risks, as well as the appropriateness of including each of the subgroups in the common system and a specific indicator to assess the exposure of the company to financial risk, are presented in *Table 2*.

The final system of risk factors and indicators, allowing to conduct a comprehensive integrated assessment of the creditworthiness of IT-industry companies, is presented in *Table. 3*. Further, in the regression model construction, it is possible to exclude any indicators from the integral assessment due to their statistical inconsistency.

The next stage after the formation of the system of risk factors is the selection and substantiation of the result indicator, which allows to quantify the level of creditworthiness of the company.

As such an indicator, the market capitalization of companies or the market price of their shares was chosen, since the market value of a company can be considered as a key outcome of the organization's activities.

Based on the developed system of factors affecting the creditworthiness of the company, the authors are constructed a statistical regression model. The dependent variable is the indicator of market capitalization of Russian companies IT-industry, the shares of which are listed on the stock exchange.

As a result of the exclusion of statistically insignificant factors from the model, we will get an equation reflecting the relationship between the value of market capitalization (cost) of IT-industry companies in Russia and internal risk factors:

$$y = -3621{,}4 + 162{,}3*x_3 + 12402*x_4 - 1117*x_6 - 170*x_7 +$$

$$+156*x_8 + 162*x_9 + 19604*x_{12} + 499*x_{13}, \quad (2)$$

where y — market capitalization (cost) of the company; x_3 — absolute liquidity ratio; x_4 — autonomy ratio; x_6 — equity to loan ratio; x_7 — period of accounts receivable turnover; x_8 — period of accounts payable turnover; x_9 — financial cycle duration; x_{12} — return on assets (ROA); x_{13} — debt/EBITDA.

The multiple correlation coefficient (R) equal to 0.94 is indicate about close relationship between the factors. Determination coefficient (R^2) shows that 89% of the variation of the dependent variable is considered in the model and is due to the influence of included factors (*Table 4*). The equation and regression coefficients are statistically significant.

In order to correctly reflect the level of influence of each of the factors on the market value of companies it is necessary to calculate the coefficients of elasticity of variables.

The main internal risk factor that has the greatest impact on the market value of companies is the autonomy coefficient. With 1% increase of autonomy ratio, the organization's market capitalization is expected to grow by 4% on average. The revealed interconnection corresponds to the economic theory and is quite reasonable: the higher the coefficient of autonomy, the greater the financial independence of the company from external sources of financing and external creditors [15]. Generally, financially sustainable companies are valued more highly by the market and investors, which is reflected in their level of capitalization.

The second most influential factor is the length of the financial cycle. Market capitalization of IT-sector companies is expected to decline by 3.7% on average with 1% increase in the financial cycle duration.

Table 2

The system of factors assessing financial risks

Group of risk	Subgroup of risk	Justification for inclusion in the model	Indicators	Calculation formula
Financial risk	Liquidity and solvency	This group allows you to assess the risks associated with a possible decline in the liquidity and solvency of the company, i.e. the inability to repay current (short-term) liabilities through sales of current (working) assets on the market. Accordingly, the inclusion of this risk makes it possible to estimate the probability of the occurrence of cash gaps in the course of operations of the company	Working capital ratio	Own working capital / Working assets
			Current ratio	Current assets / Short-term liabilities
			Absolute liquidity ratio	(Cash + short-term financial investments) / Short-term liabilities
	Financial sustainability	This group of risks allows to assess the financial independence of the company from external sources of financing (lenders). Risk of weakening the financial sustainability of the company arises due to the high level of borrowing	Autonomy ratio in shares, un.	Equity / Balance Sheet Currency
			Financial sustainability ratio in shares un.	(Equity + Long-term Liabilities) / Balance Sheet Currency
			Equity to debt ratio, %	Equity / Borrowed capital
	Business activity (turnover)	This group of risks is designed to assess the effectiveness of cash flow management and the intensity of use of the company's assets, the duration of its operational and financial cycles. The long turnover of assets has a direct impact on the company's financial performance	Accounts receivable turnover (RT), days	Number of days in period * RT / Revenue
			Accounts payable turnover (PT), days	Number of days in period * PT / Cost
			Financial cycle, days	Inventory turnover period + RT turnover period – PT turnover period

Source: compiled by the authors.

Table 3

The system of factors evaluating the creditworthiness

Group of risk	Subgroup of risk	Indicators	Indicator X_i
Financial risk	Liquidity and solvency	Working capital ratio, in shares un.	x_1
		Current ratio, in shares, un.	x_2
		Absolute liquidity ratio, in shares, un.	x_3
	Financial sustainability (capital structure)	Autonomy ratio in shares, un.	x_4
		Financial sustainability ratio, in shares, un.	x_5
		Equity to debt ratio, %	x_6
	Business activity (turnover)	Turnover period of receivables, days	x_7
		Period of accounts receivable turnover (RT), days	x_8
		Financial cycle, days	x_9
	Efficiency of activity	Return on equity (ROE), %	x_{10}
		Return on sales (ROS), %	x_{11}
		Return on assets (ROA), %	x_{12}
	Debt burden	Debt (long-term, short-term and rental liabilities) /EBITDA (earnings before interest, taxes and depreciation), un.	x_{13}
		Earnings before interest and taxes (EBIT), mln rub.	x_{14}
		Debt / Average monthly revenue, un.	x_{15}
Business risk	Industry risk	Number of active Internet users, person	x_{16}
		Level of arrears to credit institutions, %	x_{17}
		Volume of the online- advertising market, bln rub.	x_{18}
	Market risk	Share of intangible assets (IA) in balance sheet structure, %	x_{19}
		Cost on research or capital investment, mln rub.	x_{20}
		Revenue growth rate (RGR), %	x_{21}
	Business reputational risk	Share of active actions in net assets, %	x_{22}
		Share of value of enforcement proceedings in net assets, %	x_{23}

Source: compiled by the authors.

Table 4

Regression statistics indicators of the model of internal factors

Indicators	Means
Multiple correlation coefficient (*R*)	0.9420
Determination coefficient (R^2)	0.8875
Normalized determination coefficient R^2	0.8274
Standard error	545.39
Observations	24

Source: compiled by the authors.

Reduction of financial cycle is a positive trend, indicating faster production or faster payment from debtors. In general, the acceleration of the financial cycle minimizes the risk of a decrease in the level of solvency of the company, as the growth of the financial cycle increases the need to attract additional financing to replenish working capital, which are often borrowed sources of finance, which can ultimately lead to reduced financial sustainability.

The next factor on the level of influence on the market value is the ratio of equity to borrowed capital, as with the increase of this coefficient by 1% the market capitalization of IT-sector companies is expected to decline on average by 0.9%. The revealed dependence can be explained by the influence of the financial leverage mechanism: the growth of the share of debt financing in the structure of liabilities can lead to an increase the return on equity (ROE). As a rule, business profitability is also an important factor providing better value to the company from market investors. But it is important to note that as the level of financial leverage increases, financial risk and the risk of weakening financial sustainability increases.

With 1% change in the remaining internal factors, the average change in the company's market value will be less than 1%. In particular, the increase in the absolute liquidity ratio by 1% will have a positive impact on the market value of the company and will lead to an increase of 0.16% overall. The revealed relationship can also be substantiated on the basis of economic theory. As the increase in the liquidity ratio indicates a reduction in the company's insolvency risk and its ability to repay short-term liabilities with the most liquid funds in the short term, this has a positive impact on the market valuation of its value.

According to the obtained elasticity coefficient value for the variable x_{12} — return on assets (ROA), its change by 1% will lead to a projected increase in the market value of IT-companies by 0.14%. This statistical relationship between variables can also be substantiated, because the level of profitability of a business directly depends on its investment attractiveness.

Thus, the regression model confirms the relationship between the embedded internal risk factors and the market value (capitalization) company IT-industry, serving as an indicator and allowing to quantification the level of creditworthiness [16]. Therefore, by confirming the statistical significance of the variables and the model as a whole, it is possible to use this equation as one of the stages of credit scoring for companies in the IT-industry [17].

The final regression equation, which reflects the influence of business risk factors on the level of market capitalization of IT-companies, is as follows:

$$y = -777 + 3320^{*}x_{17} + 29^{*}x_{18} + 1082^{*}x_{19} + 0,3^{*}x_{20}, \quad (3)$$

where y — market capitalization (cost) of the company; x_{17} — level of arrears to credit in-

Table 5

Regression statistics indicators of the model of factors of business risks

Indicators	Means
Multiple correlation coefficient (*R*)	0.8711
Determination coefficient (R^2)	0.7589
Normalized determination coefficient R^2	0.7081
Standard error	709.3
Observations	24

Source: compiled by the authors.

stitutions,%; x_{18} — volume of the online-advertising market, bln rub.; x_{19} — share of IA in the balance sheet,%; x_{20} — expenses on IA (research development / capital investments), mln rub.

The multiple correlation coefficient (*R*) equal to 0.87 is indicate about close relationship between the variables. Determination coefficient (*R* 2), shows that 76% of the variation of the dependent variable is accounted for in the model and is due to the influence of included business risk factors (*Table 5*). The findings of this research, the equation and the regression coefficients are statistically significant.

The biggest influence on the market value of IT-industry companies has the coefficient x_{18} — volume of online-advertising market. With a 1% increase in this ratio, the capitalization of companies is projected to increase by 1% of the average, other things being equal. This dependence corresponds to the current state of the market, today the key business trend is digitalization, and more industries are launching a strategy of active introduction of digital products in business processes. The research confirms the hypothesis that the greatest impact of digitalization is observed among technology companies [18]. Given this trend of increasing digitalization and the popularity of digital services, as well as the penetration of the Internet in all areas of society, one of the fundamental sources of income of IT-industry companies is income from online-advertising.

Next in terms of impact on the capitalization of companies indicators are the share of IA in the structure of assets (with the increase of this coefficient by 1% the expected increase in the value of IT-companies will be 0.12% on average) and the value of R&D and capital investments (1% increase in expenditures of this group will lead to 0.36% increase in capitalization of IT-sector companies on average). Intellectual capital is considered as a potential source of competitive advantages of companies and a factor of increase of their market value [19].

The revealed interconnection shows that investment is attractive for those companies IT-industry, which are able to respond flexibly to changes in the market. According to Salesforce, due to the global development of the pandemic, 88% of the population expects companies to intensify digital initiatives [20]. In order to introduce and offer innovative products, follow and match the main industry trends, IT companies need to invest in their own R&D.

Thus, taking into account the statistical significance of the constructed regression model, we confirm the hypothesis about influence of factors that allow assessment of business risks on the market value of IT-industry companies, therefore, on the level of their creditworthiness.

Taking into account the creditworthiness rating methodology applied by one of the largest credit rating agencies in Russia (Expert RA JSC), we will determine the

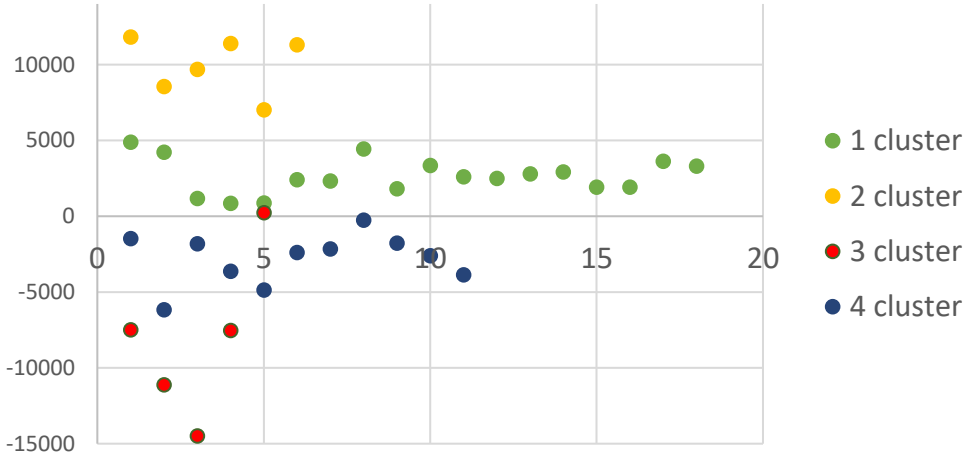

Fig. **Clustering ratings based on the results of cluster analysis**

Source: compiled by the authors.

weight of the impact of each generalized risk group on the overall integral rating of creditworthiness: financial risks — 60%, business risks — 40%.[5]

The final rating of the borrower will be based on weighting of points for each risk group and corresponding weight value. The risk group score is based on the calculation of the value for each group by substituting the specific indicators for the borrower company at the last reporting date and the relevant industry data in the regression model equations.

IMPROVING THE RELIABILITY OF THE METHODOLOGY USING THE CLUSTER ANALYSIS TOOLKIT

Data on IT-companies eliminated in the first half of 2021 have been added to the previously used regression model sample in order to increase the representativeness of the developed methodology. Thus, the final sample includes 40 observations, including 16 observations from failed IT-companies.

Therefore, based on the initial data for the IT-industry companies included in the sample, the integral rating value obtained from the assessment of the financial risk group (according to the data of the public reporting of companies for quarters) as well as the direction of business risk assessment by industry characteristics.

Further, in order to correctly divide the total of received rating values into 4 categories (ratings) with the appropriate level of creditworthiness, it is recommended to apply cluster analysis. The set of observations was divided into 4 clusters, each containing 19, 6, 4 and 11 observations, using the statistical software *R,* as a result of the application of *k* — average method.

Calculated cluster means, i.e. average values of parameters of each cluster: first cluster — 2523.6 un., second — 9952 un., third — (–10 170 un.), fourth — (–2828.5 un.). The third cluster with negative indicators includes rating values of failed companies. Graphical representation of cluster analysis results is shown in the *Figure*.

According to the clustering results, the rating values are divided into 4 categories (ratings), corresponding to the creditworthiness risk level: the first cluster corresponds to the rating level B, the second — A, the third — D, the fourth — C. By analogy with the rating matrix of rating agency Expert RA JSC each category was assigned the corresponding designation from A to D.[6]

The developed rating system and its scale reflecting the rating of the IT-industry

[5] Methodology of assigning credit ratings to non-financial companies JSC Expert RA. Official website Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

[6] Methodology of assigning credit ratings to non-financial companies JSC Expert RA. Official website Expert RA. URL: https://www.raexpert.ru/ (accessed on 01.08.2021).

Table 6

Rating scale for evaluating the creditworthiness of IT companies

Category	Rating range	Definition of rating
A	> 4400	The company is characterized by the maximum level of creditworthiness / financial reliability / financial stability. There is no information on negative trends that could have a significant impact on the financial condition of the company
B	0–4400	The company is characterized by a moderate level of creditworthiness / financial reliability / financial stability. There is information about a low exposure of the company to negative changes in the economic environment
C	–7500 < x < 0	The company is characterized by a low level of creditworthiness / financial reliability / financial stability. Negative trends are reported to have a significant impact on the financial condition of the company, but it is still possible to fulfill the obligations in the prescribed amount and time limit
D	< –7500	The company is characterized by a very low level of creditworthiness / financial reliability / financial stability. The company is in default. High probability that outstanding obligations at the Bank

Source: compiled by the authors.

Table 7

Calculation of the rating of Mail.ru Group

Indicator	Index	Coefficient	Means
1. Business risks			
Level of arrears to credit institutions, %	x_{17}	3320.25	0.02
Volume of the advertising market, bln rub.	x_{18}	29.42	73
Share of intangible assets in balance sheet, %	x_{19}	1081.99	0.59
Expenditure on R&D or capital investment, mln rub.	x_{20}	0.32	819
TOTAL			2336.8
2. Financial risk			
Absolute liquidity ratio, in shares	x_3	162.33	0.79
Autonomy ratio, in shares	x_4	12402.17	0.62
Equity to debt ratio, %	x_6	–1117.29	1.63
Turnover period of receivables, days	x_7	–170.42	48
Turnover period of payable, days	x_8	155.58	52
Financial cycle, days	x_9	162.09	–4
Return on assets, %	x_{12}	19604.19	–0.01
Debt/EBITDA, un.	x_{13}	499.42	2.18
TOTAL			2610.75

Source: compiled by the authors.

Table 8

Calculation of the integral score based on Mail.ru Group data

Group of risk of Integral rating	Rating range Means	Share, %
Business risk	2336.84	0.4
Financial risk	2610.75	0.6
TOTAL	**2501.18**	**1**

Source: compiled by the authors.

company by the level of creditworthiness risks, formed on the basis of a comprehensive risk assessment, are presented in *Table 6*.

The constructed regression equations are accepted as constituents of the rating model, allowing to carry out a quantitative assessment of risk groups taking into account the level of influence of each of the indicators on the final value of creditworthiness that negates the common problem of subjectivity in the conduct of credit analysis. The key advantage of the developed methodology is its industry-oriented risk-oriented approach, which takes into account the specifics of doing business and trends in its development in a quantifiable format.

RESULTS OF TESTING METHODOLOGY

To test the practical significance of the developed model, we will assess the creditworthiness of Mail.ru Group (from 12.10.2021 — VK).[7] Mail.ru Group — the largest IT-holding in Russia, aimed at the development of the leading Russian platform of communication and entertainment Internet services.

As the basis of calculations we use published reports for the last reporting date (Q1 2021) for assessment of financial risk, as well as relevant industry data for assessment of business risks. Results of calculations are shown in *Table 7*.

On the basis of the scores obtained, based on the results of the assessment of each risk group, it is necessary to calculate an integral assessment of the creditworthiness of the company, taking into account the set weight of each group (*Table 8*).

The final rating of Mail.ru Group, calculated on the basis of the developed author's methodology, amounted to 2 501 points, which corresponds to the rating of "B" with a moderately high level of creditworthiness. In general, the result is adequate to the conducted financial analysis of the company on the basis of its public data, which confirms the relevance of the rating received and the applicability of the methodology in practice.

CONCLUSION

Thus, in our research the algorithm of development and methodology of formation of complex rating of companies of IT-sector by the level of credit risk using mathematical and statistical tools is presented. The author's method is based on a system of identified risk factors, as well as a hypothesis about their impact on the activities of organizations of the analyzed industry. The regression analysis confirmed the relationship between the indicators included in the model and the market capitalization of companies IT-industry, serving as the result indicator, quantitatively reflecting the level of creditworthiness. The key factors influencing the creditworthiness of IT-companies are indicators of financial sustainability (autonomy ratio, equity and debt ratio), return on assets, liquidity ratio, volume of the online-advertising market, and the share of intangible assets (IA) in the

[7] 12.10.2021. Mail.ru Group announced the brand change to VK. URL: https://vk.company/ru/press/releases/11016/ (accessed on 20.10.2021).

structure of assets, the value of expenditures on R&D and capital investments.

According to the results of testing of the developed method of rating on the company Mail.ru Group the reliability of the rating assessment and practical significance of the author's methodology, which has a prospect of application by credit organizations when assessing the creditworthiness of borrowers, was confirmed, and can also be used as one of the rapid methods of diagnosis and control of risks of financial problems in IT-sector companies.

The developed credit rating model can be modified by adding to the sample historical data on defaults of borrowers, which will allow not only to predict the probability of debt repayment (probability of default) in the process of conducting credit analysis, but is also one of the ways to improve the competitiveness and efficiency of the lending organization within the IRB-approach.

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