



# JOURNAL OF CORPORATE FINANCE RESEARCH



## Journal of Corporate Finance Research

Vol. 17 | № 1 | 2023  
e-journal

[www.cfjournal.hse.ru](http://www.cfjournal.hse.ru)  
ISSN 2073-0438

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DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.5-16>

JEL classification: G20, G24, G32



# Developing a Scoring Credit Model Based on the Methodology of International Credit Rating Agencies

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## Abstract

The purpose of this work is to examine the relationship of various financial and non-financial (qualitative) factors of performance of non-financial companies and their credit ratings.

We developed the scoring model which was based on the methodologies of international and Russian rating agencies. The modelled ratings of non-financial companies for 2018–2020 were compared with actual ratings assigned by the rating agencies and discrepancies were explained. The sample includes companies from retail, protein and agriculture, steel, oil and gas sectors from Russia, USA, Luxembourg, England, Canada, India, Ukraine and Brazil.

The paper proved that addition of business and environmental, social and governance factors improved the quality of scoring models in comparison to those including only financial metrics. There are strong patterns in the resulting ratings of companies for some industries. Retail industry companies are associated with high sales indicators, while steel industry companies have high interest expenses coverage ratios. Oil and gas industry companies mostly show high results in reserves coefficients.

The study developed a credit rating forecasting tool that emulates the work of analysts of rating agencies and therefore has a high predictive power. The developed model can be used by financial market practitioners to predict the credit ratings of Russian companies in the face of the refusal of international rating agencies to rate Russian issuers.

**Keywords:** credit default prediction, credit rating modelling, credit rating system, ESG rating

**For citation:** Astakhova, A., Grishunin, S., Pomortsev, G. Developing a Scoring Credit Model Based on the Methodology of International Credit Rating Agencies. *Journal of Corporate Finance Research*. 2023;17(1): 5-16. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.5-16>

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## Introduction

The paper examines the relationship between various financial and qualitative indicators and the credit ratings of non-financial companies based on publicly available information. The study assessed the creditworthiness of non-financial companies from the following sectors: retail; steel; agriculture; oil and gas. The research is dedicated to the development of a scoring model based on the methodology of international rating agencies for predicting credit risk and probability of default of international non-financial companies. Along with the financial position of the company, the scoring model allows to take into account support factors such as group and government support, environmental influence, and to consider social factors and management efficiency, as well as the company's key success factors.

The assessment is based on the methodologies of international rating agencies that are integrated into the developed model.

## Relevance of research

First of all, the financial crisis of 2007–2008 demonstrated how important objective high-quality ratings are for the stability of the global economy. Erroneous ratings have led to the bankruptcy of a large number of firms [1]. A similar situation can emerge if the approach to companies' credit ratings is not thorough enough. Secondly, an independent credit rating methodology that unifies the existing models and adjustments is required to assess the creditworthiness of companies internationally, given the recent trends in the sphere of credit ratings and adjustments. Thirdly, large losses could be shifted to private investors, who may be driven by the incorrect ratings of the firms in which they invested. For instance, the Yutrade broker went bankrupt in 2008, and its clients lost all their investments [2]. Fourthly, corporate governance, and the environmental and social impact of a company on its creditworthiness score are now gaining popularity [3].

The objects of the research are the international non-financial companies from the retail, steel, protein and agriculture, and oil and gas industries for the period between 2018 and 2021. Therefore, the subject of research is the relationship between various financial and qualitative indicators and the credit ratings of non-financial companies.

The goals of the research are the selection and study of the scientific literature on the topic; choosing the most relevant methods and methodologies for building scoring models; collecting sample data for non-financial companies for 2018–2021; creating an Excel VBA-based interface to calculate financial and qualitative indicators; conducting a detailed analysis of model prediction accuracy; adding adjustments to improve prediction accuracy; building the scoring model suitable for rating distribution.

The scientific novelty of the research is underpinned by the limited number of studies on the topic of independent credit rating modelling for non-financial companies.

In particular, the developed scoring model considers other important metrics in addition to financial data: government and group support factors, environmental influence with social and management efficiency and sovereign rating adjustment. Other novelty factors include: independent calculation of qualitative indicators without expert guidance; identification of patterns in the values of financial indicators and the resulting credit rating. Moreover, there is a lack of research that includes qualitative factors for non-financial companies, however, its importance is underpinned by several studies. For instance, the papers by G.M. Bodnar et al. [4], B. Lehmann [5] and J. Grunert et al. [6] conclude that accuracy is increased with the incorporation of several non-financial qualitative factors to analysis; however, these results are only valid for certain countries and only for financial companies, and thus could not be used for companies from other countries. ESG ratings could be used as an additional indicator of financial performance, as F. Kiesel and F. Lücke [7] mention in their paper, and hence it would also be reasonable to use the ESG rating when modelling credit ratings. Therefore, the creation of a model which incorporates qualitative factors seems practical in future research in related fields.

The practical relevance of the research is high. The present study developed a model ready for use and implementation, presenting an interface and data output that is understandable to all users. Such a tool is especially relevant, first and foremost, for assessing the creditworthiness of companies whose ratings have not been published by rating agencies. In this case, its application is the quickest and most plausible way to obtain a rating. Secondly, the open-source code allows the model to become a universal foundation for further improvement, implementation of third-party tools and connection to various resources.

## Literature Review

The theoretical base of the paper comprises the studies of foreign and Russian researchers in the field of corporate finance and risk management. The works of the following Russian and foreign researchers were used: T.M. Zadorozhnaya, A.M. Karminsky, A.A. Polozov, B.H. Bergrem and others.

The literature review demonstrates that there is a limited number of studies on credit ratings and the development of models for assessing the credit risks of non-financial companies. In most cases, the significance of independent credit ratings and their impact on the financial system is provided. For instance, the paper by T.M. Zadorozhnaya [8] presents the basic definitions and objectives related to credit ratings and, most importantly, the tasks that the existence of ratings solves, i.e., information disclosure, setting limits on credit risk, forming an objective assessment of the borrower by the lender, promoting the diversification of funding sources, promoting the reduction of the cost of capital and directly regulating financial markets. Moreover, credit ratings are important in the financial performance assessment, as revealed in M. Singal's paper [9]. The author

concludes that the changes in credit ratings are reflected in stock prices and the corresponding investors' reaction, and thus affect a company's financial performance.

An important part of the paper is related to qualitative factors. Several research studies agree that the incorporation of qualitative and non-financial variables in the model could improve the accuracy of credit rating prediction. The papers by B. Lehmann [5] and J. Grunert et al. [6] investigate the impact of qualitative factors on the credit rating assessment, therefore, this study accommodates for the non-financial qualitative factors to improve model accuracy.

Another important point is the distinction between developed and emerging countries. The paper by A.M. Karminsky entitled "Corporate rating models for emerging markets" [10] presents several financial, macroeconomic, and qualitative indicators and their effect on the credit rating of a company using econometric models that use these coefficients in different proportions. This study also examines the important question of how results differ for companies from emerging markets and what the key differences and specifics are in assessing their credit ratings. These findings have a key value in current research, and help to interpret results and make the correct conclusions for companies from emerging markets. Thus, companies from emerging countries are more exposed to macroeconomic factors, which are considered qualitative variables, or an adjustment for the sovereign rating.

In addition, most studies involve the use of different external factors and specific indicators for each non-financial industry to assess credit risks. A.M. Karminsky's paper "Credit ratings and their modelling" [11] completely covers the issues of credit quality assessment and their emergence. The study discusses the classification of ratings and conducts an analysis of existing methodologies and principles of credit rating formation used by the most recognised rating agencies. Moreover, B. H. Bergrem's paper "An empirical study of the relationship between credit ratings and financial ratios in the E&P industry" [12] examines the key indicators that are unusual for other methodologies, and are important in the E&P (Exploration and Production) sector of the oil and gas industry. The cost of discovery and development is one of the vital keys to understanding the operating efficiency of a company, and one of the fundamental indicators in assessing the scale of a company's unproven reserves. In this case, the stable replenishment of reserves, their volume and geographic diversification, unlike company revenue, can serve as the best indicator of long-term stability. Finally, A.I. Rybalka [13] demonstrates how different specific indicators of non-financial companies could affect the probability of default using logit regressions. The author determines the importance of including qualitative indicators and their effect on the results. The results reveal the difference when several corporate governance coefficients are included, and are also valuable for current research since the paper investigates companies' ESG ratings and specifically, their governance components. It has been established that governance fac-

tors affect the probability of default, which is lowered, for instance, when the CEO of a company is also its co-owner and increases when a company becomes a subsidiary. The second finding is significant for current research when the results are compared with an adjustment for being a part of a group, which traditionally has a positive effect on the credit rating. Therefore, using different variables to assess credit ratings for companies in different industries is theoretically reasonable.

Since not only the company itself affects its credit quality, a deep investigation into adjustments to its stand-alone creditworthiness assessment is required. Karminsky's paper [10] highlights the applicability of ratings and their distribution in today's financial world and shows the importance of using external support factors on a par with internal factors, both quantitative and qualitative, in evaluating a company's financial stability in one way or another. But it is important to mention the adjustment for the overall sovereign rating. The paper by A.M. Karminsky and A.A. Polozov – "Handbook of ratings" [14] notes that a company's credit rating rarely exceeds the sovereign rating. A company's stand-alone rating is measured in a "bubble", but there are macroeconomic risks that the company does not control: political stability, competitive environment, strength of invention protection. However, there are examples of companies that refute this rule. Such companies are assigned a rating higher than the sovereign rating because, due to certain circumstances, it is possible to exclude negative factors affecting credit quality from consideration (unlike in the calculation of the sovereign rating), or simply because other strongly positive features are present.

Reconciling the results obtained by using methodologies with different scales is important. The paper by N.F. Dyachkova "Comparison of rating scales of Russian and foreign agencies: industrial and financial companies" [15] reveals the importance of correct conversion of Russian rating scales to international ones. The study examines the relationships between rating scales used by different rating agencies, and it is mostly valuable for current purposes, since several companies have not been assigned a rating by Moody's. This paper presents a method of forming numeric rating scores. These scores are used in empirical models to study relationships between ratings and explanatory factors.

Highlighting the patterns for specific industries could be complicated due to various difficulties and a dissimilarity of the companies. However, there are research studies that draw almost the same conclusions about the most important factors for a specific industry. The scale-related factors generate many advantages for a retail company over its competitors, such as market power and price leadership. These advantages can lead to greater investor attractiveness compared to smaller companies. Such a strong effect of the scale is confirmed by several studies. For instance, A.B. Curtis et al. [16] argue that the revenue variable is the main component in the retail companies' financial performance forecast. As for the steel industry, profitability-related variables, particularly that of financial perfor-

mance, are considered the most significant in assigning a credit rating, as confirmed by A. Banerjee [17]. The oil and gas industry functions in the long-term perspective, i.e., companies need to consider their reserves, which leads to higher values of these variables for such companies. Moreover, B.H. Bergrem [12] also underpins the relevance of the scale variables for the oil and gas companies, however, the monitoring of average daily oil and gas production as better representation of industry-specific factors that influence financial performance is also considered important.

The literature review demonstrates that research tasks are of primary importance for researchers and practitioners. The previous studies indicate that the results of credit risk assessment analysis differ when qualitative indicators from external databases vs. other factors are assessed.

## Data

All financial data was obtained from official company reports, and qualitative factors are measured based on publicly available information. The financial data was retrieved from Bloomberg and Thomson Reuters terminals. The financial variables used are revenue, EBIT, interest expenses, retained cash flow, total debt, EBITDA, net debt, return on tangible assets, book capitalization, cash flow from operations, dividends. Specific variables for the oil and gas industry are also used: proven and developed reserves and average daily production. Therefore, the database is a sample of the five largest companies in each industry with previously published Moody's ratings and publicly available reports and forecasts. Additional qualitative data on 5 companies is obtained to test the ESG rating model. In most cases, since the majority of the companies in question publish IFRS statements, all their calculations are conducted in US dollars. But for representativeness we added two companies that use national currency for calculations, X5 Retail Group (Russian rubles) and Husky Inc. (Canadian dollars). The companies from eight countries are examined: Russia, USA, Luxembourg, England, Canada, India, Ukraine and Brazil. The average value 2018–2020 is calculated for each factor in the model. This is due to the fact that ratings are assigned through a cycle. With this approach, seasonal fluctuations in business activity are averaged. Since our model takes into account sovereign risks, the sample includes sovereign ratings for the studied countries with forecasts. This data was obtained from the Bloomberg system. However, a selection bias problem could be present due to the small number of observations in the dataset. Hence, the findings corresponding to the industry patterns are only relevant for similar situations.

**Table 1.** Rating scale

Credit rating	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C
Grade	1	3	6	9	12	15	18	20	21

*Note:* The rating grade is calculated for each sub-factor in the model.

*Source:* Moody's.

## Methodology

The methodological base of the paper was formed by the work of international rating agencies. The following methodologies were used: Moody's retail industry methodology [18]; Moody's steel industry methodology [19]; Moody's protein and agriculture industry methodology [20]; Moody's oil and gas (E&P) industry methodology [21]; ACRA government support methodology [22]; ACRA group belonging methodology [23]; Expert RA ESG rating methodology [24].

Moody's published methodologies used in the construction of the model do not completely reflect the procedure of companies' rating formation by Moody's. They only reflect the principles of assessment of the most common important indicators in a specific industry, which allow the authors of the model to use other relevant tools when compiling the rating calculator. The presented methodologies comprise a method of indicator evaluation on an 8–9 point scale, converting them from this scale to a quantitative scale according to Moody's rating evaluation formula and converting them into a final credit rating as demonstrated in Figure 1. A certain advantage of the selected methodologies over those of international competitors – Fitch and S&P – is the more expansive grading in the calculation of qualitative indicators, with more “binomial” parameters (value 0 or 1) in evaluation. The data for evaluation can only be found implicitly, by studying the companies' official presentations to investors or similar documents, in which they disclose information relevant for the study using the model.

**Figure 1.** The formula for the overall stand-alone credit rating

$$\sum_{i=1}^n x_i \cdot weight_i = X_s .$$

*Note:*  $x_i$  is a grade of a subfactor  $i$  and  $X_s$  is an overall stand-alone numerical credit rating.

*Source:* Moody's and authors' calculations.

The assessment is based on key indicators such as: scale, company's business profile, profitability and efficiency, leverage and coverage, and the financial policies pursued by the company. Generally, these indicators also contain sub-factors, which, when combined, will better reflect the value of the overall indicator itself. Each subfactor value is measured as a weighted year average: 2018 – 15%, 2019 – 25%, 2020 – 30% and 2021 – 30%.

Therefore, each factor and sub-factor is assessed and then transposed to the numerical value according to Table 1 to proceed to a calculation of the final rating using the weights specified in Tables A1–A4 depending on the industry.



The created model will take the external influences into consideration; the result will not be a stand-alone rating. The model will allow to examine the influence of state support, group support, as well as to calculate the ESG rating. The selected methodologies are used to study, evaluate and take into account the influence of parent structures and the state on companies in the Russian Federation, but, since the model is designed to calculate the rating for companies around the world, these methodologies were taken only as the foundation and, as a result, the points relevant to the specifics of the Russian Federation were adapted to other countries. The estimates of the influence of state support and the of being a part of a group will be provided as corrections to the original stand-alone rating according to the specified methodologies, while the ESG rating was created as an independent rating, which could be included with the overall results of any company.

To account for external support from the state or shareholders, the joint default analysis approach was used. This approach includes assessment of two dimensions of support: (1) the strength of the links between the company and its shareholders; and (2) the probability of shareholders' support of the company (Table A5). The probability of support is assessed using the creditworthiness of the shareholder (SICA) with the following factors: presence of a legal relationship, presence of contingent liabilities (including sureties and guarantees), strategic importance and operational integration. Subsequently, the final adjustment value to stand-alone creditworthiness assessment (SCA) is calculated according to Table A5. The adjustment for state support requires an assessment of systemic importance and state influence levels as qualitative factors, and subsequent calculation of the adjustment value for the support from the shareholders (Table A6).

Moreover, the final credit rating is then compared with the stand-alone rating to avoid outliers and adjust for the specific country's macroeconomic risks. Therefore, the final quantitative credit rating is calculated as presented in Figure 2.

**Figure 2.** The formula for the final credit rating

$$\min(\text{sovereign rating}, X_s + GOV + GROUP) = X_f.$$

*Note:* GOV and GROUP represent adjustment by state and group support, respectively.

*Source:* Authors' calculations.

**Table 2.** Model ratings with adjustments of companies from the retail industry

Company	Agency rating	With adjustments	Best coefficient	Worst coefficient
X5 Retail Group (USD)	Ba1	Baa3	Sales	EBIT / Interest Expense
X5 Retail Group (RUB)	Ba1	Baa3	Sales	EBIT / Interest Expense
Costco	Aa3	Aa3	Sales	RCF / Net Debt
Walmart	Aa2	A2	Sales	RCF / Net Debt
Starbucks	Baa1	Baa1	Sales	RCF / Net Debt
Party City Holdco Inc.	Caa1	B3	Sales	Debt / EBITDA

*Note:* Best and worst coefficients are the most and least successful results among financial coefficients in terms of value added to financial rating, not adjusted for coefficient weight.

*Source:* Authors' calculations.

## Results

### Baseline credit assessment results

The results of this model can be divided into two categories: company ratings compared to Moody's ratings and general patterns and trends identified based on the results of the model. To begin with, it should be noted that the model does not allow a company to possess a rating higher than the corresponding sovereign rating of its country. These results, presented by Moody's, were designated as outliers, and these companies' ratings were equated to the sovereign ratings.

The research results demonstrate that the resulting model is highly accurate, as the average deviation from the Moody's rating without adjustments is  $-0.75$  points. With applied adjustments, model accuracy becomes  $-0.25$  points, with an average ESG rating deviation of  $0.5$  points. This high accuracy value indicates that all the required coefficients were considered because, when the amount of data under consideration increases, the amount of discrepancies decreases, which also indicates that they should be considered when assessing credit quality.

The difference in the results may mainly indicate the existence of discrepancies in the data between potential users and rating agencies due to different years studied or different exchange rates of national currencies. The model mostly underestimates the ratings, which is caused by the presence of crisis years, when the main financial indicators are traditionally lower, in the sample.

Certain patterns emerged in the database, and the "Sales" coefficient for the retail industry is the most common successful result out of financial coefficients in terms of value added to the financial rating, not adjusted for coefficient weight for all the companies in the sample (Table 2). It could confirm that the key characteristic of the retail industry is that its sales generate the main profit, because it directly dictates the company's position in the market. On the other hand, 4 out of 5 companies demonstrate the least successful results in financial coefficients in terms of value added to financial rating, not adjusted for weight of debt-related coefficients (Table 2). It is important to note that the results obtained for X5 Retail Group, which are calculated in American dollars and rubles, do not differ from each other, which may indicate the correct accounting for the currency in which the reports are presented.

In addition, there is a clear pattern in the steel industry, with the “EBIT/Interest Expense” coefficient being the most successful for 4 out of 5 companies (Table 3). It can indicate a company’s positive net profits and low interest expenses on short-term and long-term debts. While the worst indicators differ, 2 companies have almost the same deficiency in the CFO/Debt indicator (Table 3), which may indicate a small amount of free

funds from operating activities. This indicator is important as it directly reflects the amount of cash that the company generates from its income. Also, 2 companies have an equally unsuccessful sales indicator (Table 3), which may be caused by the lack of demand for goods in the years under consideration or hint to a weak position in the markets where the company carries out its activities.

**Table 3.** Model ratings with adjustments for companies in the steel industry

Company	Agency rating	With adjustments	Best coefficient	Worst coefficient
MMK	Baa2	Baa3	EBIT / Interest Expense	Sales
NLMK	Baa2	Baa3	EBIT / Interest Expense	CFO / Debt
Severstal	Baa2	Baa3	EBIT / Interest Expense	Sales
EVRAZ	Ba1	Baa3	EBIT / Interest Expense	CFO / Debt
ArcelorMittal	Ba1	Baa3	Sales	Debt / BookCap

*Note:* Best and worst coefficients are the most and least successful results in financial coefficients in terms of value added to financial rating, not adjusted for coefficient weight.

*Source:* Authors’ calculations.

The oil and gas industry, especially the exploration and production sector, is directly related to the reserves and volumes of daily production. Therefore, the most successful results in this industry are revealed by the Debt / PD reserves indicator, and this is the case for each company (Table 4). Hence, it is possible to state that in this industry reserve indicators are important for companies and even despite the crisis years, the management board monitors and maintains this indicator at the proper level. The least successful indicator results for 4 out of 5 companies are reflected in RCF/Debt coefficient (Table 4), which may be due to the companies’ high debt ratio or low retained

cash flow. This would be a negative signal for investors, as this indicator is used to determine the company’s ability to repay its debts from cash generated from operations, i.e., sales, after dividend payments. Notably, the only company with a different least successful indicator is Russneft, whose possible bankruptcy has been discussed in the news. It has the least successful results in the Average Daily Production coefficient that indicates poor sales estimates, which would negatively affect all financial results and, importantly, the company’s lack of willingness to compete in the market and shows little impact on the development of the industry.

**Table 4.** Model ratings with adjustments of companies from the oil and gas (E&P sector) industry

Company	Agency rating	With adjustments	Best coefficient	Worst coefficient
Oil India	Baa3	Baa3	Debt / Reserves	RCF / Debt
Husky	A2	A3	Debt / Reserves	RCF / Debt
Russneft	Caa2	B2	Debt / Reserves	Avg Daily Prod
EOG resources	A3	Baa3	Debt / Reserves	RCF / Debt
Murphy Oil Corp	Ba3	Ba2	Debt / Reserves	RCF / Debt

*Note:* Best and worst coefficients are the most and least successful results in financial coefficients in terms of value added to financial rating, not adjusted for coefficient weight.

*Source:* Authors’ calculations.

It is difficult to identify clear patterns for the most or least successful indicators in the protein and agriculture industry, which may be due to the sample of companies in the database: they are not similar to each other and may rank differently in sales and systemic importance within their

markets. Only two companies have the same most successful metric, which is CFO/Debt (Table 5), and while it is equally positive, it does not have a very high rating. Because of high competition and low market power, the debt load is the key distinguishing factor between solvent and

insolvent companies in this industry. The least successful performers differ even more, although the two companies have similarly lagged Debt/Book Capitalization (Table 5),

suggesting that the metric that measures a company's total outstanding debt as a percentage of total company capitalization is lagging and requires work in the future.

**Table 5.** Model ratings with adjustments of companies from the protein and agriculture industry

Company	Agency rating	With adjustments	Best coefficient	Worst coefficient
Cherkizovo Group	B1	Ba3	Debt / EBITDA	EBIT / Interest Expense
Archer-Daniels-Midland Company	A2	Baa2	Sales	CFO / Debt
MHP SE	B2	B1	CFO / Debt	Debt / BookCap
Minerva S.A.	Ba3	B2	CFO / Debt	Debt / BookCap
Ingredion Inc	Baa1	Baa1	EBIT / Interest Expense	Sales

*Note:* Best and worst coefficients are the most and least successful results in financial coefficients in terms of value added to financial rating, not adjusted for coefficient weight.

*Source:* Authors' calculations.

The model's ability to predict and indicate weaknesses in companies, which can be adjusted by substituting different values, as well as to point out the line of effort, together with the resulting patterns in the relationship between the credit rating and the financial indicator values can help to identify a company's strengths and predict its level of credit risk.

### ESG Rating results

The ESG rating is built into the model as an independent tool for calculating the rating of possible environmental and social damages, as well as corporate governance risks in the company. When calculating the main credit rating of a company, the potential user of the model can introduce corrections and proceed to the calculation of the ESG rating with the average variance between actual and modelled rating of about 0.5 notches.

The ratings obtained by the model and the rating agencies for PIK, AK BARS, GLAVSTROY, GTLK and TRINFICO apparently coincide (Table 6), since the Expert RA methodology was taken as the foundation when forming the ESG rating in the model, which is very similar to the NRA methodology for the majority of coefficients. However, in the case of X5, the obtained result is different: the rating calculated using the model is higher than the agency rating, which may be due to a different approach to evaluation and different views on environmental, social and corporate governance issues. The MSCI methodology is a guide to rating indicators on a broader scale. Each indicator is assessed on a scale of 0 to 10, adding more detail to the actions, while increasing the subjectivity of the assessment, as the user is given an opportunity in advance to assess the company's actions on a positive-negative spectrum, even though all the necessary data is publicly available, and it is easy to find relevant answers to all questions in each of the three areas.

**Table 6.** Model ESG ratings results

Company	Agency rating	Model rating
PIK GROUP	ESG-2 (Expert RA)	ESG-2
PJSC AK BARS BANK	ESG-3 (Expert RA)	ESG-3
GLAVSTROY	ESG-4 (Expert RA)	ESG-4
GLTK	ESG-3 (Expert RA)	ESG-3
TRINFICO	B1 (NRA)	ESG-3 (B1 NRA's scale)
X5 Retail Group	BB (MSCI)	ESG-3 (A-BBB MSCI's scale)

*Source:* Authors' calculations.

## Conclusion, Contribution and Implication

An analysis of deviations from Moody's estimates was carried out; the obtained difference in the results can mainly indicate the presence of discrepancies in the data between potential users and rating agencies due to different years being analyzed or different exchange rates of national currencies. The model mostly underrates the results due to the presence of crisis years, when key financial indicators are traditionally lower, in the sample.

Differences in the results may also positively suggest an unbiased approach to assessing credit quality, that is, one without strong subjectivity. The approach to the assessment of qualitative indicators is different; accordingly, long-term ratings obtained by the rating agencies are not necessarily the only correct ones. The entire process of their formation is fully described in this paper, accordingly, the unbiased nature of the results obtained is an undeniable advantage.

From the analysis of the indicators, the most and least successful performances in each of the industries are identified and the reasons behind these patterns are demonstrated. The model's ability to predict and indicate weaknesses in companies' performance, which can be adjusted by substituting different values, as well as to point out line of effort, together with the resulting patterns in the relationship between the credit rating and the values of financial indicators can help to identify the strengths of a company and predict its level of credit risk.

Other positive aspects of the resulting model are its versatility, both in application and in its high adaptability to various new tasks. It can be modified in an uncomplicated way to study the credit quality of companies from other industries, a region's credit rating or the formation of sovereign ratings, depending on the interests of a potential customer.

The research has also provided detailed analyses of the information power (importance) of financial and nonfinancial factors within each credit rating scoring model.

The obtained tool can be updated, supplemented, and improved, and the example of the ESG rating shows how easy it is to build a variety of new solutions to tasks that will affect the final level of credit risk of the company. As this scoring model is a universal tool with a user-friendly interface and a ready database that can be updated for further development and expansion of various specific tasks, it can account for all possible necessary factors for the solution of risk assessment-related tasks. Therefore, such a model has great potential for development and practical application.

## Acknowledgements

The research was funded by the Russian Science Foundation (project No. 23-18-00756)

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## Appendix 1

**Table A1.** Retail industry

Rating factors	Weight, %	$x_i$	Weight <sub>i</sub> , %
Scale	10.00	Revenue	10.00
Business profile	30/00	Product stability	10.00
		Execution and Competitive Position	20.00
Leverage and coverage	45.00	EBIT / Interest Expense	15.00
		Retained Cash Flow / Net Debt	15.00
		Debt / EBITDA	15.00
Financial Policy	15.00	Financial Policy	15.00%
<b>Total</b>	<b>100.00</b>	<b>Total</b>	<b>100.00</b>

Source: Moody's and author's calculations.

## Appendix 2

**Table A2.** Oil and Gas industry

Rating factors	Weight, %	$x_i$	Weight <sub>i</sub> , %
Scale	20.00	Average Daily Production(Mboe/d)	10.00
		Proved Developed Reserves(MMboe)	10.00
Business profile	10.00	Business profile	10.00
Profitability and efficiency	25.00	Leveraged Full-Cycle Ratio (EBIT Margin)	25.00
		EBITDA / Interest Expense	7.50
Leverage and coverage	30.00	Debt / Average Daily Production	7.50
		Debt / PD Reserves boe	7.50
		RCF / Debt	7.50
Financial Policy	15.00	Financial Policy	15.00
<b>Total</b>	<b>100.00</b>	<b>Total</b>	<b>100.00</b>

Source: Moody's and author's calculations.

## Appendix 3

Table A3. Steel industry

Rating factors	Weight, %	$x_i$	Weight <sub>i</sub> , %
Scale	20.00	Revenue	20.00
Business profile	20.00	Business profile	20.00
Profitability and efficiency	15.00	EBIT Margin	10.00
		Return on Tangible Assets	5.00
Leverage and coverage	35.00	EBIT / Interest Expense	7.50
		Debt / Book Capitalization	5.00
		Debt / EBITDA	15.00
		(CFO-Dividends) / Debt	7.50
Financial Policy	10.00	Financial Policy	10.00
<b>Total</b>	<b>100.00</b>	<b>Total</b>	<b>100.00</b>

Source: Moody's and author's calculations.

## Appendix 4

Table A4. Protein and agriculture industry

Rating factors	Weight, %	$x_i$	Weight <sub>i</sub> , %
Scale	10.00	Revenue	10.00
Business profile	35.00	Geographic diversification	5.00
		Segment Diversification	5.00
		Market share	5.00
		Product Portfolio Profile	10.00
		Income stability	10/00
Leverage and coverage	40.00	Debt / EBITDA	10.00
		CFO / Debt	10.00
		Debt / Book Capitalization	10.00
		EBIT / Interest Expense	10.00
Financial policy	15.00	Financial policy	15.00
<b>Total</b>	<b>100.00</b>	<b>Total</b>	<b>100.00</b>

Source: Moody's and author's calculations.

## Appendix 5

**Table A5.** Adjustment for support from the state or other shareholders

		Degree of relationship				
		Very strong	Strong	Moderate	Weak	Very weak
Supporting institution category	Strong	Not higher than SICA*	Not higher than SCA + 4, but not higher than SICA* - 1	Not higher than SCA + 3, but not higher than SICA* - 2	Not higher than SCA + 2	SCA
	Moderately strong	Not higher than SICA*	Not higher than SCA + 2	Not higher than SCA + 1	SCA	SCA
	Neutral	SCA	SCA	SCA	SCA	SCA
	Moderately weak	SICA*	Not higher than SICA* + 1	SCA	SCA	SCA
	Weak	SICA*	Not higher than SICA* + 1	Not higher than SICA* + 2	SCA	SCA

\* SICA or supporting institution's credit rating, if any.

Source: ACRA.

## Appendix 6

**Table A6.** Adjustment for state and shareholder support

		Systemic importance level			
		Very high	High	Medium	Low
Level of state influence	Very strong	Parity	Parity - [from 1 to 5 notches]	Not exceeding SCA + 3	Not exceeding SCA + 1
	Strong	Parity - [from 1 to 3 notches]	Not exceeding SCA + 3	Not exceeding SCA + 2	Not exceeding SCA + 1
	Moderate	Not exceeding SCA + 3	Not exceeding SCA + 2	Not exceeding SCA + 1	SCA
	Weak	Not exceeding SCA + 1	Not exceeding SCA + 1	SCA	SCA

Source: ACRA.

**Contribution of the authors:** the authors contributed equally to this article.

The authors declare no conflicts of interests.

The article was submitted 06.09.2022; approved after reviewing 08.10.2022; accepted for publication 14.11.2022.



DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.17-26>

JEL classification: G30, G32, G21



# Do Emerging Markets Succeed in Implementing Sustainability Principles in Infrastructure Finance? Evidence from Public-Private Partnerships in Russia

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## Abstract

This paper is the author's contribution to existing literature on the evaluation of ways to co-create ESG benefits in the process of implementing a public-private partnership (PPP). The author developed his own ESG rating based on a sound set of indicators and an independent evaluation of publicly available information on sustainable development issues. For the purposes of compiling a rating score, the specific issues relevant to the evaluation of a PPP project's sustainability considerations in view of national agenda were analyzed. Based on an analysis of academic literature and publicly available information about similar ratings, the author proposes an approach to measuring these issues and incorporating the results in the integrated ESG rating. The developed ESG benefit evaluation instrument may be used by institutional, private and state PPP market participants for a comprehensive analysis of their investment activity. The case study analysis of two PPP projects from Russian practice revealed sustainability failures in corporate governance practices in the process of investing in infrastructure; in addition, the author proposed potential ways of overcoming some of the failures based on case comparison. This paper provides a new outlook on the methodology of a PPP-adjusted ESG rating that is relevant for evaluating and monitoring of corresponding investments in infrastructure on emerging markets.

**Keywords:** public-private partnerships (PPP), ESG rating, ratings and rating agencies, sustainable development, sustainability investments, project analysis, infrastructure finance

**For citation:** Kharlamov, A. Do Emerging Markets Succeed in Implementing Sustainability Principles in Infrastructure Finance? Evidence from Public-Private Partnerships in Russia. *Journal of Corporate Finance Research*. 2023;17(1): 17-26. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.17-26>

## Introduction

Today, public-private partnerships (PPP) are actively used worldwide<sup>1</sup> to attract investments in the infrastructure sector; this mechanism is also becoming popular among the member countries of the Eurasian Economic Union [1]. According to the definition by D. Grimsey and M.K. Lewis, “public-private partnerships are arrangements whereby private parties participate in, or provide support for, the provision of infrastructure, and a PPP project results in a contract for a private entity to deliver public infrastructure-based services” [2]. Infrastructure in this definition is asset-based and refers to both economic infrastructure (e.g., motorways, railways, and bridges) and social infrastructure (e.g., schools, social housing, hospitals and prisons) [2].

Some typical characteristics that distinguish PPPs from traditional public procurements include the use of long-term infrastructure contracts [3], private investments in public infrastructure, provision of public services by a private company and the transfer of certain risks to the private sector [4], a focus on the specification of project outputs rather than project inputs, and the integration or “bundling” of different functions into a single contract [2]. Taking into account the abovementioned characteristics, it is sound to consider PPPs as separate businesses that are emerging within the long-term contractual relationship with the state authorities.

At the same time, it is reasonable to analyze PPP vehicles separately from corporations. Although these companies are private, they are established for the sole purpose of implementing a specific project or rendering specific services for the state authority (the grantor), the operations of those companies are controlled by the grantor, who is frequently the sole buyer of the company’s services. Namely, PPP companies are established and operated in close cooperation with the state and highly dependent on the contractual relationship with the corresponding state authority. That’s why this type of the companies might be considered a transition type between profit-oriented private corporations and non-for-profit state enterprises.

PPPs are sometimes mentioned as a potential vehicle for achieving the state’s sustainability goals [2; 4; 5]. However, the evidence from some researchers [6] shows that it is up to the PPP participants to ultimately decide to what extent they will pursue sustainability goals. At the same time, there is evidence from developed markets that the key role in ensuring the sustainable implementation of a PPP is fulfilled by the state authority [6]. Consequently, to implement the PPP that go beyond mere financial added value, a strong coordinating role is required from the public partner. Following those conclusions, corresponding governance recommendations for the public procurer have been proposed in recent research [6].

In 2010–2021 in view of the increase in the number of transactions and in the volume of private investments in public infrastructure (performed both through PPPs and non-PPPs), the current worldwide trend is to increase the share of “green” investments<sup>2</sup>. That’s why it’s becoming vital not only to evaluate, but also to assess infrastructure projects in terms of the achieved sustainability impacts.

Currently available ESG rating methodologies and indices overlook the measures specific to public-private partnerships and infrastructure investment in general. Current methodologies are focused on public companies, and even if certain ratings are applicable to infrastructure projects, they do not take into account either national specifics, or PPP aspects that evaluate the actions of public partners, rather than only the investors’ activities.

This paper builds on the necessity of creating an integrated ESG rating score that accounts for specific PPP features to enable institutional, private and public market participants to conduct a comprehensive analysis of their investment activity. This ESG rating is required not only to evaluate the project’s attractiveness during the start-up period, but it is also needed at the later stages of the project life cycle for assessment of the investment activities by the wide range of stakeholders. In the latter case, what is very important is that an efficient set of indicators could be susceptible to independent verification based on the publicly available information about the project.

To date, the assessment of efficiency of PPP project implementation in Russia is focused on the efforts to assess the overall integrated effect, as well as the evaluation of budget benefits and economic effects and risks for stakeholders [7]. However, how frequently and consistently do Russian PPP participants evaluate sustainability factors when investing? How to assess the overall project performance against sustainability principles and measures? To answer these questions, a specific methodology has been developed and specific ESG indicators related to PPP activities have been proposed in this paper. The proposed methodology is then applied to the case studies of two Russian mega-projects for their evaluation. The following research questions are examined: (1) What specific issues could be addressed when analyzing sustainability considerations of a PPP project? (2) How to measure those specific issues and how to include the estimate in an integrated rating of ESG impact? (3) What failures in corporate governance practices are encountered in implementing sustainable investing, and how can they be avoided in future?

The remainder of this article is structured as follows: Section 1 provides a literature review and a discussion of the current research on PPP sustainability. Subsequently, Section 2 describes the methodology for the development of an ESG rating. Section 3 continues with the findings from

<sup>1</sup> Infrastructure Monitor 2022. Global trends in private investment in infrastructure. Global Infrastructure Hub.

<sup>2</sup> Infrastructure Monitor 2022. Global trends in private investment in infrastructure. Global Infrastructure Hub.

the application of the developed ESG rating to case studies, reveals failures in projects' sustainable development and infers recommendations for overcoming certain sustainability failures based on a comparison of project cases. Finally, Section 4 discusses the conclusions and limitations of the research.

## Literature Review

The review of academic literature is structured in the following two blocs: the *Sustainability in PPPs* bloc reviews the recent research papers on sustainability issues in PPP projects, and the *ESG rating* bloc discusses how the existing ESG ratings developed by banks and rating agencies might be applicable to real-life PPP cases, their differences and their limitations associated with methodology.

### Sustainability in PPPs

The issues of sustainable development (hereafter SD) have already been addressed in a number of research papers on PPP problematics. Although the methodological approaches are only being developed, the authors usually perform case study analysis for different projects and companies, which presumably incorporate SD aspects in their processes and decisions. To address research questions, researchers usually interviewed project managers, conducted extensive analysis of project tender documentation and even design specifications. The major secondary source of information on project development is the open publications in various media, including the Internet.

M. Hueskes et al. [6] focused their research on the questions of how public procurers deal with sustainability when procuring PPPs and how the incorporation of sustainability considerations can be stimulated. They performed an empirical research of PPP projects in Flanders (Belgium) based on an analysis of the tender documents of twenty-five PPPs and case studies of two PPP projects, which included interviews of project insiders regarding governance practices used to achieve sustainability goals.

L.A. Keeyes and M. Huemann [8] developed a conceptual framework for the analysis of an agricultural innovation project on how the project's SD benefits are co-created by multiple stakeholders involved in infrastructure projects, beyond the usual project objectives and results. The authors analyzed different stages of the life cycle of an infrastructure project where SD benefits are created and outlined the elements that support the co-creation of the project's sustainable development benefits.

F. Villalba-Romero et al. [9] assessed the performance of transport infrastructure projects in terms of achieving sustainability principles (i.e., the three pillars). They fulfilled the task by developing a simple measurement matrix for assessing sustainability in transport projects. The matrix was applied to the assessment of the four infrastructure project case studies from different parts of the EU, specifically, toll roads in Greece, Portugal, Spain and the UK. This

paper proposed a basic approach to assessing sustainability performance using a combination of quantitative and qualitative content analysis (QCA) based on the extensive questionnaires filled out by project insiders. The paper assessed project performance in terms of sustainability and compared sustainability metrics against the common indicators that determine a project's success. Sustainability performance is also compared against conventional project management in order to see the deviation of results, if any. The three pillars, i.e., economic, social and environmental, are used to measure sustainability; whilst the "iron triangle", i.e., quality, cost and time, are considered to assess project performance.

The above-mentioned research papers on sustainability in PPP projects developed their own analysis frameworks and assessment tool. For example, M. Hueskes et al. [6] developed their own system comprising 6 criteria and 18 sub-criteria for further analysis of project-related data on implementation of sustainability in project tender documentation and other guidelines. Those criteria and sub-criteria aren't measured, they are used as a checklist to evaluate the presence of sustainability consideration in documentation. At the same time, they provide an example of criteria applicable to PPPs. Moreover, the analysis conducted by M. Hueskes et al. [6] concentrated exclusively on the activities of the public party. The current paper builds on the analysis of M. Hueskes et al. [6], however, it introduces measures of the criteria that are measurable and analyses the activities of the private party in addition to those of the public party.

All research papers are based on the analysis of qualitative, rather than quantitative non-public information and confidential interviews with project insiders, with a focus on the tendering process, and the negotiation and construction stages of the corresponding projects, however, none of the authors performed an extensive analysis of projects' operational stage. This paper fills in this gap by introducing numerical ESG criteria measures and by taking into consideration SD-related activities of project stakeholders in the operational stage.

In addition, the research framework doesn't provide for questionnaires and direct interviews with project insiders due to a lack of access to the corresponding employees. Instead, the research is based on the analysis of publicly available information and official sustainability reports disclosed by project founders. Questionnaires and interviews could improve the quality of project evaluation, however, they would not affect the development of a framework for this analysis.

Another research gap filled in by the current paper is the analysis of SD co-creation based on case studies from emerging markets.

The author believes that such a sustainability analysis must be based mainly on public information or on the information which may be made public easily in plain language and a structured way. This kind of sustainability development analysis could also be conducted with the help

of an ESG rating based either on an existing ESG rating methodology or on a methodology developed specifically for PPPs. Such an approach could allow for the future comparability of different projects' ESG ratings based on a common set of criteria. However, in the absence of an established ESG rating practice for PPPs, the analysis of the examples of existing ESG rating methodologies applicable to corporations and their projects could shed light on the possible improvements of the methodology developed by the above-mentioned researchers.

## ESG ratings

The recent research on ESG rating methodology shows that the significant divergence of different methodologies allows to obtain completely different ranks for the same company [10]. The primary reason would be the “lack of a commonality in the definition of ESG (i) characteristics, (ii) attributes and (iii) standards in defining E, S and G components” [10]. Another reason is that different raters use different numbers of criteria in their assessments. For example, MSCI and FTSE Russell represent the extremes, assessing 37 and 300 ESG criteria, respectively. Other agencies, in turn, assess different metrics related to the industry that the company belongs to (see Sustainalytics and RebecoSAM). Finally, the difficulty arises in achieving a generally acceptable definition of ESG materiality, i.e., an assessment of whether a specific event or a process may ultimately trigger the weighting mechanism of the assessed criteria and generate further divergence in the overall rating [10].

Other authors also highlighted that there are four leading ESG rating providers (MSCI, S&P Dow Jones, FTSE Russell, and Thomson Reuters) and a range of significant ESG indexes (e.g., MSCI ACWI ESG Index, Dow Jones Sustainability World Index, FTSE4Good Global Index, and the Thomson Reuters ESG Indexes for US Large Cap stocks and Developed Markets (ex-US)) [11]. The limitations of the existing ratings include the bias towards tracking larger firms in developed countries, and the fact that “ESG indexes designed decisions can lead to a ‘one-size-fits-all’ approach, which may obscure the nuances of the underlying company’s behavior” [11]. Besides, there are indices that were developed especially for assessing infrastructure projects.

SuRe Standard was developed in partnership with Global Infrastructure Basel Foundation and Natixis. The analysis is carried out in regard to 14 different topics using 61 ESG criteria [12]. Since 2012, this standard has been used in more than 150 infrastructure projects.

The Envision project also aims to explore a single infrastructure project. Envision uses sixty sustainability indicators of environmental, social, and economic impact. These criteria are divided into five categories: quality of life, leadership, resource allocation, the natural world, climate and risks [13].

Both the ratings of SuRe Standard and Envision projects are project-based, which is why they’re more suitable for the evaluation of a PPP than the previous company-based rating introduced above. However, the criteria are too numerous to perform the calculation and verification based on public information. The evaluation process requires special competences and may not be performed without reporting commitments from the project founder. This peculiarity is particularly problematic for emerging markets, where significant information asymmetry and poor institutional environment create the conditions for possible fraud related to communicating correct project-related information. Another disadvantage of these rating methodologies is that they don’t take into account the activities of the public partner related to their functions described in the PPP agreement, which is why in the case of a PPP the rating score wouldn’t be comprehensive.

Taking into account these peculiarities of existing methodologies, a specific analysis framework has been developed for the purpose of this research.

However, ESG rating methodologies is not fully disclosed by their proprietors – rating agencies and banks – which makes its comprehensive analysis impossible without access to legally protected information. Moreover, they are permanently reassessed based on the practice of its implementation and ongoing research on the subject of ESG. However, the analysis of available rating methodologies allows to calibrate the approach to the development of an analysis framework.

## Methodology and Analysis Framework

The case study methodology has been used to achieve the main goal of this research. Two private-public partnership Russian projects (Western High-Speed Diameter and M-11 «Neva») were compared. The application of the author’s proprietary methodology of ESG-rating to real life cases provides the answer to one of the research questions: to what extent do Russian PPP participants take sustainability factors into account when performing the corresponding investments and operating the new infrastructure?

In order to conduct these case studies, the following algorithm is used. All the relevant information about projects and their financial indicators were taken from the National Public-Private Partnership Center of Russia<sup>3</sup>. The concessionaires’ so-called “sustainable development reports” prepared on a voluntary basis were analyzed for ESG criteria assessment. The availability of detailed and sensitive sustainability information on project performance was the key factor in the selection of those projects for case study analysis. Another reason for the selection of these projects for the analysis is that both of them are pioneering PPP projects in Russia launched in early 2010, and a broad range of reliable data has been accumulated not only about the construction, but also about the operation stage.

<sup>3</sup> URL: [pppcenter.ru](http://pppcenter.ru); [rosinfra.ru](http://rosinfra.ru)/project

A list of ESG criteria has been developed as a starting point for the analysis. Subsequently, the activities of public and private parties implementing the project are evaluated against each of the criteria. Such a list of sustainability criteria is the sphere where a country's or even local area specifics could play a significant role, i.e., the project allowing to overcome or even resolve major national environmental, social and governance problems could obtain a higher rating in comparison to the one that aggravates the corresponding problem. The more important the problem is to the public, the higher the rating for a project that resolves it, and vice-versa. This is a specific approach to the materiality of the sustainability criterion, which was applied in this research. Using this approach as the starting point, the source of the information for the rating metrics could then play a certain role in the assessment, i.e., source reliability, novelty and applicability of the obtained information. As a result, the sustainability analysis framework could be based on the following steps:

- defining the main environmental, social and political issues of the public;
- defining the criteria allowing to evaluate the project's influence on resolving the abovementioned issues;
- assessment of infrastructure projects based on selected criteria;
- adjustment of the score for source reliability, novelty and applicability of the obtained information.

The local environmental agenda has been taken from the polling performed by major national polling center WCI-OM in 2019 [14], while the social issues are taken from the research published by research center Romir in 2016 [15], which is publicly accessible. The list of social issues has been further supplemented by the problems related to projects specifics and relevant social problems they aim to resolve. The list of the analysed governance issues is very typical for many ESG ratings, because it's focused on the

ways in which a private entity copes with operational risks and whether it successfully implements corporate social responsibility (CSR) policy.

At the next stage, the exact indicators were selected from the following types of indicators. *Performance-based* indicators, also called performance-oriented indicators, which are efficiency scores calculated based on the level of goal achievement initially stated by the contractor. This type of indicators is aimed to measure operation efficiency, shed light on the trends and report the results. *Practice-based* indicators, or prescriptive indicators, reveal the presence of required instruments or systems to ensure the implementation of best practices. These indicators are process-oriented, rather than result-oriented, which means that the causal relationship between policy implementation and the obtained result needs to be confirmed. That's why such indicators could obtain a lower rank during the evaluation process than those that are performance-based. Another type of indicators used in the assessment process is *target-based* indicators. These indicators reveal whether the operation is based on an explicit plan, or on policy and monitoring. An example of such an indicator may be a roadmap or a rating based on a number of milestones to be achieved. As a result, such indicators could be easily measurable and verifiable, at the same time, an achieved milestone can't be unambiguously equated with the achievement of the corresponding broad social or environmental goal, because the latter is as so easily measurable. That is why a target-based indicator could obtain a lower rank when compared to the other above mentioned indicator types. A simple scoring scale was selected in this research to evaluate the type of indicator: target-based indicator – 1 point, practice-based indicator – 2 points, performance-based indicator – 3 points.

A list of 13 indicators was developed and corresponding indicators were proposed for further evaluation, as presented in Table 1. The indicators below are also ranked according to the indicator type.

**Table 1.** ESG criteria

Category	Criterion	Indicator	Party	Type
Environmental	Air pollution	1 Emission level during construction phase	Private	Performance-based
		2 Car exhaust emissions after start-up of the operation phase in attraction zone	Private	Performance-based
	Waste recycling	3 Quality (level) and speed of waste recycling	Private	Practice-based
	River and lake pollution	4 Increased river and lake pollution in the attraction zone	Private	Performance-based
	Deforestation and deterioration of protected nature territories	5 Square meters of cutdown trees, negative impact on protected nature territories	Public / Private	Performance-based

Category	Criterion	Indicator	Party	Type	
Social	Unemployment	6	Number of new permanent jobs (direct effect)	Private / Public	Target-based
	Traffic jams	7	Reducing trip time, traffic congestion	Private	Target-based
	Human resources	8	Respect for labour rights and labour law	Private	Practice-based
	Noise levels	9	Level of noise during construction and operation phases	Private	Performance-based
	Housing policies	10	Number of residential buildings demolished in the project's attraction zone	Public	Practice-based
Governance	CSR policy	11	Transparence and openness of CSR policy, level of disclosure of ESG-related information in annual reports	Private	Practice-based
	Construction standards	12	Number of court suits related to disregard for construction standards	Public / Private	Target-based
	Corruption	13	Number of cases (court suits) of asset misappropriation	Public / Private	Practice-based

Source: Author's analysis.

Each of the 13 indicators was evaluated based on a 5-grade scale where: 1 stands for completely unacceptable actions, 5 stands for excellent actions/policy in the chosen category. The full evaluation scale is presented in Table 2.

**Table 2.** Evaluation scale

Rating	Grade	Percentage rating, %
● Excellent	5	80–100
● Good	4	60–80
● Satisfactory	3	40–60
● Acceptable	2	20–40
● Inacceptable	1	0–20

Source: Author's analysis.

Finally, in order to calculate an integrated rating, it is necessary to adjust the score for the information source reliability. During the assessment process, the following types of information sources were used: highly reliable and timely source (high-quality data), reliable and less timely sources (moderate-quality data), and reliable, but non-timely sources (low-quality data). The complete score information is presented in Table 3.

**Table 3.** Data source quality

Quality level	Criterion	Score
High-quality data	Data is timely (published in the last 1–2 years)	3
	Data is obtained from official reports of PPP participants	
Moderate-quality data	Data is published by a PPP participant	2
	Data is less timely (published 2–5 years ago)	
Low-quality data	Data published over 5 years ago	1

Source: Author's analysis.

## Results/Findings and Discussion

The final overall integrated rating demonstrated that the SD consideration result is approximately the same for both projects, however, the rating score components are not homogeneous. The Western High-Speed Diameter project is an internationally well-known example of a Russian public-private partnership. This project is often considered as one of the best private-public partnership projects in Russia in the field of infrastructure development. However, the results of the analysis revealed the presence of significant flaws, which undoubtedly made the project look bad in comparison with similar international transport projects. The M-11 highway project is not as well known worldwide, which is why it is frequently considered inferior to the Western High-Speed Diameter at the international expert level. However, the project's overall ESG score is 3 out of 5 points for both projects, which indicates the weak attention of Russian authorities and investors to the project's ESG impact as well as presumably poor relevant statutory regulation.

Despite the similar overall rating of both projects, there are clearly significant differences in the individual grades for each of the thirteen indicators. These important differences are revealed in the level of air pollution during the construction phase, the level of lake and river pollution, the implemented human resource policy and the level of openness and transparency of operations.

When analyzing the problem of air pollution along each highway, it should be noted that the Western High-Speed Diameter crosses the residential areas of Saint Petersburg, which is why the compensatory activities performed to offset the negative effects are more expensive and time-consuming. Contrary to the WHSD, the M-11 highway is located entirely in non-residential areas, and as a result the need to perform any significant measures to eliminate the air pollution effects is much lower. In addition, the environmental footprint of the WHSD project has attracted the attention of both environmental experts and local communities.

A similar situation occurs when we analyze the influence of the projects on river and lake pollution. In view of the limited possibilities to alter the WHSD route, the majority of rivers and subsurface waters in the proximity to the construction site suffered a negative impact. At the same time, the location of M-11 highway allowed to choose the optimal route easily, thereby bypassing a number of rivers and lakes during the project's design stage, which was actually performed by state authorities, rather than the concessionaire.

Nonetheless, it's important to note the discovered transgressions that occurred during construction and operation of the highways, which have a significant negative impact on the integrated rating. During the comparative analysis of technological construction solutions and the cases of non-compliance of the contractors with estab-

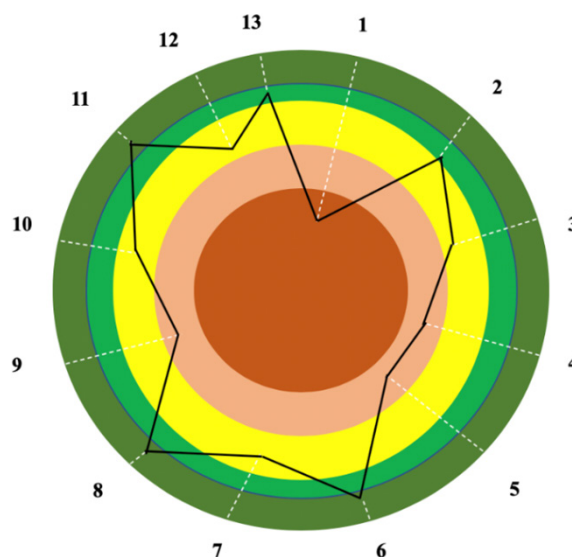
lished rules and norms, we could conclude that breaches of code during the construction of the WHSD were more significant than during the construction of M-11. However, it should also be noted that the inspections of construction sites by regulatory authorities revealed infractions in both projects.

Policy analysis performed by the concessionaire companies in the sphere of human resources and operations openness revealed that, the concessionaires of M-11 project disclose only a small part of information about the measures implemented to improve working conditions for their employees and promotion of openness and transparency. Despite the fact that this is a project of high public interest and attention, obtaining any information about its operations is a highly challenging process because of its influence on the economy of the regions in attraction area, as well as due to the level of state's financial support provided. On the contrary, Northern Capital Highway, the concessionaire of the WHSD project, broadly discloses CSR policy measures. The project's web-site contains not only the list of measures performed, but also the planned events and measures aimed at improving the processes for attracting new highway users and communicating with the project's stakeholders. This is clearly a positive example of SD effect co-creation by project participants.

A more illustrative graph of the ESG rating calculated for each of the analyzed projects is the so-called sustainable polygon. Figure 1 presents the sustainable polygon for the WHSD. The same illustration for the M-11 project is presented in Figure 2.

The sustainability polygon shows which of the thirteen indicators have an "inacceptable" score (close to the circle's red center) and which have an "excellent" score (close to the green rim). The numbers correspond to the criterion's number in Table 1 above.

**Figure 1.** Sustainable polygon for WHSD



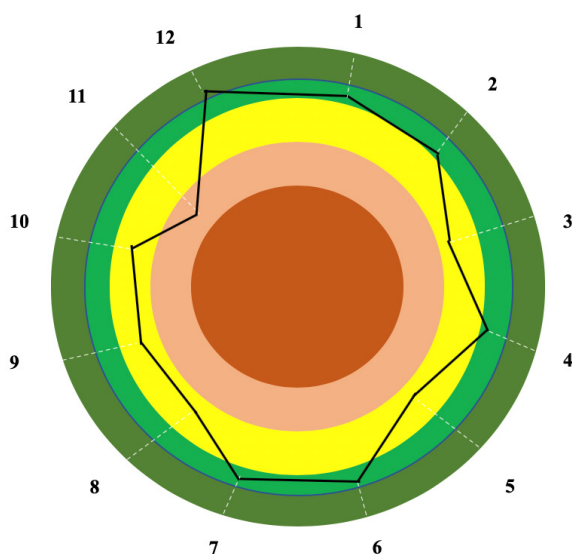
Source: Prepared by author.

When analysing the sustainability polygon of the WHSD,

it should be noted that the evaluation results for the selected indicators are quite heterogeneous. Figure 1 reveals the concessionaire's failures to implement reasonable technical solutions and operational planning during construction phase, as well as to control and monitor compliance with important environmental and social requirements. At the same time, we must note the significant efforts of the concessionaire to introduce the principles of openness and transparency of operation, regular communications with a wide range of stakeholders and to eliminate the negative impact caused by project implementation to the local communities.

The sustainable polygon for the M-11 highway project demonstrates that the actions of the concessionaire during the construction process led to a stable negative impact on the environmental and social situation in the project's attraction zone. Such a conclusion could be inferred from the fact that the diagram on Figure 2 is smoother than that on Figure 1. There are no prominent failures in some specific areas, except for some significantly less efficient governance practices than in the previous case. There are no significant successes either; on average the criterion is evaluated at a "satisfactory" or "good" levels. However, a number of significant offenses with respect to construction norms were revealed. What is more important, is the policy fully concealing company operations from the public attention, because significant offences, especially in the related to environmental impact and corruption may simply be hidden from the public scrutiny. That's why overall illustration provided by the M-11 highway sustainability polygon might be significantly biased in comparison to the WHSD polygon, and the project's actual integrated rating may prove to be lower than the current one.

**Figure 2.** Sustainable polygon for M-11 highway



Source: Prepared by author.

During the analysis of the obtained results we may infer the reasons for the similarity of the projects' overall sustainability ratings. In the case of the WHSD project, the

initial evaluation of environmental and social indicators is significantly worse than the same indicators for the M-11 highway, while the timeliness of the sources of information about the WHSD is significantly better than of those about the M-11. Thus, if we calculate the ESG rating without adjustment for the quality of information sources, the result obtained for the ESG rating of the M-11 highway could be even higher than the one for the WHSD. However, the significance of the data source's high quality is obvious, which is why the corresponding adjustment is required and the obtained ESG rating for WHSD could be set at a similar level with the one of M-11, with regard to all the above-mentioned limitations of analysis.

## Conclusion, Contribution and Limitations

This paper presents the methodology of compiling a ESG rating specific for PPP projects and based on public information only and voluntary disclosures by the project initiators. The numerical ESG ratings obtained in two case studies were visualized in Figures 1 and 2. The issues related to sustainability of PPP projects implemented in Russian practice were examined and addressed, however the conclusions and developed tools are applicable to many similar emerging markets.

The literature analysis from the *Sustainability in PPPs* bloc allowed to draw attention to other researchers' answer to the question "(1) What specific issues could be addressed when analyzing the sustainability considerations of a PPP project?" and to identify research gaps related to the question "(2) How to measure those specific issues?" The *ESG rating* bloc allowed to review current approaches to measuring sustainability issues for investment projects, and identifies the research gap regarding specific PPP project-related ratings.

This paper builds on the analysis of other research and takes into account the activities of both the private and the public parties. It also fills in this gap by quantifying ESG criteria, although previous researchers used qualitative measures only, and by taking into consideration the SD activities of project stakeholders in operational stage. In contrast to other academicians' approaches, the research framework in this paper doesn't provide for the use of questionnaires and direct interviews with project insiders due to lack of access to the corresponding insiders. Instead, the research is mainly based on the analysis of publicly available information and official sustainability reports disclosed by the project founders. The questionnaires and interviews could be able to improve the quality of projects evaluation, however they won't affect the author's development of an analysis framework. Another research gap filled in by this paper is the analysis of sustainability activities on emerging markets. Compared to similar project-based ESG ratings, i.e., that of Envision, the author's proprietary ESG rating provides for the evaluation of the activities of the public party in addition to the evaluation of activities of project founder. The research demonstrates that the introduction in cor-



porate governance guidelines of the board's responsibility for the evaluation and publication of the ESG rating could significantly improve the governance practices, including the efficient communication of sustainability issues to concerned stakeholders and shifting the board's focus from profit-making to sustainable development matters.

ESG impact was unfortunately not on the agenda of major PPP project participants in Russia in 2010–2021. As demonstrated by the calculation of the above rating scores, there is ample room for improvements at the state regulation level, as well as in private business practices in the coming years. Meanwhile, active participation in implementation of the projects launched by such international financial institutions (the IFIs) as EBRD makes it possible to ensure the disclosure of pertinent sustainability information to stakeholders and the introduction of relevant practices on stakeholder involvement and problem-solving measures. The research shows that participation of IFIs does not prevent significant failures in the implementation of technical solutions and obeying construction norms, probably due to the fact that it's a more complex problem in the sphere of statutory regulation and overall tender process. The positive role of IFI nonetheless lies in timely problem communication and stakeholder involvement in the search for efficient solutions.

This paper also demonstrates the positive impacts of timely disclosure of the pertinent sustainability matters in the integrated reporting of the concessionaire company, as well as the importance of disclosure of sustainability-related activities by public authorities directly involved in the implementation of PPP projects. The corresponding sustainability disclosure responsibility for both parties to a PPP project should be introduced in legislation.

The research carried out in this paper could be continued, since the sustainability-related rating may be supplemented by various criteria, not only in the studied areas, but also in other areas that may have an impact on the ESG assessment, for example, the level of technological complexity, innovativeness of project activities, etc. Therefore, the methodology developed in this paper could serve as a basis for ESG analysis of PPP projects on transport, as well as in other infrastructure sectors. However, when conducting further research, it is necessary to take into account the problem that emerged in the research process: the availability of public data on completed projects, or the reporting gaps. Unfortunately, a significant part of the information that supports the analysis is not available for research due to the fact that private investors and public partners in concessions and long-term investment agreements are not obliged to disclose up-to-date assessments of the environmental and social audits. Meanwhile, concession companies, which attract high public interest, actively use the gaps in reporting regulations and reporting standards that allow them to make only a very small part of project-related information publicly available and leaving stakeholders uninformed about important matters of project implementation. Among the relevant sources of sustainability-related information are the construction control and surveyor

reports, project stage commissioning reports and acts, environmental and social audits, legal documentation and public hearing protocols.

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The article was submitted 25.12.2022; approved after reviewing 23.01.2023; accepted for publication 10.02.2023.

DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.27-43>

JEL classification: G30, G21, G34



# How Do Corporate Governance Factors Influence Banks' Value? Evidence from Russia

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## Abstract

In this research study we built 3 models that evaluate the panel data of 30 Russian banks with the largest assets and highest reliability. Comparison of all three models by means of specification tests led us to the conclusion that the OLS model with the explanatory power of 67% is optimal.

The presence of women on the board of directors negatively affects the banks' valuation, while the number of the board of directors' meetings, number of directors and presence of an audit committee have a positive impact on the net asset value of banks. If the share of women increases by 1%, the bank's net asset value will decrease by 86%. If the board of directors has a functioning risk management committee, the bank's net asset value will grow by 225%. In case of an increase in the number of the board of directors' members by 1%, the bank's net asset value will grow by 4.4%. If the number of meetings of the board of directors per year grows twofold, the bank's net asset value will increase by 118%.

**Keywords:** bank, corporate governance, valuation of corporate governance efficiency, empiric model

**For citation:** Uskova, N. How Do Corporate Governance Factors Influence Banks' Value: Evidence from Russia. *Journal of Corporate Finance Research*. 2023;17(1): 27-43. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.27-43>

## Introduction

The banking sector has a number of significant differences from other industries. First, the difference becomes apparent after a comparison of banks' and other companies' reports. In statements of financial standing made by commercial banks, originated loans comprise the majority of assets, unlike statements of real sector companies where debts (liabilities) assume the first position. Banks' assets are less transparent than those of non-financial companies, therefore there is an opportunity to transfer a part of risk from shareholders to the holders of company debt. In addition, we may find other significant differences in the statements of financial standing. A bank's statement of financial standing does not comprise the items typical for real-sector companies, i.e., revenue, cost price, etc. Instead, banks disclose interest revenue (revenue equivalent) and interest expense (cost price equivalent).

Clearly, the structure and functioning of the banking sector companies are of a specific character, therefore, their corporate governance also differs from the corporate governance of non-financial companies.

### Notion of Corporate Governance

The modern notion of corporate governance was entrenched in the principles of corporate governance developed by the Organization for Economic Cooperation and Development (OECD [1]) as far back as 2004. According to OECD documents, corporate governance is defined as the internal organization of a company that involves a set of relationships between a company's three principal governing bodies: the board of directors (BD), general meeting of shareholders (GMS) and members of the executive board.

From a legal standpoint, several key approaches to defining the notion of corporate governance are determined. Thus, T.V. Kashanina thinks that corporate governance should be understood as the functioning of the governing bodies that control a company's core activity [2], E.A. Sukhanov compares corporate governance to the competences of the governing bodies, but considers them to be subjects of civil law [3], while A.E. Chistyakov et al. understands corporate governance as a set of relationships between governing bodies, as well as other internal bodies and committees within the company, which are established to attain short-term objectives [4]. In the opinion of N.N. Pakhomova, corporate governance is to a greater extent related to the emergence of the ownership right of governance participants instead of corporate operations [5], and I. N. Tkachenko in the study guide dedicated to legal relations offers the same approach to defining corporate governance as N.N. Pakhomova [6].

**Table 1.** Requirements of the Moscow Exchange for issuers

Requirement	Listing level	
	Level I	Level II
Number of independent members of the BD	At least 20% of BD members and at least three persons	At least two persons

The main distinction of foreign approaches is the addition of corporate external relations to the system of interrelations between governance bodies.

Since corporate governance concerns a certain legal business structure – a corporation – it should be considered only within its specifics and be limited by them, i.e., the notion of corporate governance may not be applied to any other type of business structure. Therefore, governance bodies are usually understood as three principal subjects: GMS, BD and the executive board, which is characteristic of a joint-stock company (JSC). Each governance body performs certain functions.

Thus, after analyzing several approaches to defining corporate governance, we can provide its general characteristic. Corporate governance is:

- a management system applicable only to JSC;
- a set of relationships between three principal governance bodies of a JSC (GMS, BD and the executive board), as well as other structures, sometimes external ones;
- a form of exercising the ownership right.

## Corporate Governance Code

After the crisis of 2008, the Bank of Russia issued the first editions of the Corporate Governance Code. A new edition of the Code was published in March 2014, and it was no longer of a theoretical nature. It was targeted at the practical application and implementation of standards in order to improve the efficiency of managing a company [7].

The Code's main provisions address both legal and ethical aspects: the presence of independent directors on the BD; requirements for defining directors as independent; corporate dividend policy; organizing the functioning of the BD; risk management; fair treatment of minority shareholders.

It is important to note that the use of the Code and complying with the recommendations of the Central Bank is not obligatory. The companies make the decision concerning the implementation of standards into their corporate governance structure independently.

## Corporate Governance Requirements of the Moscow Exchange

The Moscow Exchange also imposes requirements on issuers that wish to be listed [8]. Certain corporate governance requirements are imposed on each listing level. In case of failure to fulfill these requirements, company shares are not admitted to the desired level (Table 1).

Requirement	Listing level	
	Level I	Level II
Presence of an audit committee	+	+
Presence of a remuneration committee	+	–
Presence of an HR committee	+	–
Presence of a corporate secretary	+	+
Presence of a Regulation on the Corporate Secretary	+	–
Presence of a dividend policy document	+	+
Presence of an internal audit committee	+	+
Presence of a Regulation on the Internal Audit	+	+

Notes: Designation “+” – a requirement should be fulfilled, “–” – a requirement is not obligatory.

Source: Compiled by the author on the basis of source [8].

## Approaches to Evaluating a Company in Econometric Analysis

In order to demonstrate the company valuation, the notion of market value is usually applied, however, researchers define it in their papers in different ways. Tobin's Q is frequently used [9]. Sometimes an absolute value – the company's market capitalization – is used instead of a ratio (coefficient) for evaluation [4; 10–12]. It is obtained by multiplying the number of issued shares by their mean stock price. Some papers also propose a valuation on the basis of share price, which allows to disregard company size [13; 14].

The indicator that represents the equivalent of a company's economic earnings – *EVA* (*economic value added*) – is considered to be rather complex. Its advantage is that it is calculated mainly based on the corporate balance-sheet and takes into consideration both borrowed capital and equity capital. Besides, unlike NPV (net present value), EVA does not require a forecast of cash flows, but allows to make a conclusion regarding company value.

From a theoretical point of view, all methods may be divided into three groups: 1) the income approach; 2) the comparative approach; 3) the ownership-based approach.

Particular attention should be heeded to evaluating an unlisted company. Foreign and Russian literature offers several ways to evaluate such a company: on the basis of net asset value; using indices the utilize factor analysis, etc.

**Table 2.** Research sample

Number	Bank	CB license number	Region
1	Sberbank	1481	Moscow and Moscow Region
2	VTB	1000	Saint-Petersburg and Saint-Petersburg Region
3	Gazprombank	354	Moscow and Moscow Region

## Approaches to Corporate Governance Evaluation

Studies related to the analysis of valuation of corporate governance in various economic sectors began most actively in the early 20<sup>th</sup> century [2; 4; 15; 16]. It should be noted that ratings compiled by specialized agencies or by the authors themselves are used to assess the level of corporate governance in some papers. Aggregation of several factors within one indicator may be considered an advantage of such an approach. At the same time, the inability to evaluate the influence of each specific regressor and the extent of its influence are the main drawbacks.

Here are the two principal approaches to the evaluation of corporate governance quality, which are applied to define the level of its influence on company value:

The index method (evaluation based on ratings compiled by agencies or researchers), which comprises several factors at the same time, but may assess only the general nature of influence of corporate governance.

Consideration of independent corporate governance factors and evaluation of each of them separately.

## Methodological Framework of the Research

The Russian banking sector was selected for the research study [17; 18]. The sample consists of **30 banks** listed by the Bank of Russia as the largest ones in terms of assets and on the *Forbes* list as the most reliable ones (Table 2).

Number	Bank	CB license number	Region
4	Alfa-Bank	1326	Moscow and Moscow Region
5	Russian Agricultural Bank	3349	Moscow and Moscow Region
6	Credit Bank of Moscow	1978	Moscow and Moscow Region
7	Sovcombank	963	Kostroma Region
8	Raiffeisenbank	3292	Moscow and Moscow Region
9	Rosbank	2272	Moscow and Moscow Region
10	UniCredit Bank	1	Moscow and Moscow Region
11	Bank Russia	328	Saint-Petersburg and Saint-Petersburg Region
12	Russian Regional Development Bank	3287	Moscow and Moscow Region
13	Tinkoff Bank	2673	Moscow and Moscow Region
14	Bank Saint-Petersburg	436	Saint-Petersburg and Saint-Petersburg Region
15	Citibank	2557	Moscow and Moscow Region
16	AK Bars	2590	Tatarstan
17	NovikomBank	2546	Moscow and Moscow Region
18	SMP Bank	3368	Moscow and Moscow Region
19	Uralsib	30	Moscow and Moscow Region
20	Bank Dom.RF	2312	Moscow and Moscow Region
21	Pochta Bank	650	Moscow and Moscow Region
22	BM-Bank	2748	Moscow and Moscow Region
23	Peresvet	2110	Moscow and Moscow Region
24	RNCB	1354	Simferopol
25	Home Credit Bank	316	Moscow and Moscow Region
26	Moscow Industrial Bank	912	Moscow and Moscow Region
27	Russian Standard	2289	Moscow and Moscow Region
28	Absolut Bank	2306	Moscow and Moscow Region
29	Almazergienbank	2602	Sakha (Yakutia)
30	Center-invest	2225	Rostov Region

Source: Compiled by the author.

The research period (2016–2020) was selected for several reasons: first, such studies had been carried out in Russia prior to 2016; second, we decided not to analyze the crisis period (2015–2016) because it could skew the results. We chose the net asset indicator (or the net asset value,

NAV) as the target variable since it is the most common evaluation method in the banking sector. Since the size of companies in the sample differs significantly, data with logarithms is more representative. We used 18 variables as corporate governance factors (Table 3).

**Table 3.** Description of Variables

Variable	Description
Y	Bank's net assets value, bln. RUB
Board size	Number of directors on the BD as at the end of the year
Independent directors	Share of independent directors on the BD

Variable	Description
Female directors	Share of women on the BD
Foreign directors	Share of foreigners on the BD
Board meetings	Number of meetings of the BD per year
Audit committee dummy	Presence of an audit committee (dummy variable)
Audit committee size	Number of directors on the audit committee as at the end of the year
Audit committee CEO participation	CEO's participation in the audit committee
Audit committee number of meetings	Number of meetings of the audit committee per year
Strategy committee dummy	Presence of a strategy committee (dummy variable)
Strategy committee size	Number of directors on the strategy committee as at the end of the year
Strategy committee CEO participation	CEO's participation in the strategy committee
Strategy committee number of meetings	Number of meetings of the strategy committee per year
Risk committee dummy	Presence of a risk committee (dummy variable)
Risk committee size	Number of directors on the risk committee as at the end of a year
Risk committee CEO participation	CEO's participation in the risk committee
Risk committee number of meetings	Number of meetings of the risk committee per year

Source: Compiled by the author.

A distinctive feature of study of the Russian banking sector is the limited nature of disclosed corporate governance information as compared to the American and European markets. Therefore, it was somewhat difficult to find a single source of data. For this reason, most of the information related to the corporate governance factors was obtained from annual bank reports published on their official sites or from the Interfax Center of Corporate Information Disclosure. Reports of Bank Dom.RF were only available at *Cbonds*.

In the present research, we **put forward the following hypotheses**:

$H_1$ : The share of independent directors has a positive influence on banks' valuation.

$H_2$ : When the number of women on the board of directors increases, the bank's valuation improves.

$H_3$ : Factors of the presence of risk, strategy and audit committees will be significant in the model.

The research studies 30 entities over the course of 5 years, for a total of 150 observations.

## Econometric Analysis of the Influence of Corporate Governance on Russian Banks' Valuation

### Building an OLS model

#### OLS of an Unbalanced Panel

The data structure may be considered a **panel** because the sample contains information on the entities, all of which are observed over a certain period. Structural data is usually studied by means of the ordinary least squares estimation (OLS), fixed effects model (*FE*) or the random effects model (*RE*).

Such objects as  $x_{it}$  are considered, where  $i$  is the sequential number of observation (1 ...  $n$ );  $t$  – time point (1 ...  $T$ ). In this case,  $i = 30$  and  $T = 5$  because the period in question is 5 years (2016-2020).

Inasmuch as some values are missing due to the absence of data, the panel may be considered **unbalanced**. First, we will construct an OLS model on the basis of the data with some missing values.

We added all considered variables to OLS. Net assets were used as  $Y$  – the target variable, other 17 factors from table 3 were used as independent variables.

As a result of evaluation, we obtained an OLS model (Table 4). All factors turned out to be insignificant, while the determination coefficient was too high ( $R^2 = 0.99$ ).

**Table 4.** OLS. Dependent variable Y

	Coefficient	Standard error	t statistics	p-value
Const	9.08459e + 09	9.72942e + 09	0.9337	0.4193
BoardSize	-4.42807e + 08	1.53010e + 09	-0.2894	0.7911
IndependentDirectors	-8.36947e + 09	3.97748e + 10	-0.2104	0.8468
FemaleDirectors	-1.14558e + 11	6.24151e + 10	-1.835	0.1638
ForeignDirectors	3.39598e + 09	4.19348e + 09	0.8098	0.4773
BoardMeetings	-4.12233e + 08	3.80213e + 08	-1.084	0.3576
AuditCommitteedummy	-3.09504e + 10	1.58436e + 10	-1.953	0.1458
AuditCommitteeSize	-2.61342e + 09	4.55573e + 09	-0.5737	0.6064
AuditCommitteeCEOparticipation	-1.41583e + 10	1.72133e + 10	-0.8225	0.4711
AuditCommitteeNumberofMeetings	3.17644e + 09	1.41532e + 09	2.244	0.1105
StrategyCommitteedummy	3.76524e + 10	1.81802e + 10	2.071	0.1301
StrategyCommitteeSize	1.94612e + 09	1.40576e + 09	1.384	0.2602
StrategyCommitteeNumberofMeetings	-2.31519e + 09	2.02841e + 09	-1.141	0.3366
RiskCommitteedummy	3.18577e + 10	2.02574e + 10	1.573	0.2139
RiskCommitteeSize	2.97484e + 09	3.50202e + 09	0.8495	0.4580
RiskCommitteeNumberofMeetings	1.63187e + 09	7.31829e + 08	2.230	0.1120
Mean value of the dependent variable	1.11e + 10	<b>Standard deviation of the dependent variable</b>		1.16e + 10
Sum of squared errors	1.92e + 19	<b>Standard error of the model</b>		2.53e + 09
<b>R square</b>	0.992088	<b>Corrected R square</b>		0.95252
<b>F(15, 3)</b>	25.07713	<b>P value (F)</b>		0.011061
Log likelihood	-420.7797	<b>Akaike criterion</b>		873.5595
Schwarz criterion	888.6705	<b>Hannan-Quinn criterion</b>		876.1169
<b>rho parameter</b>	-0.466542	<b>Durbin-Watson statistic</b>		2.295005

Source: Gretl.

The plot of residuals revealed heteroscedasticity, i.e., random errors have an uneven dispersion:

$$V(\hat{a}_i) = \sigma_i \neq \text{const}.$$

The consequences of heteroscedasticity are the inefficiency of OLS coefficient estimates and incorrect calculation of t statistics due to the bias and invalidity of coefficients' standard errors.

Since heteroscedasticity in most cases always occurs in the real data, it is customary to apply **robust standard errors**.

After adding robust standard errors, we built a new OLS model (Table 5). Four factors turned out to be significant: the share of women on the BD, presence of an audit committee, number of meetings of the risk and strategy committees. In addition, the model is significant overall: the *p-value* is smaller than the significance level.

**Table 5.** OLS with robust errors. Dependent variable Y

	Coefficient	Standard error	t statistics	p-value	Significance
Const	9.08459e + 09	1.14853e + 10	0.7910	0.4648	
BoardSize	-4.42807e + 08	2.07885e + 09	-0.2130	0.8397	
IndependentDirectors	-8.36947e + 09	2.50591e + 10	-0.3340	0.7519	



	Coefficient	Standard error	t statistics	p-value	Significance
FemaleDirectors	-1.14558e + 11	2.33699e + 10	-4.902	0.0045	***
ForeignDirectors	3.39598e + 09	2.37880e + 09	1.428	0.2128	
BoardMeetings	-4.12233e + 08	2.12278e + 08	-1.942	0.1098	
AuditCommitteedummy	-3.09504e + 10	7.78422e + 09	-3.976	0.0106	**
AuditCommitteeSize	-2.61342e + 09	4.72623e + 09	-0.5530	0.6041	
AuditCommitteeCEOparticpati	-1.41583e + 10	1.96991e + 10	-0.7187	0.5045	
AuditCommitteeNumberofMeeti	3.17644e + 09	2.31218e + 09	1.374	0.2279	
StrategyCommitteedummy	3.76524e + 10	3.00924e + 10	1.251	0.2662	
StrategyCommitteeSize	1.94612e + 09	2.10301e + 09	0.9254	0.3972	
StrategyCommitteeNumberofMe	-2.31519e + 09	5.69684e + 08	-4.064	0.0097	***
RiskCommitteedummy	3.18577e + 10	3.13783e + 10	1.015	0.3566	
RiskCommitteeSize	2.97484e + 09	3.98657e + 09	0.7462	0.4891	
RiskCommitteeNumberofMeeti	1.63187e + 09	2.69099e + 08	6.064	0.0018	***
Mean value of the dependent variable	1.11e + 10	<b>Standard deviation of the dependent variable</b>		1.16e + 10	
<b>Sum of squared errors</b>	1.92e + 19	<b>Standard error of the model</b>		2.53e + 09	
<b>R square</b>	0.992088	<b>Corrected R square</b>		0.952526	
<b>F(15, 5)</b>	1.29e + 15	<b>P value (F)</b>		6.24e - 38	
<b>Log likelihood</b>	-420.7797	<b>Akaike criterion</b>		873.5595	
<b>Schwarz criterion</b>	888.6705	<b>Hannan-Quinn criterion</b>		876.1169	
<b>rho parameter</b>	-0.466542	<b>Durbin-Watson statistic</b>		2.295005	

Notes: \* Designates significance at a 10% level; \*\* Designates significance at a 5% level; \*\*\* Designates significance at a 1% level.

Source: Gretl.

Furthermore, we conducted the *Ramsey test (RESET)* - an *endogeneity test* that indicates whether the supposition of regressor exogeneity is true. The regressor is considered to be exogenous if it does not correlate to a random error in the model.  $H_0$  indicates that the specification of the initial model is correct. As long as  $p\text{-value} = P(F(2,1) > 2.75063) =$

$= 0.002$ , which is less than the critical value, the zero hypothesis is rejected. Consequently, the specification of the constructed model may be considered incorrect, i.e., it is necessary to convert data. For this reason, we used the logarithm of the dependent variable Y, which represents the banks' NAV, to build the third model with converted data (Table 6).

**Table 6.** OLS: dependent variable  $\ln Y$

	Coefficient	Standard error	t statistics	p-value	Significance
Const	19.2758	1.54466	12.48	<0.0001	***
BoardSize	-0.0960308	0.250281	-0.3837	0.7170	
IndependentDirectors	0.0504522	4.37744	0.01153	0.9912	
FemaleDirectors	-7.04002	4.76878	-1.476	0.1999	
ForeignDirectors	2.63506	0.348869	7.553	0.0006	***
BoardMeetings	-0.0355600	0.0303296	-1.172	0.2938	
AuditCommitteedummy	-3.21682	1.40427	-2.291	0.0706	*
AuditCommitteeSize	-0.215873	0.565690	-0.3816	0.7184	

	Coefficient	Standard error	t statistics	p-value	Significance
AuditCommitteeCEOparticipati	1.29983	0.322810	4.027	0.0101	**
AuditCommitteeNumberofMeeti	0.193918	0.146682	1.322	0.2434	
StrategyCommitteedummy	6.15598	2.40423	2.560	0.0506	*
StrategyCommitteeSize	0.100167	0.113199	0.8849	0.4167	
StrategyCommitteeNumberofMe	-0.184176	0.180378	-1.021	0.3541	
RiskCommitteedummy	1.67363	2.14385	0.7807	0.4703	
RiskCommitteeSize	0.236691	0.135748	1.744	0.1417	
RiskCommitteeNumberofMeeti	0.124198	0.0419622	2.960	0.0315	**
Mean value of the dependent variable	22.15727	<b>Standard deviation of the dependent variable</b>		1.746957	
Sum of squared errors	0.113276	<b>Standard error of the model</b>		0.194316	
<b>R square</b>	0.997938	<b>Corrected R square</b>		0.987628	
<b>F(15, 5)</b>	3.59e + 14	<b>P value (F)</b>		1.53e - 36	
Log likelihood	21.70263	<b>Akaike criterion</b>		-11.40526	
Schwarz criterion	3.705761	<b>Hannan-Quinn criterion</b>		-8.847877	
<b>rho parameter</b>	-0.276441	<b>Durbin-Watson statistic</b>		2.054812	

Source: Gretl.

The model's explanatory power increased in comparison to the previous model ( $R^2 = 0.997$ ), the indicator of the share of foreign directors was added to significant factors. However, the Ramsey test once again demonstrated that the model specification is incorrect. Missing data that impacts the model may be one of possible reasons. Therefore, we made the decision to add the missing values.

For this purpose, we constructed an OLS model for all observations without missing values. The obtained coefficients were used to forecast the lacking values. Thus, we obtained a balanced panel that presents the data for all observations.

#### *OLS of an Balanced Panel*

Now the OLS model was constructed on the basis of new data, and robust errors and logarithmation were taken into consideration. Thus, the new model turned out to be significant overall, however, the perfect collinearity of the factor representing the bank CEO's participation in the risk committee was revealed. Apart from that, the correlation matrix shows a strong relationship of this factor with all the other factors related to the risk committee: its presence, size and number of meetings per year.

As a result of analysis of the correlation matrix, we decided to eliminate the factor of CEO's participation in the risk committee from the model. Thus, the model utilizes 16 factors. The new OLS model has a high value of  $R^2 = 0.98$  (Table 7).

**Table 7.** OLS of balanced data. Dependent variable ln Y

	Coefficient	Standard error	t statistics	p-value
IndependentDirectors	-60.1611	66.2420	-0.9082	0.3988
FemaleDirectors	-1.12108	12.5312	-0.08946	0.9316
ForeignDirectors	1.29677	4.60411	0.2817	0.7877
AuditCommitteeSize	2.94006	4.33491	0.6782	0.5229
AuditCommitteeCEOparticipation	-26.0268	40.0120	-0.6505	0.5395
AuditCommitteeNumberofMeetings	0.351006	1.07810	0.3256	0.7558
StrategyCommitteeSize	-0.138428	0.893606	-0.1549	0.8820
StrategyCommitteeCEOparticipation	17.1378	19.9800	0.8577	0.4240
StrategyCommitteeNumberofMeetings	0.852699	1.48833	0.5729	0.5875

	Coefficient	Standard error	t statistics	p-value
RiskCommitteeSize	-1.21310	4.29278	-0.2826	0.7870
RiskCommitteeNumberofMeetngs	0.489926	0.351709	1.393	0.2130
BoardSize	1.79396	1.36986	1.310	0.2382
BoardMeetings	0.367144	0.339293	1.082	0.3208
Mean value of the dependent variable	21.59839	<b>Standard deviation of the dependent variable</b>		1.905989
Sum of squared errors	126.8300	<b>Standard error of the model</b>		3.395586
<b>Uncentred R square</b>	0.988756	<b>Centered R square</b>		-0.517937
Log likelihood	-54.03205	<b>Akaike criterion</b>		134.0641
Schwarz criterion	149.3788	<b>Hannan-Quinn criterion</b>		138.1271
<b>rho parameter</b>	-0.106979	<b>Durbin-Watson statistic</b>		1.596886

Source: Gretl.

The Ramsey test showed that the model specification is correct:  $p\text{-value} = 1.33e - 11$ . In addition, all factors turned out to be insignificant, which gives reason to suggest that a partial multicollinearity of factors is still present.

We subsequently analyzed the correlation matrix between all variables and noted a strong correlation of the binary variable of the presence of a strategy committee with the following factors related to this committee:

the number of meetings of the strategy committee per year  $r = 0.739$ ;

the size of the strategy committee  $r = 0.911$ ;

CEO's participation in the strategy committee  $r = 0.795$ .

Values of the correlation ratio exceeding 0.8 are usually indicative of a strong interrelation between variables.

In a similar way, we revealed a strong correlation between the corresponding factors in regard to the audit committee.

In order to make sure that the conclusions made as a result of analysis of correlation matrices are correct, we conducted the **multicollinearity test**.

The Belsley-Kuh-Welsch (*BKW*) test diagnosed the presence of data collinearity. The indices calculated on the basis of this test are indicative of the strength of interrelation between the variables. According to *BKW*, if the obtained index value exceeds 30, it reveals a strong (close to linear) dependence, while a value in the range of 10 to 30 is indicative of a moderate dependence.

Thus, we verified the variables of the three committees (the risk, strategy and audit committee), and assessing four factors in regard to each: dummy, CEO's participation, number of meetings and committee size.

As a result of the conducted tests, collinearity was not found in the risk and audit committee, while in the strategy committee the committee size parameter revealed the index value of 21.6 (>10). It means that this factor has a moderately strong relationship with other parameters. Thus, we excluded the *StrategyCommitteeSize* factor from the model.

Then we constructed a new model with regard to the excluded factor (Table 8).

**Table 8.** OLS of balanced data. Dependent variable ln Y

	Coefficient	Standard error	t statistics	p-value	Significance
Const	17.8792	2.14471	8.336	<0.0001	***
BoardSize	0.291603	0.265856	1.097	0.3012	
IndependentDirectors	-0.696860	1.36285	-0.5113	0.6214	
FemaleDirectors	-3.25271	1.95492	-1.664	0.1305	
ForeignDirectors	0.809417	0.643148	1.259	0.2399	
BoardMeetings	0.00425396	0.020326	0.2093	0.8389	
AuditCommitteedummy	0.879120	1.26036	0.6975	0.5031	
AuditCommitteeSize	0.0660033	0.199987	0.3300	0.7489	
AuditCommitteeCEOparticipation	-2.03148	1.00668	-2.018	0.0744	*
AuditCommitteeNumberofMeetings	0.0389559	0.0485224	0.8028	0.4428	

	Coefficient	Standard error	t statistics	p-value	Significance
StrategyCommitteedummy	0.195874	1.65653	0.1182	0.9085	
StrategyCommitteeCEOparticipation	4.21506	1.45409	2.899	0.0176	**
StrategyCommitteeNumberofMeetings	-0.156576	0.0956471	-1.637	0.1361	
RiskCommitteedummy	3.32764	3.15767	1.054	0.3194	
RiskCommitteeSize	0.284131	0.239014	1.189	0.2650	
RiskCommitteeNumberofMeetings	0.142983	0.0615514	2.323	0.0453	**
Mean value of the dependent variable	21.22325	<b>Standard deviation of the dependent variable</b>		1.681836	
<b>Sum of squared errors</b>	4.357507	<b>Standard error of the model</b>		0.455522	
<b>R square</b>	0.957207	<b>Corrected R square</b>		0.926641	
<b>Log likelihood</b>	-12.92889	<b>Akaike criterion</b>		57.85779	
<b>Schwarz criterion</b>	83.63248	<b>Hannan-Quinn criterion</b>		66.94457	
<b>rho parameter</b>	0.312358	<b>Durbin-Watson statistic</b>		0.616400	

Source: Gretl.

The Ramsey test indicates that even when the elimination of multicollinearity is taken into consideration, model specification is incorrect again. This problem may occur in case of a high value of the determination coefficient and a large number of regressors. Therefore, it is best to eliminate some of them relying not merely on econometric results, but also on the cause-and-effect relationship between the factors in actual life.

As long as all binary variables are related to the factors associated with them (for example, if a committee does not exist, all the other indicators for this committee will be

zero), it is reasonable to use only dummy variables in the model. Therefore, all regressors related to CEO participation, committee size and number of its meetings per year were excluded from the model.

Now the OLS model consists of an equation with eight variables and a constant (Table 9). The determination coefficient decreased significantly, i.e., multicollinearity had been eliminated. However, the Ramsey test indicates that the model specification is incorrect ( $p$ -value = 0.001, which is smaller than the significance level).

**Table 9.** OLS with seven factors. Dependent variable  $\ln Y$

	Coefficient	Standard error	t statistics	p-value	Significance
Const	15.4587	0.821465	18.82	<0.0001	***
BoardSize	0.528190	0.0898649	5.878	<0.0001	***
IndependentDirectors	0.508225	0.637996	0.7966	0.4350	
FemaleDirectors	-1.50849	1.09859	-1.373	0.1849	
ForeignDirectors	0.258631	0.616665	0.4194	0.6794	
BoardMeetings	0.0252048	0.0153989	1.637	0.1173	
AuditCommitteedummy	0.153450	0.362111	0.4238	0.6763	
StrategyCommitteedummy	-0.118317	0.431540	-0.2742	0.7868	
RiskCommitteedummy	0.955509	0.472413	2.023	0.0567	*
Mean value of the dependent variable	20.50812	<b>Standard deviation of the dependent variable</b>		1.594168	
Sum of squared errors	84.97872	<b>Standard error of the model</b>		0.940848	
<b>R square</b>	0.678479	<b>Corrected R square</b>		0.651686	

	Coefficient	Standard error	<i>t</i> statistics	<i>p</i> -value	Significance
<i>F</i> (8, 20)	6,903489	<b><i>P</i>-value (<i>F</i>)</b>		0.000221	
Log likelihood	-137.8817	<b>Akaike criterion</b>		293.7633	
Schwarz criterion	317.6490	<b>Hannan-Quinn criterion</b>		303.4423	
<i>rho</i> parameter	0.814419	<b>Durbin-Watson statistic</b>		0.293595	

Source: Gretl.

Operations with primary data usually help to improve the model – by means of data conversion application of logarithmation, the first-order difference and other changes. In order to understand whether conversions are required, one has to analyze the initial variables. Only 8 out of 18 initial factors are still present in the model:

- three dummy variables indicating the presence or absence of functioning committees of the BD;
- three regressors that represent the share of women, foreigners or independent directors on the BD are relative variables;
- two factors in absolute terms – *BoardSize* and *BoardMeetings*.

The last two regressors may mispresent coefficients in the model and influence the results due to the fact that they are not normalized. Therefore, we presented box-and-whisker

descriptive statistics for these regressors. The constructed graphs indicate that there are outliers in both cases. The median of the *BoardMeetings* variable is close to the higher quartile, while the whiskers of the *BoardSize* factor are nonproportional. The above allows us to conclude that in both cases data is distributed in a non-normal way, therefore it requires standardization, which will be performed by means of logarithmation.

After the logarithmation of the *BoardSize* and *BoardMeetings* factors, we obtained the model with  $R^2 = 0.66$  and four significant factors apart from the constant, which are: the share of women on the board of directors (*FemaleDirectors*), the presence of a risk committee (*RiskCommitteedummy*), the logarithm of the number of meetings of the board of directors per year ( $\ln$  *BoardMeetings*) and the logarithm of the size of the board of directors ( $\ln$  *BoardSize*). The Ramsey test showed that the model specification is correct because *p*-value = **0.397**, which exceeds the threshold significance level (Table 10).

**Table 10.** OLS with  $\ln$  *BoardSize* and  $\ln$  *BoardMeetings*. Dependent variable  $\ln Y$

	Coefficient	Standard error	<i>t</i> statistics	<i>p</i> -value	Significance
Const	7.53600	1.16456	6.471	<0.0001	***
IndependentDirectors	0.374311	0.476878	0.7849	0.4345	
FemaleDirectors	-1.93003	0.794519	-2.429	0.0170	**
ForeignDirectors	0.368774	0.326375	1.130	0.2614	
AuditCommitteedummy	0.270962	0.334256	0.8106	0.4196	
StrategyCommitteedummy	-0.00837847	0.252711	-0.03315	0.9736	
RiskCommitteedummy	1.18262	0.255035	4.637	<0.0001	***
$\ln$ <i>BoardMeetings</i>	1.18516	0.297310	3.986	0.0001	***
$\ln$ <i>BoardSize</i>	4.40150	0.376219	11.70	<0.0001	***
Mean value of the dependent variable	20.51396	<b>Standard deviation of the dependent variable</b>		1.600760	
Sum of squared errors	90.68009	<b>Standard error of the model</b>		0.976999	
<b><i>R</i> square</b>	0.656424	<b>Corrected <i>R</i> square</b>		0.627492	
<i>F</i> (8, 95)	22.68799	<b><i>P</i>-value (<i>F</i>)</b>		5.40e-19	
Log likelihood	-140.4428	<b>Akaike criterion</b>		298.8857	
Schwarz criterion	322.6852	<b>Hannan-Quinn criterion</b>		308.5276	
<i>rho</i> parameter	0.774356	<b>Durbin-Watson statistic</b>		0.341886	

Source: Gretl.

Thus, the final OLS model may be presented as the following regression equation:

$$\begin{aligned} \ln Y = & 7.54 + 0.374 \cdot \text{IndependentDirectors} - \\ & -1.93 \cdot \text{FemaleDirectors} + \\ & +0.369 \cdot \text{ForeignDirectors} + \\ & +0.270 \cdot \text{AuditCommitteedummy} + \\ & -0.0083 \cdot \text{StrategyCommitteedummy} + \\ & +1.18 \cdot \text{RisksCommitteedummy} + \\ & +4.40 \cdot \ln \text{BoardSize} + \\ & +1.18 \cdot \ln \text{BoardMeetings}. \end{aligned}$$

It is reasonable to only interpret the influence of the four factors that turned out to be significant.

As long as the coefficient of the *FemaleDirectors* variable is high, i.e., it significantly exceeds 0.1, modulo, the calculation of influence based on an approximation formula may distort the results, so we have to refine the calculations:

$$\begin{aligned} \ln \hat{y}_1 - \ln \hat{y}_0 &= -1.93; \\ \ln \left( \frac{\hat{y}_1}{\hat{y}_0} \right) &= -1.93; \\ \frac{\hat{y}_1}{\hat{y}_0} &= e^{-1.93} = 0.145; \\ \frac{\hat{y}_1 - \hat{y}_0}{\hat{y}_0} &= -0.86. \end{aligned}$$

Consequently, when the *FemaleDirectors* variable increases by one, the dependent variable *Y* decreases by 86%. Hence, if a risk committee starts functioning on the BD (dummy variable equals 1), the bank's NAV will decrease by 86%.

Operating on the premise that the coefficient of the binary variable *RisksCommitteedummy* is also rather high, the calculation of influence using an approximation formula may skew the results, so we have to refine the calculations:

$$\begin{aligned} \ln \hat{y}_1 - \ln \hat{y}_0 &= 1.18; \\ \ln \left( \frac{\hat{y}_1}{\hat{y}_0} \right) &= 1.18; \\ \frac{\hat{y}_1}{\hat{y}_0} &= e^{1.18} = 3.25; \\ \frac{\hat{y}_1 - \hat{y}_0}{\hat{y}_0} &= 2.25. \end{aligned}$$

Consequently, when the *RisksCommitteedummy* variable increases by one, the dependent variable *Y* increases by 225%. Hence, if a risk committee starts functioning on the BD (dummy variable equals 1), the bank's NAV will decrease by 225%.

Suppose  $\ln \text{BoardSize} = \ln x_3$ , then

$$d(\ln Y) = 4.4 \frac{dx_3}{x_3}; \frac{dY}{Y} = 4.4 \frac{dx_3}{x_3}; \frac{\Delta Y}{Y} = 4.4 \frac{\Delta x_3}{x_3}.$$

Consequently, when the *BoardSize* variable increases by 1%, variable *Y* (bank's NAV) will increase by 4.4%, i.e., if the number of BD members grows by 1%, the bank's estimate on the basis of NAV increases by 4.4%.

Suppose  $\ln \text{BoardMeetings} = \ln x_4$ , then

$$d(\ln Y) = 1.18 \frac{dx_4}{x_4}; \frac{dY}{Y} = 1.18 \frac{dx_4}{x_4}; \frac{\Delta Y}{Y} = 1.18 \frac{\Delta x_4}{x_4}.$$

Consequently, in case of an increase of the *BoardMeetings* variable by 1%, variable *Y* (bank's NAV) will increase by 1.18%, i.e., when the number of BD meetings per year grows twofold, the bank's estimate on the basis of NAV increases by 118%.

## Verification of Model Quality

If we construct a graph of OLS model residues, it will reveal that they are distributed normally. Regardless of the several multicollinearity and heteroscedasticity tests (Ramsey test) we performed when building the OLS model and transforming it into the final form, it is necessary to ensure once again that the above-mentioned problems don't exist.

First, we conducted the multicollinearity test by means of the *inflation factor method*.

The method implies the calculation of *VIF* (*variance inflation factors*) for each regressor to define the relationship between different factors. In order to calculate the coefficient, which corresponds to the  $x^{(j)}$  factor, an additional regression needs to be constructed. In its equation, the  $x^{(j)}$  regressor will be on the left and all the other regressors of the initial model will be on the right. Thus, we will calculate the multiple correlation coefficient for *j* variable and other factors ( $R_j^2$ ). Then we will determine *VIF* coefficients according to the following formula:

$$VIF_j = \frac{1}{1 - R_j^2}.$$

Thus, we obtained the coefficients of all regressors in the constructed OLS model (Table 11).

**Table 11.** *VIF* coefficients

Regressor	<i>VIF</i>
<i>IndependentDirectors</i>	1.154
<i>FemaleDirectors</i>	1.147
<i>ForeignDirectors</i>	1.085
<i>AuditCommitteedummy</i>	1.585
<i>StrategyCommitteedummy</i>	1.723
<i>RiskCommitteedummy</i>	1.425
$\ln \text{BoardMeetings}$	1.251
$\ln \text{BoardSize}$	1.165

Source: Gretl.

As long as the values of all coefficients do not exceed 10, we may conclude that **there is no collinearity**.

Then we performed the White test, which verifies the zero hypothesis of absence of heteroscedasticity.

$$H_0 : \sigma_1^2 = \sigma_2^2 = \dots = \sigma_n^2 = \text{const} .$$

The test statistics is as follows:  $nR^2 \sim \chi^2(p)$ , where  $p$  is the number of variables in the second regression, while the estimated value equals  $nR^2$ .

According to the White test, the  $p$ -value =  $P(\chi^2(39) > 60.841024) = 0.014142$ . Hence, since  $p$ -value exceeds the threshold significance level and the test statistics exceeds the estimated value, the zero hypothesis is not rejected, i.e., **there is no heteroscedasticity in the model**. Consequently, random errors show homoscedasticity.

### Building a Random Effects Model (GLS)

A prerequisite for the random effects model or GLS (generalized least squares) is the non-correlatability of unobserved effects  $\mu_i$  with the regressor:

$$E(\mu_i | x_{i1}^{(1)}, x_{i2}^{(1)}, \dots, x_{iT}^{(1)}, x_{i1}^{(2)}, \dots, x_{iT}^{(2)}, x_{i1}^{(k)}, \dots, x_{iT}^{(k)}) = E(\mu_i) = 0$$

The equation of the random effects model takes the following general form:

$$y_{it} = \alpha + \beta x_{it} + v_{it}, \text{ where } v_{it} = \mu_0 + \varepsilon_{it} .$$

The main advantage of this model in comparison with the fixed effects model is that it allows to evaluate regressor coefficients that remain unchanged within the predetermined period.

In the constructed GLS model, all coefficients except the  $\ln$  *BoardSize* turned out to be insignificant (Table 12).

**Table 12.** The random effects model (GLS). Dependent variable  $\ln Y$

	Coefficient	Standard error	$z$	$p$ -value	Significance
Const	18.7573	1.35161	13.88	<0.0001	***
IndependentDirectors	0.145897	0.384911	0.3790	0.7047	
FemaleDirectors	-0.446829	0.657920	-0.6792	0.4970	
ForeignDirectors	0.588857	0.513720	1.146	0.2517	
AuditCommitteedummy	0.100629	0.107172	0.9390	0.3478	
StrategyCommitteedummy	0.327719	0.322139	1.017	0.3090	
RiskCommitteedummy	0.00161951	0.177536	0.009122	0.9927	
$\ln\_BoardMeetings$	-0.162665	0.196014	-0.8299	0.4066	
$\ln\_BoardSize$	0.883519	0.480911	1.837	0.0662	*
Mean value of the dependent variable	20.51396	<b>Standard deviation of the dependent variable</b>		1.600760	
Sum of squared errors	218.9924	<b>Standard error of the model</b>		1.510355	
Log likelihood	-186.2912	<b>Akaike criterion</b>		390.5824	
Schwarz criterion	414.3819	<b>Hannan-Quinn criterion</b>		400.2243	
<b>rho parameter</b>	0.450087	<b>Durbin-Watson statistic</b>		0.711062	

Source: Gretl.

The regression equation takes the following form:

$$\ln Y = 18.8 + 0.146 \cdot \text{IndependentDirectors} - 0.447 \cdot \text{FemaleDirectors} + 0.589 \cdot \text{ForeignDirectors} + 0.101 \cdot \text{AuditCommitteedummy} + 0.328 \cdot \text{StrategyCommitteedummy} + 0.00162 \cdot \text{RisksCommitteedummy} - 0.163 \cdot \ln$$

### Building a Fixed effects Model

In the last evaluated model- the fixed effects model - only the constant was found to be significant, while all factors turned out to be insignificant (Table 13).

**Table 13.** The fixed effects model. Dependent variable  $\ln Y$ 

	Coefficient	Standard error	t statistics	p-value	Significance
Const	20.4042	1.12498	18.14	<0.0001	***
<i>IndependentDirectors</i>	-0.114379	0.492655	-0.2322	0.8188	
<i>FemaleDirectors</i>	-0.108947	0.559222	-0.1948	0.8475	
<i>ForeignDirectors</i>	0.649975	0.547888	1.186	0.2494	
<i>AuditCommitteedummy</i>	0.00457190	0.138197	0.03308	0.9739	
<i>StrategyCommitteedummy</i>	0.589526	0.394195	1.496	0.1504	
<i>RiskCommitteedummy</i>	0.0431834	0.153967	0.2805	0.7820	
$\ln$ BoardMeetings	-0.268975	0.204445	-1.316	0.2032	
$\ln$ BoardSize	0.237635	0.380486	0.6246	0.5393	
Mean value of the dependent variable	20.51396	Standard deviation of the dependent variable		1.600760	
Sum of squared errors	4.971401	Standard error of the model		0.257459	
<b>LSDV R square</b>	0.981164	<b>Within R square</b>		0.560325	
Log likelihood	10.54623	<b>Akaike criterion</b>		36.90754	
Schwarz criterion	113.5949	<b>Hannan-Quinn criterion</b>		67.97583	
<b>rho parameter</b>	0.450087	<b>Durbin-Watson statistic</b>		0.711062	

Source: Gretl.

The regression equation takes the following form:

$$\ln Y = 20.4 - 0.114 \cdot \text{IndependentDirectors} - 0.109 \cdot \text{FemaleDirectors} + 0.650 \cdot \text{ForeignDirectors} + 0.00457 \cdot \text{AuditCommitteedummy} + 0.590 \cdot \text{StrategyCommitteedummy} + 0.0432 \cdot \text{RisksCommitteedummy} - 0.269 \cdot \ln \text{BoardMeetings} + 0.238 \cdot \ln \text{BoardSize}$$

### Choosing the Best Model

In this research we applied three approaches to the evaluation of panel data and constructed the corresponding models: the OLS model (pooled regression), the random effects model (GLS), and the fixed effects model (FE).

We summarized the obtained estimates in Table 14.

**Table 14.** Comparison of models

Model	OLS	GLS (RE)	FE
Const	7.54 (***)	18.76 (***)	20.40 (***)
<i>IndependentDirectors</i>	0.37	0.15	-0.11
<i>FemaleDirectors</i>	-1.93 (**)	-0.45	-0.11
<i>ForeignDirectors</i>	0.37	0.59	0.65
<i>AuditCommitteedummy</i>	0.27	0.10	0.005
<i>StrategyCommitteedummy</i>	-0.008	0.33	0.59
<i>RiskCommitteedummy</i>	1.18 (***)	0.0016	0.04
$\ln$ BoardMeetings	1.19 (***)	-0.16	-0.27



Model	OLS	GLS (RE)	FE
In BoardSize	4.40 (***)	0.88 (*)	0.24
Individual effects	No	Yes	Yes
Number of observations	150	150	150
R <sup>2</sup>	0.66	-	0.56

Notes: Significance of coefficients is indicated in brackets.

Source: Gretl.

In order to choose one of the models, it is necessary to apply specification tests (Table 15).

**Table 15.** Specification tests

Test	Models
Hausman	FE and RE
Breusch-Pagan	RE and OLS
Linear restriction test	FE and OLS

Source: Compiled by the author.

First, we applied the **Hausman test**, which compares the estimates in the random effects model with those obtained by means of an intragroup transformation in the fixed effects model. The zero hypothesis states that the estimates of the random effects model are consistent:

$$H_0 : \mu_0 \text{ do not correlate with } x_{it_0} \forall i, i_0, t_0.$$

At the same time, the estimated value of statistics is as follows:

$$(\hat{\beta}_{FE} - \hat{\beta}_{RE})'(\hat{V}(\hat{\beta}_{FE}) - \hat{V}(\hat{\beta}_{RE}))^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \sim \chi^2(k),$$

where  $k$  is the number of estimated variable coefficients of variables.

According to the performed test,  $\chi^2(8) = 72.8498$ ,  $p$ -value = 0.0617. Thus, the  $p$ -value exceeds the 5% significance level. This allows to conclude that the zero hypothesis is not rejected, i.e., the estimates of the random effects model are consistent and we have to choose the random effects model (RE).

Then we conducted the **Breusch-Pagan test**, which allows to compare the OLS and RE models. According to the test, the OLS model may be used if there are no individual effects ( $\mu_0$ ). The zero hypothesis states that all objects of the RE model are homogeneous, i.e., the variance equals zero.

$$H_0 : \text{Var}(\mu_0) = \sigma_\mu^2 = 0.$$

At the same time, the estimated value of statistics is as follows:

$$LM = \frac{nT}{2(T-1)} \left( \frac{\sum_{i=1}^n (\sum_{t=1}^T e_{it})^2}{\sum_{i=1}^n (\sum_{t=1}^T e_{it})} - 1 \right)^2 \sim \chi^2(1),$$

where  $e_{it}$  – model residuals OLS.

According to the conducted test,  $\chi^2(1) = 87,7817$ ,  $p$ -value = 0.1215. Hence,  $p$ -value exceeds the threshold significance level, the zero hypothesis is not rejected, i.e., it is unnecessary to use the random effects model and we may apply an ordinary OLS model, which does not take random effects into consideration.

Thus, the regression evaluated by means of OLS (*pooled regression*) is the optimal model. It may be represented by the following equation:

$$\begin{aligned} &= 7.54 + 0.374 \cdot \text{IndependentDirectors} - \\ &- 1.93 \cdot \text{FemaleDirectors} + \\ &+ 0,369 \cdot \text{ForeignDirectors} + \\ &+ 0,270 \cdot \text{AuditCommitteedummy} \\ &- 0,0083 \cdot \text{StrategyCommitteedummy} + \\ &+ 1.18 \cdot \text{RisksCommitteedummy} + \\ &= 4.40 \cdot \text{In BoardSize} + 1.18 \cdot \text{In} \end{aligned}$$

The obtained model may be interpreted as follows:

When the *FemaleDirectors* variable increases by one, the dependent variable  $Y$  is reduced by 86%. Hence, if the share of women increases by 1%, the bank's NAV will decrease by 86%.

If the *RisksCommitteedummy* variable increases by one, the dependent variable  $Y$  is reduced by 225%. Consequently, if a risk committee starts functioning on the BD (dummy variable equals 1), the bank's NAV will increase by 225%.

In case the *BoardSize* variable increases by 1%, variable  $Y$  (bank's NAV) will increase by 4.4%, i.e., if the number of the BD members grows by 1%, the bank's estimate on the basis of NAV will increase by 4.4%

In case of an increase of the *BoardMeetings* variable by 1%, variable  $Y$  (bank's NAV) will increase by 1.18%, i.e., when the number of BD meetings per year grows twofold, the bank's estimate on the basis of NAV increases by 118%.

Thus, we may make the following conclusions:

We cannot make a reliable conclusion concerning the first hypothesis, which states that the share of independent directors has a positive influence on Russian banks' valuation because this factor turned out to be insignificant.

The second hypothesis, which states that female representation on the board of directors has a positive effect on a bank's valuation is rejected with an error probability of 10%. In spite of the fact that the diversification of a bank's

board of directors usually exceeds its performance and, consequently, the company valuation, the model demonstrates that there is an opposite effect in Russian banks.

The third hypothesis about the significance of the presence of committees on the board of directors is accepted partially because only the presence of a risk committee turned out to be significant. We cannot make a reliable conclusion about other committees based on the studied sample.

## Conclusion

Several financial crises allowed to detect the drawbacks of the Russian banking system, which may be eliminated only in case of a joint influence of the megaregulator and the internal arrangement of the financial sector companies.

In this research study we have analyzed various approaches to defining the notion of corporate governance. It may be characterized as the system of interrelations between the principal governance bodies of a JSC (GMS, BD and the executive board), which aims to improve the efficiency of corporate operations.

After the CB introduced the Corporate Governance Code, many companies implemented the recommendations of the Bank of Russia into their practice and started to disclose the information on corporate governance annually. The corporate governance requirements imposed by the Moscow Exchange on the companies that wish to obtain the 1<sup>st</sup> and 2<sup>nd</sup> listing levels also improve the quality of corporate governance.

In this research, we have constructed three models, evaluating the panel data of 30 Russian banks, which are the largest in terms of assets and have the highest reliability. Initially, we added 18 regressors and one dependent variable – the banks' NAV. Due to an incorrect specification revealed by the Ramsey test, we eliminated several variables. The OLS model was verified for the absence of heteroscedasticity multicollinearity. Then we built two models, namely, random effects and fixed effects models. Comparison of all three models by means of specification tests led us to conclude that the OLS model with the explanatory power of 67% is optimal.

According to the regression equation, the presence of women among the directors worsens a bank's valuation, while the number of BD meetings, the number of directors and the presence of an audit committee have a positive impact on a bank's NAV. If the share of women increases by 1%, a bank's NAV will be reduced by 86%. If a risk committee starts functioning on the BD, the bank's NAV will grow by 225%. If the number of BD members increases by 1%, the bank's NAV will grow by 4.4%, and if the number of BD meetings per year increases twofold, it will grow by 118%.

Bank clustering, i.e., in terms of assets, may be a potential research perspective, in order to determine significant factors for each category. Apart from that, one may consider other corporate governance factors, for instance, those related to the organizational arrangement of a general shareholders' meeting.

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DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.44-53>

JEL classification: G17, G32, O32, O33



# Impact of Intangible Assets on Bank Performance in Emerging Capital Markets: Evidence from Russia

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## Abstract

The article examines the impact of innovations on the performance of commercial banks. The size of intangible assets is used as a proxy for innovation, since most innovations in the banking sector, unlike those in industry, are intangible and include licenses, software, employees' knowledge and experience, corporate culture, etc. Most researchers agree that an increase in efficiency and performance of financial companies is mainly underpinned by intangible assets, especially their unobservable part. The purpose of the study is to identify the relationship between innovation and financial performance of banks. Thirteen largest systemically important Russian banks of various forms of ownership in 2011–2020 were considered in the course of the research. This choice stems from the fact that these banks account for over 2/3 of the entire banking system in terms of assets, and have their own specifics compared to other banks both within Russia and in the world. This study is limited by the fact that only large Russian banks were considered, while the specifics of medium and small banks, which have significantly fewer opportunities and are ready to take on higher risks, were not assessed. The scientific novelty lies in the fact that intangible assets are reflected in the work by a quantitative change used to assess the innovative activity of banks, for which a suitable approach is proposed. The results of empirical analysis demonstrate that the growth of intangible assets allows banks to increase the volume of both interest and commission income and slow down the rise of expenses, thereby ensuring profit growth. In turn, this stimulates increased liabilities, however, due to regulatory requirements, the share of equity remains almost unchanged at about 10% of the asset value. This trend indicates that even smaller banks can compete with larger ones by implementing innovation and building intangible assets.

**Keywords:** intangibles, innovation, financial efficiency, stability, intellectual capital**For citation:** Egorov, A. Impact of Intangible Assets on Bank Performance in Emerging Capital Markets: Evidence from Russia. *Journal of Corporate Finance Research*. 2023;17(1): 44-53. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.44-53>

# Evaluation of Influence of Innovation on Banks' Financial Performance

## Introduction

The ability of commercial banks to fulfill their obligations in full and in due time has always been and will be an important issue for managers and shareholders of a company, as well as for creditors and regulators. A country's social and economic development may have an adverse impact on the resilience of commercial banks, which are not ready for new conditions. Special features of the institutional structure have a significant impact on such development. Development of the technological base, which serves as the fundamental social variable, influences social practices and behavior standards in the society and promotes institutional changes.

Today, the rapid growth of information technology is transforming the rules of the game, and commercial banks have to adapt to them quickly. They have to transform all areas of their activity, create new products, implement new forms of communication with partners and clients, speed up information collection and processing, etc. On the one hand, it results in a growing role of intangible assets and provides additional revenue, and, on the other hand, it requires serious expenditures and additional financing. As users of financial technology, banks apply economic and statistical models to create and assess new securities, to evaluate and distribute revenues, to make decisions concerning asset portfolio management on the basis of current and historic data. Financial engineering is used to create new derivative financial instruments, credit and market risk models, which are applied in order to improve portfolio management and assess loan applications. Financial information technology is used to collect, process and distribute data, as well as to develop economic and statistical models. However, it is rather difficult to assess these innovations and formulate the relationship between them and the performance and resilience indicators of the banks which implement them, in quantitative and numerical form. In the banking sector, intangible assets are the key innovation indicator, and their size characterizes the level of activity in this sphere.

In the first section, we present a literature review. On its basis we define the role of intangible assets in the procedure of innovation implementation and consider the methods of assessing the scale of intangible assets as a variable of innovation activity. We showed that the intangible component creates the innovation potential, without which the development of companies in any sector of the economy is impossible, especially in the financial sector.

Based on these methods, in the second section we offer a quantitative method of evaluating innovation using the intangible assets variable. Using this method, we analyze the influence of innovation on banks' financial performance. It is demonstrated that within 10 years the growth of the

intangible assets volume resulted in an increased demand for banking products and services, thus driving the growth of interest and commission income, as well as the increase of bank assets.

## Literature Review

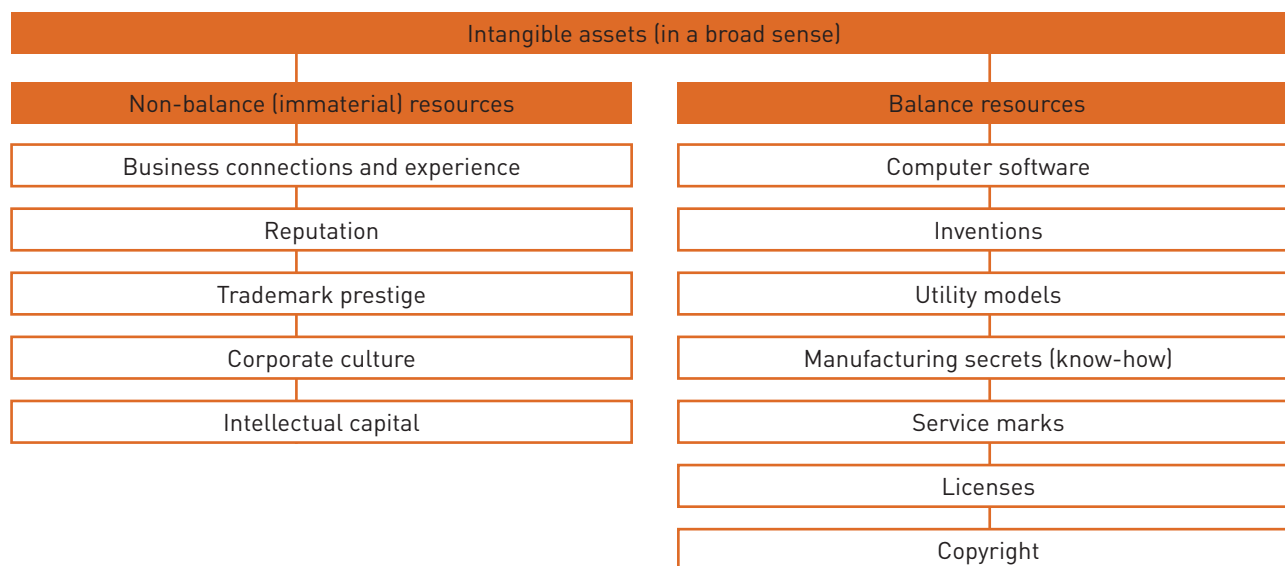
Intangible assets differ completely from fixed assets in their dynamics and risk profile. For this reason, it is an intricate problem to assess the companies that produce them. M.G. Marrano, J. Haskel and G. Wallis describe the distinctive characteristics of intangible assets, including their side effects [1]. For example, the extensive driver network is an advantage of the Uber business model, but it is not unusual for an Uber driver to work simultaneously for other companies. The authors also describe the scaled nature of these assets, and how after the initial expenses for the first unit, products may be replicated infinitely at practically no cost. Obtaining reliable indicators of an intangible asset's value is a problem for investors because R&D efforts are entered in accounting records only as expenditures. This, in turn, has a negative impact on revenue forecasts, which may conceal the innovation areas and discourage public companies from investing in R&D. Other intangible assets such as patents and brand value may also be absent from financial statements. Finally, intangible assets have marginal value, which is often low, and are easily scalable to the benefit of the business.

It is necessary to review accounting indicators in order to develop the best approach to defining modern innovators and finance innovation. This allows to focus on understanding the long-term value of intangible and strategic assets [2]. Fixed assets may comprise the premises and equipment essential for manufacturing and delivery. One may evaluate these assets to provide an accurate description of their value. These fixed assets may be bought and sold, borrowed and used in order to support other financial instruments. However, intangible assets are more important for the innovative development of a bank (Figure 1).

Intangible assets are of non-physical and nonmonetary nature. They are difficult to measure quantitatively or are disguised as cash, but some intangible assets may be used to raise funds. Consequently, they should be protected. Intangible assets are the assets whose economic influence depends on a complex decision-making procedure. Based on this procedure, companies decide whether to invest in such assets. This supposition adds intangible assets to the analysis of increase in productivity at both the macro- and micro-levels. However, this starting point is ignored both in theoretical and empirical studies of innovation, where intangible assets are usually considered fragmentarily and their strategic prerequisites are ignored. Many studies, i.e., the one by S. Montresor and A. Vezzani, consider intangible assets as simple "resources," which, along with other fixed assets, allow companies to manufacture more physical products (or make a product of higher value) within a "standard" production function structure or make new inventions within the so-called "knowledge

production function” [3]. Here the most important aspect is the scientific content of intangible assets. The emphasis is exclusively on the way in which firms accumulate such knowledge with time and how they manage, after deduction of depreciation and obsolescence, to accrue intangible capital, which H. Lööf and A. Heshmati in innovation economics consider a synonym for “knowledge capital” [4].

**Figure 1.** Bank’s intangible assets



Source: Regulation of the Bank of Russia of 27.02.2017 No. 579-P.

Many authors pursue different approaches to evaluation of intangible assets, which may conventionally be subdivided into: 1) accounting and 2) economic types.

The accounting approach is based on the fact that an intangible asset should be identifiable, separable and created as a result of contractual or other legal rights. Such assets may be licensed, transferred for use, sold, etc. They may comprise trademarks, patents, software, copyright etc. At the same time, the value of an intangible asset is defined by adding together the expenses incurred directly by the purchase and development of this asset. In addition, the expenses for intangible assets are included in their value only if there is a possibility that they will generate profit in the future and that there is a reliable system for evaluating this asset. This provision is entrenched, for example, in IFRS (IAS) 38 Intangible Assets, in accordance with which the value of intangible assets is determined on companies’ accounting balance sheet in many countries across the globe. A similar provision is stated in US GAAP standards (Topic 350 and 985). This approach allows to evaluate rather precisely the observed volume of intangible assets, i.e., the assets that have been recorded in the statements and, if necessary, may be sold, bought or transferred for use. Such approach allows to compare volumes of intangible assets on the balance sheet of joint-stock companies, as well as companies with other forms of ownership. However, the accounting method does not allow to evaluate those intangible assets that are difficult to record by means of a simple acknowledgement of expenses.

Investment in intangible assets provides companies with knowledge that may be used as the basis for the transformation of business processes and implementation of innovation in order to manufacture products and services that are more convenient and attractive for consumers, thus exerting a positive influence on company reputation [5].

The economic approach is, in the first instance, an approach focused on unobservable intangible assets that are not recorded on the balance sheet, but play an equally important role as those that are. The most significant unobservable asset is intellectual capital. In the opinion of many researchers [6; 7], precisely this component of intangible assets makes a significant contribution to creation of value. Such companies as Google or Apple are global leaders due to their intellectual capital. Therefore, an increasing number of researchers are paying attention to this unobservable form of assets [8; 9]. At the same time, intangible assets (both observable and unobservable) are not intrinsically a competitive advantage of a firm. In order to have a competitive advantage, a company has to properly use its intellectual capital, maximizing company value. In this case, the correct use is not a comprehensive methodology, but a series of management decisions unique for each company which, taking random variables into consideration, result in a local win over competitors. Intellectual capital is an important corporate asset because conventional methods of measuring efficiency are unable to present intangible aspects of corporate activity [10].

It should be noted that T.A. Garanina separates the notions of “intangible assets” and “intellectual capital” [11]. In her opinion, these two notions are equal in value, but intellectual capital is considered in terms of creation of value, while intangible assets are examined in terms of distribution, similarly to the division of the balance sheet into assets and liabilities. I. Caddy [12], M.G. Harvey and R.F.

Lusch [13] take a different view. They introduce the term of “intangible liabilities,” which have negative consequences for the company (defective goods, hazardous employment, low-quality management, share price manipulations, race discrimination etc.). This term is expressed as the following equation:

$$\text{Assets}_{\text{intangible}} = \text{Liabilities}_{\text{intangible}} + \text{Capital}_{\text{intellectual}}. \quad (1)$$

The differences in approaches lead to a relative difficulty of comparing the results obtained in papers of various researchers. However, it is fair to assume that the majority of authors do not deny the significance of intangible assets, and intellectual capital in particular, however, each author has their own opinion concerning their structure. Thus, we may divide intangible assets into two components: internal (patents, licenses etc.) and external (trademarks, client relations etc.). On the other hand, R. Petty and J. Guthrie [9] consider intangible assets in terms of supply chains and distribution channels (organizational capital), and human capital, which comprises employees, suppliers and customers. L. Edvinsson and M.S. Malone [14], J. Roos et al. [15] hold a similar opinion. E.R. Baiburina and I.V. Ivashkovskaya in their paper point to the growing role of quality in a company’s relationships with its contractors and the network mechanisms of business conduct based on this factor, as well as on the fact that business relations are an element of long-term stability [16]. Human, organizational (including innovation and process), client and network capital are determined on the basis of this concept. N. Feruleva and I. Ivashkovskaya have singled out and systematized the indicators related to intellectual capital and have found out that indicators of this capital are still poorly studied and deserve a more careful assessment [17]. There are also numerous other versions: A. Brooking [8] defines human, market and infrastructure capital; T. Günther subdivides the capital structure into internal and external elements and points to a great role of employee competence [18]. A.N. Kozyrev singles out human, organizational and client capital [19].

There are many approaches, but we generally distinguish three components of intellectual capital: human (employee competence), relational (external, client, social, market) and organizational (structural, internal, infrastructure). In the opinion of T.A. Garanina, classifications that have more than three intellectual capital components actually just parcel out individual elements from the above-mentioned three or leave out the components indicated by other authors [11]. According to D.L. Volkov and T.A. Garanina, human capital does not merely comprise knowledge, skills and experience. It is also the ability to derive benefit from these features [20]. Relational capital does not only encompass the relationships with external environment. It is also the ability to derive benefits from these relationships. In its turn, structural capital is the ability to benefit from intellectual property items and infrastructure assets (corporate culture, management structure etc.).

The scope of intangible assets was assessed differently by various authors. The main viewpoints are as follows:

- 1) in order to assess human capital, we used indicators of personnel expenses and personnel productivity;
- 2) in order to assess relational capital, we used indicators of income and business expenses (including advertising, packing costs, etc.);
- 3) in order to assess organizational (structural) capital, we used the ratio of expenses to revenue, the capital-output ratio, etc.

Apart from that, intangible assets can also be evaluated through the difference between the market and balance-sheet values of the company or their ratio (for example, Tobin’s Q ratio [21]). This technique proceeds from the assumption that investors conduct a comprehensive analysis of corporate activity and buy shares at a price that they consider justified. If a company develops and has a high potential, investors will actively buy its shares, leading to a share price growth. Otherwise, investors will be wary about the company, and as a result, the share price may be even lower than the book value of assets and (or) equity. However, this technique has its flaws. First, it is easy to define the market value of joint-stock companies, but there are quite a few other forms of ownership, where the accurate price may only be determined at the date of sale. Second, investors may show a lack of judgment or act in a chaotic manner because each investor has his/her own opinion and investment strategy. Divergent strategies of different investors that hold small shares of the market create the random walk effect, when the asset price grows not only because of rational reasons related directly to the company, but due to a large range of causes (from a local manager’s dismissal to the government’s foreign policy) that may be completely unrelated to the specific company [22; 23].

Summarizing the above, we may note that at present the procedure of implementing innovation is related directly to intangible assets. This is contingent upon the following: on the one hand, intellectual capital creates the conditions for struggling against conservatism and accepting innovations, on the other hand, current innovations, especially in the banking sphere, take the form of non-material assets (software, risk assessment techniques, business culture, etc.). There is currently no clear definition of intangible assets that would take all aspects into consideration, hence, there are no universal techniques for the valuation of such assets. However, there is no doubt that this is an asset that creates innovation potential, without which development is impossible in any economic sector.

## Model and Data

In order to analyze the influence of intangible assets on the banking business, we collected data about 13 systemically important Russian banks over 10 years (2011–2020). The list of systemically important banks was compiled by the Central Bank of Russia, and as at the beginning of 2022 comprised 13 most influential banks, whose assets amount to about 80% of the value of all the assets in the Russian banking sector. This list comprises six government-owned banks (Sberbank, VTB, Gazprombank, Otkrytie, Russian

Agricultural Bank (Rosselkhozbank), Promsvyazbank), four private banks (Alfa-bank, MCB, Sovcombank, Tinkoff bank) and three foreign-owned banks (UniCredit bank, Raiffeisenbank, Rosbank). These banks cover the major part of the banking sector, have different forms of ownership and efficiency levels. We took intangible assets (intangible assets) and unobservable intangible assets (intangibles) as the indicators of the innovation variable.

According to the Regulation of the bank of Russia dated 27.02.2017 No. 579-P On the Chart of Accounts for Book-keeping for Lending Institutions and the Manner of its Application, intangible assets are posted at account 60901 Intangible Assets. This category comprises the property with no material form, but which may be identified clearly (software, patents etc.). The value of intangible assets was taken as at the beginning of the year and value of dependent variables – as at the end of the year. This allowed to evaluate the general impact of implementing innovation on the banking business indicators over the year.

Unobservable intangible assets (intangibles) are rather difficult to assess because they are not clearly recorded in reports. Besides, the banking business, unlike other types of activity, has its specific features. Banks have almost no production facilities, since the main production factor in any bank is capital, which determines the scope of economic activity. A bank also has to fulfill the rather strict requirements of the Central Bank, which significantly limit its activity. Bank product prices depend greatly on the Central Bank rate, while an increase in the price is possible only if the assumed risks increase. However, capital utilization efficiency varies among banks. This difference exists because each individual bank strives to optimize its expenses and structure, to create corporate culture, assess risks more accurately etc. Some banks manage to do so successfully, while others fail. The results depend on the size of intellectual capital and the share of intangible liabilities.

**Table 1.** Assets of 13 of Russian systemically important banks, RUB bn.

Year	Sberbank	VTB	GPB	Alfa-bank	Tinkoff	Roselkhoz- bank	UniCredit	Sovcombank	MCB	Rosbank	Ppromsvyaz- bank	Otkrytie	Raiffeisen- bank
2020	32 980	16 354	7237	4580	810	3820	1270	1454	2909	1369		2600	1452
2019	27 584	13 815	6326	3635	555	3218	1214	1155	2435	1205	1940	2330	1274
2018	26 900	13 642	6152	3216	378	3338	1358	965	2136	1082	1257	1393	1115
2017	23 159	9631	5268	2496	268	3078	1178	666	1830	924	994	1767	838
2016	21 721	9429	4749	2247	172	2679	1148	531	1383	758	1252	2678	753
2015	22 707	9395	4953	2059	140	2511	1375	506	1186	861	1218	2966	851
2014	21 747	8295	4636	2157	113	2067	1344	207	572	941	1061	2716	866
2013	16 275	5268	3565	1477	105	1816	904	124	446	689	736	935	694
2012	13 582	4313	2767	1307	73	1578	871	92	310	650	686	636	614
2011	10 419	4172	2398	923	31	1384	878	56	229	599	561	454	572

Source: Author's calculations based on the data provided by the Bank of Russia.

Sberbank is the largest bank in the sample of 13 systemically important banks. Its assets as at the end of 2020 exceeded RUB 32 tn. which is 40 times greater than Tinkoff's assets (Table 1). At the same time, Sberbank grew 3.2 times in 10 years, while Tinkoff grew 26.1-fold.



**Table 2.** Revenue of 13 Russian systemically important banks, RUB bn.

Year	Sberbank	VTB	GPB	Alfa-bank	Tinkoff	Rosselkhozbank	Rosselkhozbank	UniCredit	Sovcombank	MCB	Ppromsvyazbank	Otkrytie	Raiffeisenbank
2020	2928	1127	452	392	186	261	77	147	169	97		188	115
2019	2884	1166	446	364	149	275	97	118	162	96	149	183	127
2018	2608	1062	411	309	113	266	94	81	154	81	116	143	109
2017	2454	705	400	271	89	278	87	69	137	69	130	206	93
2016	2440	751	419	245	66	290	100	57	124	72	129	202	88
2015	2289	658	403	234	56	242	98	47	99	80	121	200	87
2014	1903	440	296	197	49	189	77	28	65	81	94	105	75
2013	1528	319	236	161	42	170	60	20	48	71	79	74	67
2012	1254	246	194	119	24	151	54	13	32	64	71	48	52
2011	972	212	141	92	11	125	49	9	24	57	60	37	50

Source: Author's calculations based on the data provided by the Bank of Russia.

It should be noted that Sberbank surpasses Tinkoff just 15.7 times in terms of revenue. Also, over the 10 years, Sberbank's revenue has increased three-fold, while Tinkoff's revenue grew 16.9-fold (Table 2).

In the sample of 13 banks over 10 years, Otkrytie showed the worst income/assets ratio in 2014, which amounted to 0.039 or 3.9% (=105/2716).

$$\text{Intangibles} = \frac{\text{Income}}{0,039} - \text{Assets}. \quad (2)$$

We presume that 3.9% of earning power in this sample within this period is the level that may be achieved without significant investment in financial innovation. Based on this earning power, we recalculated the assets required for all banks for all periods to get the revenue indicated in reports. In other words, if a bank has RUB 100 of assets, does not invest in innovation and does not increase the volume

of intangible assets, it will get RUB 3.9 in income by the end of the year.

At the same time, an innovative bank will get RUB 15 of revenue over the same period of time. In order to obtain such revenue without innovation, the bank would have needed approximately RUB 385 of assets, but it has only RUB 100 on the books. It means that RUB 285 of assets (=385 – 100) are unobservable intangible assets (intangibles).

Among the 13 largest banks in 10 years, Sberbank had the greatest volume of unobservable intangible assets in 2019 (RUB 47 tn. or about 129% of its asset value), while VTB (the second bank in Russia in terms of the total value of assets), had intangible assets exceeding 100% only in 2015 (Table 3). At the same time, in terms of the share, Tinkoff had about 1021% of the total asset value of such intangible assets (RUB 1152 bn.) in 2014.

**Table 3.** Intangible assets of 13 Russian systemically important banks recalculated using the basic earning ratio, RUB bn.

Year	Sberbank	VTB	GPB	Alfa-bank	Tinkoff	Rosselkhozbank	UniCredit	Sovcombank	MCB	Ppromsvyazbank	Otkrytie	Raiffeisenbank	UniCredit
2020	42 748	12 789	4460	5557	3998	2936	713	2352	1460	1152		2252	1531
2019	47 023	16 347	5210	5767	3303	3893	1293	1892	1766	1283	1914	2392	1999

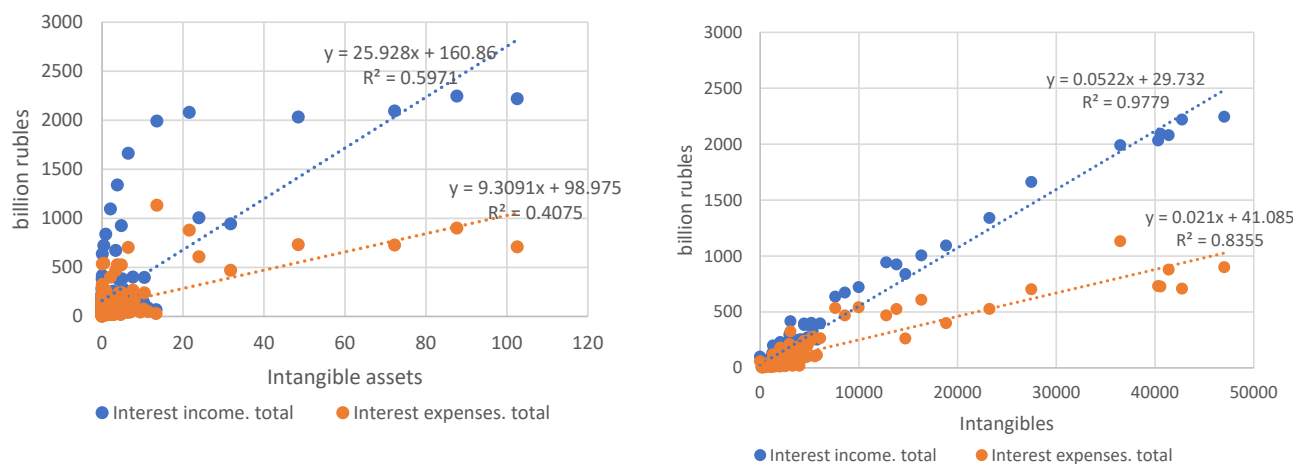
Year	Sberbank	VTB	GPB	Alfa-bank	Tinkoff	Roselkhozbank	UniCredit	Sovcombank	MCB	Ppromsvyazbank	Otkrytie	Raiffeisenbank	UniCredit
2018	40 556	13 830	4466	4782	2552	3548	1086	1140	1852	1014	1748	2302	1699
2017	40 324	8602	5086	4509	2021	4125	1080	1108	1711	865	2360	3556	1573
2016	41 402	9999	6094	4083	1540	4814	1444	936	1832	1094	2075	2553	1532
2015	36 487	7615	5481	4004	1304	3749	1165	712	1380	1202	1921	2209	1399
2014	27 476	3083	3021	2936	1152	2808	650	519	1120	1143	1374	0	1079
2013	23 245	2986	2532	2679	975	2589	645	387	785	1155	1298	968	1028
2012	18 851	2050	2241	1768	542	2332	528	249	524	1004	1138	601	731
2011	14 727	1307	1239	1443	262	1861	401	166	392	883	988	503	713

Source: Author’s calculations based on the data provided by the Bank of Russia.

As for intangible assets, Sberbank is also the leader, since it has more financial opportunities. However, the gap between Sberbank and Tinkoff is just 10.7 times. This can be explained by the fact that Tinkoff’s decisions are more innovative, which allows it to develop more rapidly and compete with larger banks. Figure 2 shows the dependence of interest income and expenses on intangible assets over

one year. As we see in the diagram, the growth of intangible assets facilitates an increase in interest income. So, the growth of balance-sheet intangible assets by RUB 1 results in an increase of interest income by RUB 25.9, while the growth of unobservable intangible assets by RUB 1 leads to an increase by RUB 0.08. However, the correlation with balance-sheet intangible assets is rather low.

Figure 2. Dependence of interest income and expenses on intangible assets over one year, RUB bn.

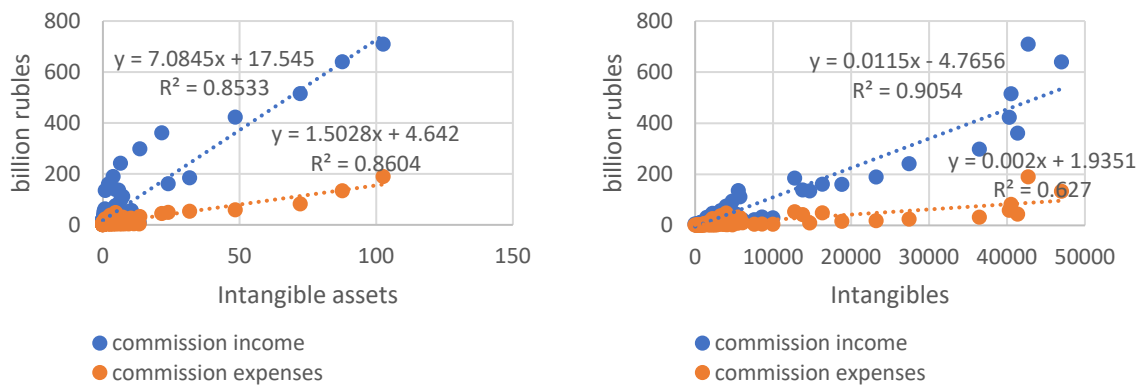


Source: Author’s calculations based on the data provided by the Bank of Russia.

As we see in Figure 3, the growth of intangible assets facilitates an increase in commission income. Thus, a rise in balance-sheet intangible assets by RUB 1 leads to a growth of commission income by RUB 7, while an increase in unob-

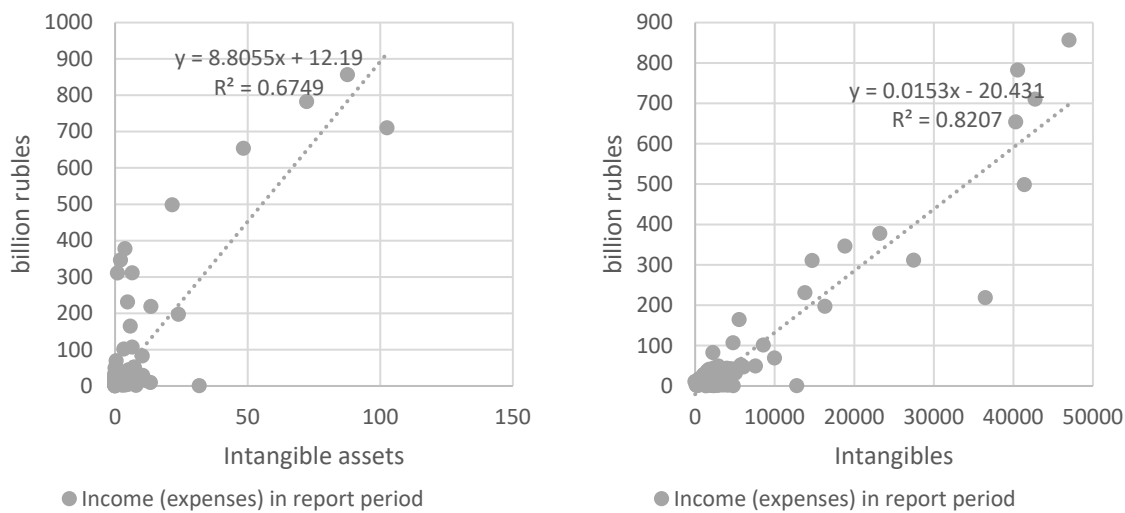
servable intangible assets by RUB 1 – to a growth by RUB 0.01. At the same time, the correlation with balance-sheet intangible assets is rather high.

**Figure 3.** Dependence of commission income and expenses over a year on intangible assets, RUB bn.



Source: Author’s calculations based on the data provided by the Bank of Russia.

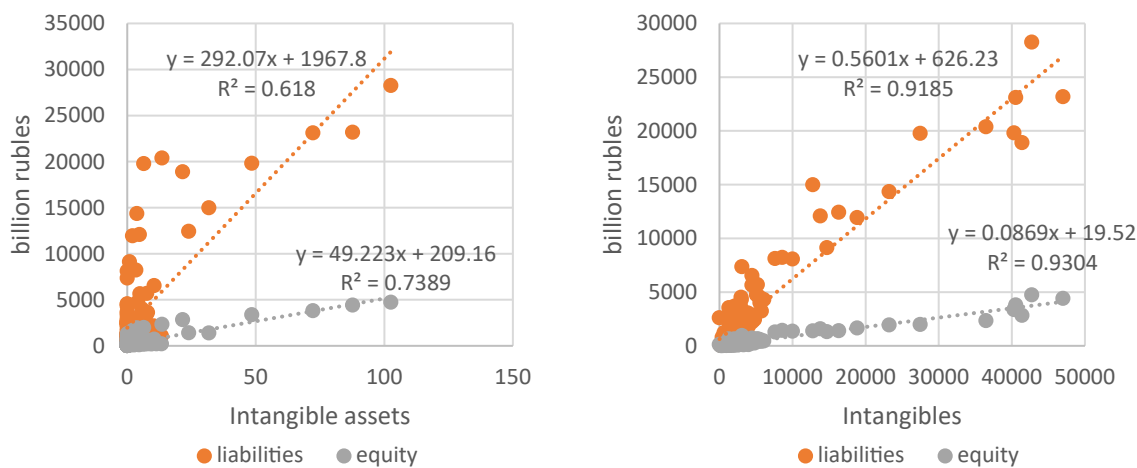
**Figure 4.** Dependence of income on intangible assets over one year, RUB bn.



Source: Author’s calculations based on the data provided by the Bank of Russia.

Due to the fact that income is more sensitive than expenses to the growth of intangible assets, the banks’ profit has a positive slope as intangible assets grow (Figure 4). This is achieved by means of spending optimization, cutting down the number of offices and employees and expansion of digital solutions.

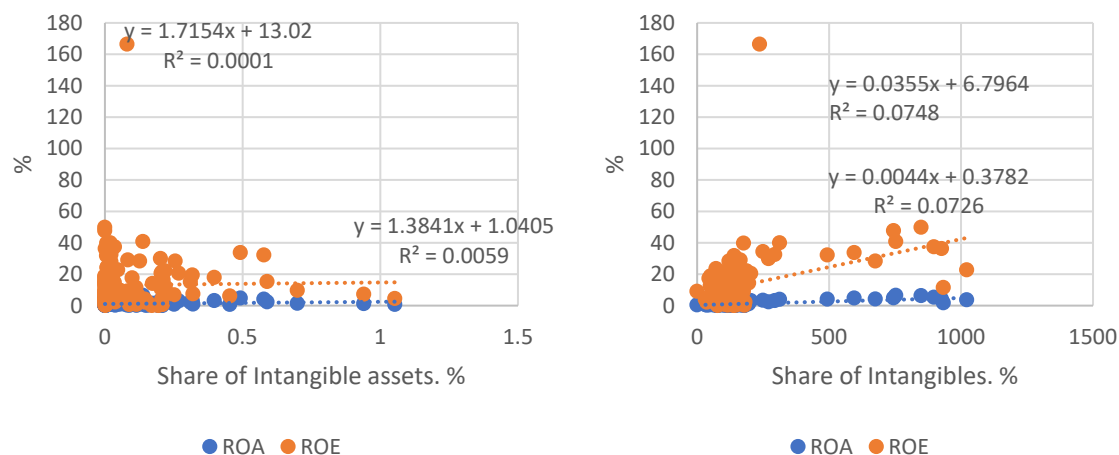
**Figure 5.** Dependence of liabilities and equity as at the end of the year on intangible assets, RUB bn.



Source: Author’s calculations based on the data provided by the Bank of Russia.

An increase in income due to intangible assets requires additional funds for development, which entails a growth of a bank's liabilities. However, in terms of the share, banks' equity was on average approximately 10% and experienced only a marginal decrease (Figure 5).

**Figure 6.** Dependence of ROE and ROA on the share of intangible assets



Source: Author's calculations based on the data provided by the Bank of Russia.

As long as innovation allows to reduce the share of expenses, while the share of income grows, Figure 6 shows a positive slope of both ROE and ROA. It is due to the fact that innovation allows to find more solvent customers, to evaluate the borrower's risk level more accurately, as well as to decrease costs by reducing the number of bank departments and downsizing. However, the return on equity does not exceed 20% for the majority of companies because the Central Bank significantly limits banking sector activity, and banks cannot assume higher risks.

## Discussion of Results

In this research we have analyzed 13 banks over 10 years (2011–2020). These banks were selected because they hold over 2/3 of assets of Russia's entire banking system. Such banks have their own specifics in comparison to other banks, both in Russia and abroad. The present research is limited by the fact that we have considered only large Russian banks and have not analyzed the specifics of medium and small banks, of which there are approximately 400 in Russia, which are less regulated by the Central Bank and willing to assume higher risks. We used the "intangible assets" indicator as the innovation variable. At the same time, intangible assets were divided into balance-sheet assets (intangible assets) and unobservable ones (intangibles).

The balance-sheet intangible assets have a significant influence on banks' operations; however, the correlation was low in the majority of models. It is due to the fact that this indicator does not take into consideration the assets that are difficult to identify. On the other hand, unobservable assets had higher correlation with the indicators of banks' business activity. Generally, we assumed that the growth of intangible assets has a positive impact on the increase of both interest income and commission income. At the same time, intangible assets allow to increase income quicker than expenses. Due to this fact, banks with large intangible assets had higher revenue. Growth in income requires additional

funds for development, thus driving the growth of a bank's liabilities, however, the share of liabilities remains almost unchanged at the 90% level. It should also be noted that an inverse dependence is possible, whereby larger companies have more opportunities for the implementation of bigger volumes of intangible assets. However, according to statistics, out of Russia's 13 largest banks over 10 years (2011–2020), Sberbank had the largest amount of unobservable intangible assets in 2019 (RUB 47 tn. or about 129% of the asset value), while VTB (the second bank in Russia in terms of the total asset value) had intangible assets exceeding 100% only in 2015. At the same time, Tinkoff in 2014 had about 1021% of the total asset value in such intangible assets (RUB 1152 bn.). It means that relatively small innovative banks may compete with larger traditional banks, which invest a smaller relative share in intangible assets.

## Conclusion

Intangible assets are an important factor of commercial banks' development. Growth of intangible assets is indicative of banks' innovative development and produces a positive impact on their business activity. Many researchers point out that without investing in intangible assets, it is impossible to achieve an increase in productivity and, hence, in the earning power of business activity. In this connection, the greatest influence is exerted not by intangible assets that are recorded in the companies' balance sheets (patents, licenses, software etc.), but by unobservable assets (corporate culture, reputation, knowledge, experience, etc.). However, there are still no clear descriptions of these assets or comprehensive techniques for their evaluation.

As analysis of 13 systemically important Russian banks over 10 years (2011–2020) demonstrated that the growth of the volume of intangible assets results in an expansion of demand for banking products and services, which increases interest and commission income and revenue, as well as accumulation of assets. On the other hand, innovation is partly aimed

at the reduction of risks and expenses of business activity, which results in a growth of ROE and ROA. It should be noted that in the banking business a growth in earning power has significant regulatory limitations because higher revenues are directly related to increased risk levels. A growth in demand also makes banks increase the share of liabilities, which may have a negative impact on a bank's future financial resilience, making banks less sensitive to crises.

## Acknowledgements

The study was conducted with the support of the Russian Science Foundation (Project No. 23-18-00756).

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The article was submitted 25.12.2022; approved after reviewing 23.01.2023; accepted for publication 10.02.2023.

DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.54-63>

JEL classification: G30, G32, G34, G35, G41



# Determinants of Dividend Payments of Russian Companies

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## Abstract

The Russian stock market is one of the leaders in terms of dividend yield among developed and developing countries. Against this background, it is appropriate to study the determinants that affect the decisions on the implementation of payments and their amount. The literature on this topic in emerging markets in general and specifically in Russia has a number of gaps and contradictions that determine the scientific novelty of the work – the analysis in regard to the impact on the probability of payments and on dividend yield is carried out simultaneously; contradictory determinants are examined. In emerging markets, the relationship between dividends and the age of members of the Board of Directors and the personal income tax rate on dividends is taken into account, and specifically in Russia – their relationship to the number of members of the Board of Directors, the ownership stake of the CEO and institutional shareholders, the company's life cycle stage (LC), the dual role of the chairman of the Board of Directors and executive director. The study is conducted on the 2012–2019 data for a sample of 40 companies listed on the Moscow Exchange. The method incorporates two regression models – a linear one with random effects and a probit model. As a result of the analysis, the manifestation of the agency effect in the Russian market was confirmed by a significant positive dependence of the probability of payments on the dual role of the chairman of the Board of Directors and the executive director, the portion of shares held by the CEO, a significant negative relationship with the number of members of the Board of Directors and liquidity. The agency and behavioral effects are confirmed by a significant positive relationship between the probability of payments and the age of the members of the Board of Directors and a significant negative relationship with profitability. The influence of client effects is confirmed by a significant positive relationship between profitability and the personal income tax rate on dividends, as well as between the probability of payments and the share of institutions in ownership. It is also confirmed that companies that are mature in terms of the life cycle stage are more likely to pay dividends and do it more often. In general, there is a more significant influence of non-financial variables on the probability of payments and of financial variables on profitability.

The results of the study can be used by private investors, banks, investment funds and brokerage companies to form expectations for companies' dividend yield and the probability of payments with regard to the specifics of the Russian market.

**Keywords:** dividends, dividend policy, dividend yield, stock market, agency theory, behavioral theory, business life cycle, life cycle theory, client theory, Russian markets, developing markets.

**For citation:** Shapovalova, S. Determinants of Dividend Payments of Russian Companies. *Journal of Corporate Finance Research*. 2023;17(1): 54-63. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.54-63>

## Introduction

A company's dividend payouts are one of the main factors of its attractiveness in the stock market. Investors receive revenue from share ownership in two ways: by means of dividends or by capital gains due to business growth.

In the Russian market investors are more interested in the companies where they will earn on dividends (*value stock*) than in the companies whose shares are traded in order to earn on growth (*growth stock*). Leadership of the Russian companies in dividend yield in developed and emerging markets confirms this fact and proves the attractiveness of the Russian market.

Analysis of the determinants of dividend payments in the Russian market is conducted simultaneously in two areas: the influence on dividend yield and on probability of payments. The research studies determinants that include the average age of the board of directors (BD), personal income tax rate on dividends, number of BD members, ownership stake of the CEO and institutional shareholders, life cycle (LC) stage of the company, dual role of the BD chairman and the executive director (simultaneous performance of the BD chairman and the executive director functions by the same person). The research object are Russian companies listed on the Moscow Exchange and the research subject are the determinants of their dividend payments.

We used the *Bloomberg* database, a range of news providers (Vedomosti, RBC, Kommersant) and other open-access Internet resources as data sources in our research.

## Theoretical Aspects of Dividend Payments

### Theories of Dividend Payment Motives

The study of the motives and determinants of a company's dividend payments stems from the 1960s, the

time of emergence of the *dividend irrelevance theory* originated by F. Modigliani and M. Miller [1]. The fundamental idea of this theory is that in perfect capital markets dividends do not influence the evaluation of the company stock value or its intrinsic value. Before this theory emerged, the dominant view was that the larger the dividends paid out by a company, the higher its value [2]. However, the key supposition of the theory on the perfect nature of the capital market is difficult to accomplish. Ultimately, other theories describing the motives for dividend payments have emerged. Each of them attempted to offer the approach closest to the real market. Let us consider the theories applied in our subsequent research.

*The agency theory* is based on the presence of a conflict of interests between the company shareholders and its management [3]. Agency costs decrease company value, so the management has to balance its financing policy in order to minimize them [4].

*The life cycle theory (LC)* asserts that the companies mature in terms of their LC stage with fewer investment opportunities are most disposed to pay out dividends. The firms at earlier LC stages have more attractive investment opportunities and a very limited capital value [5].

One of the ways to calculate the parameters that may be used to study the influence of the LC on dividend payments is Tobin's Q ratio.

Another way to calculate the parameters of a company's LC for the purpose of studying its influence on dividend payments is the approach proposed by Victoria Dickinson [6]. It consists in defining the LC stage on the basis of characteristics of a company's three cash flows: operating, financing and investment. Depending on the positive or negative sign of each, the company is assigned to one of the four LC stages (Table 1): start-up, growth, maturity, decline – on the basis of unique sets made of three signs.

**Table 1.** Cash flow signs for defining the LC stage

Cash flow	Start-up stage	Growth stage	Maturity stage	Decline stage
Operating	–	+	+	–
Financing	+	+	–	+/-
Investment	–	–	–	+

Source: [6].

*The client theory* of dividend payment motives indicates that the possible reason for dividend payments by a company is the difference in taxation between various groups of investors [7–9]. The situations when taxation of profit from dividends and profit from capital gains is different may also serve as an example of the client theory [7; 10; 11]. Another interesting example of the client theory is the influence of personal income taxation on dividend payments. Some researchers in their papers confirm a positive

relationship between the growth of the tax rate on personal income and dividend yield [12; 13].

All the above theories are classic theories. The literature also defines *behavioral theories* of dividend payment motives. These theories indicate that there is a relationship between the behavioral aspects of the corporate management and the corporate dividend policy, and in the first instance, the management's attitude to risk and management overconfidence [14–18].

## Methodology of Empirical Analysis of Dividend Payment

### Determinants in the Russian Market

#### *Putting Forward Research Hypotheses*

This paper seeks to reveal the key determinants of the dividend policy of Russian companies. In order to achieve this goal, we initially put forth a range of hypotheses structured by determinants' groups based on their affiliation with a specific theory of dividend payment motives.

**Group 1.** Determinants resulting from the study of the agency theory of dividend payment motives:

1.1. Dual role of the BD chairman and the executive director has a statistically significant positive influence on the probability of dividend payments by Russian companies and their profitability.

1.2. Probability of dividend payments and their profitability in Russian companies show a negative relationship with the number of BD members.

1.3. The stake of shares owned by the CEO has a positive influence on dividend yield and probability of payout.

1.4. Liquidity has a negative influence on dividend yield in the Russian market.

**Group 2.** A determinant at the junction of the agency and behavioral theory of dividend payment motives.

2.1. The average age of BD members has a positive influence on the probability of dividend payments and their profitability in Russian companies.

**Group 3.** Determinants resulting from the study of the client theory of dividend payment motives.

3.1. The personal income tax rate on dividends in Russia has a positive influence on dividend yield.

3.2. The share of institutions in ownership has a positive influence on the probability of dividend payments and their profitability.

**Group 4.** Determinants resulting from the study of the business LC theory:

4.1. In the Russian market, the maturity stage of the LC has a positive influence on dividend yield and probability of dividend payments.

4.2. A company's investment opportunities have a negative influence on its dividend yield and probability of payments in the Russian market.

#### *Data Sample*

For the analysis, we selected 40 Russian public companies listed on the Moscow Exchange. There were three selection criteria: 1) dividend payments; 2) economy sector; 3) data availability. A company should have paid dividends at least once within the research period in order to be selected for the sample. We eliminated from our list the companies from the financial and housing and utilities sector because the regulation of their operations is highly specific. We also eliminated several companies from the sample based on

the criterion of information availability because approximately 70% of information about them was not presented in the database.

The interval of 2012–2019 was selected as the time period for the research in order to include the period of the 2014–2015 economic crisis. The data was collected from open information sources, mainly *Bloomberg*, analytical Internet resources, and annual reports of the companies in question.

In this paper we use two dependent variables for the empirical research: probability of dividend payments and dividend yield. Probability of payment is presented as a dummy variable where "1" means that company paid dividends in a certain year, "0" – no payments. The dividend yield is calculated as a ratio of the annual paid dividend per share to the company share price. We use the average annual dividend yield because all other indicators are calculated by year.

Independent (explanatory) variables analyzed in empirical models are divided into financial and non-financial ones.

**Financial variables** used in the research comprise the following: financial leverage (ratio of debt to equity); market capitalization (total value of a company's outstanding shares); return on assets (ratio of net income to total assets on the balance sheet); ratio of capital investment to a company's operating cash flow (this variable is used in relative terms in order to mitigate companies' significant size differences); the current liquidity ratio (ratio of current assets to current liabilities); Tobin's Q ratio (ratio of a company's market value in the form of capitalization to the replacement asset value or, otherwise speaking, a company's intrinsic value); LC stage (the indicator is a dummy variable where "1" means that the company is at the maturity LC stage, while "0" stands for any other stage).

In order for the model to account for the fact that a company's decision on dividend payout based on the reports from the preceding full reporting year, some financial variables were added in specifications with a one-year lag. This category comprises the financial leverage, liquidity and return on assets variables.

**Non-financial variables** used in the research comprise the average age of BD members; CEO ownership stake; industry (metallurgical and oil and gas industries; the indicators are added to the model as dummy variables where "1" stands for a company's affiliation with a certain industry and "0" – the fact that the company is unrelated to it); dual role of the BD chairman and the executive director (this parameter is a dummy variable where "1" means that the two roles are fulfilled by the same person, and "0" – that it is not); the number of BD members; share of institutions in ownership; share of free-float.

The following non-financial macroeconomic indicators are analyzed in empirical models: personal income tax rate on dividends as a dummy variable where "1" is the rate of 13%, and "0" – the rate of 9% (the rate was increased in 2015); ratio of the total market capitalization of all Russian companies to its GDP or the Buffet indicator; time factors



represented by the dummy variables for each year in order to account for the effects of various business cycles (i.e., dummy variable for 2014 takes on the value of "1" if the data describes 2014 and "0" – otherwise).

### Description of Econometric Models

In order to determine the methodology of study of the relationship between dividend payment probability and dividend yield, on one hand, and the determinants selected for analysis, on the other, it is necessary to pay attention to data characteristics. In our case, panel data was used because the indicators have been collected over several time periods (years).

The model also has to take into account the type of the dependent variable. When we analyze the dependence of dividend yield on a series of determinants, we typically use the linear model. This regression will be built in three versions: the pooled, fixed effects and random effects models.

We subsequently conducted a series of tests to choose the model most suitable for our data. We applied the Hausman test to choose between fixed effects and random effects regressions, the Wald test – to choose between the pooled regression and the fixed effects model and the Breusch-Pagan test – to verify random effects and choose between the pooled regression and the random effects model.

The equation of the linear regression model, which is used in this research to study the influence of a range of financial and non-financial determinants on **dividend yield**, is created by means of primary specification testing in order to detect the best set of parameters from the point of view of the regression's explanatory power, and is as follows:

$$\text{Dividend Yield}_t = \alpha_0 + \alpha_1 \text{Board Average Age}_t + \alpha_2 \text{Metals and Mining}_t + \alpha_3 \text{Oil and Gas}_t + \alpha_4 \text{Dividend Tax}_t + \alpha_5 \text{Executive Chairman}_t + \alpha_6 \text{Debt to Equity}_{t-1} + \alpha_7 \text{QTobin}_t + \alpha_8 \text{ROA}_{t-1} + \alpha_9 \text{Year14}_t + \alpha_{10} \text{Year15}_t + \alpha_{11} \log(\text{Market Cap})_t + \alpha_{12} \text{CAPEX to CFO}_t + \varepsilon_t \quad (1)$$

In this model, the **independent variables** are as follows: the board members' average age; dummy variable of the personal income tax rate on dividends (dividend tax); dummy indicator of dual role of the BD chairman and the executive director (executive chairman); Tobin's Q.

The **control variables** are the following indicators: financial leverage with a 1-year lag (*debt to equity previous*); return on assets with a 1-year lag (*ROA previous*); years of economic crisis (*year14*, *year15*); market capitalization logarithm ( $\log(\text{market cap})$ ); ratio of capital investment to operating cash flow (*CAPEX to CFO*); dummy indicator of the metallurgical (*metals and mining*) and oil and gas industries.

The second dependent variable in this research is the **probability of dividend payments**. For the purposes of econometric analysis, this parameter is expressed as a dummy variable where "1" means that the company paid dividends and "0" – that there was no dividend payments that year. **Binary choice models** are applied in the cases when dummy variable is used as the independent variable. There are two types of such regressions: logistic and probit ones.

These two types do not differ significantly and, as a rule, they are built in order to choose the most suitable one according to the descriptive power by means of the Akaike criterion and pseudo  $R^2$ .

By means of primary testing of specifications for the subsequent study of the dependence of the dividend payment probability on a series of financial and non-financial determinants, we composed the following equation of the binary choice regression model:

$$\text{Probability of dividend payment}_t = \alpha_0 + \alpha_1 \text{Board Average Age}_t + \alpha_2 \text{Metals and Mining}_t + \alpha_3 \text{Executive Chairman}_t + \alpha_4 \text{Debt to Equity}_{t-1} + \alpha_5 \text{Maturity}_t + \alpha_6 \text{Percent of Shares Held by Institutions}_t + \alpha_8 \text{Board Size}_t + \alpha_9 \text{ROA}_{t-1} + \alpha_{10} \text{Current Ratio}_{t-1} + \alpha_{11} \text{RU Market Cap to GDP}_t + \alpha_{12} \text{Percent of Shares Held by CEO}_t + \alpha_{13} \log(\text{Free Float Share})_t + \varepsilon_t \quad (2)$$

In this model we will analyze the following determinants as **independent variables**: BD average age (*board members' average age*); the dummy indicator of the dual role of BD chairman and executive director (*executive chairman*); dummy indicator of the maturity LC stage (*maturity*); number of BD members (*board size*); shares owned by institutions (*percent of shares held by institutions*); CEO ownership stake (*percent of shares held by CEO*).

In the regression model we use the following indicators as **control variables**: financial leverage with a 1-year lag (*debt to equity previous*); return on assets with a 1-year lag (*ROA previous*); dummy indicator of the metallurgical industry (*metals and mining*); current liquidity ratio with a 1-year lag (*current ratio previous*); ratio of the RF total market capitalization to GDP (*RU market cap to GDP*); share of free float stock (*free float*).

## Results of Empirical Study

### Diagnostics and Interpretation of the Results of the Random Effects Linear Regression

In order to choose the best linear regression of panel data in terms of descriptive power, we built three types of this model: pooled regression, fixed effects and random effects models. Then we performed the econometric tests required to choose the best model.

In order to compare the pooled regression and the random effects model, the Breusch-Pagan test was performed for random effects. As a result of the test, the *P-value* of the Breusch-Pagan statistic turned out to be statistically significant, which is indicative of random effects in the tested data and means that in this case the choice of the random effects model is correct.

The comparison of the pooled regression and the fixed effects model by applying the Wald test demonstrated that the fixed effects model could be used in this study and that it surpassed the simple regression (significance of *F*-statistic has been achieved for *P-value*).

The Hausman test was conducted in order to compare the fixed effects and the random effects models. The diagnos-

tics revealed the insignificance of the Hausman statistic in regard to *P-value*. Thus, it is necessary to choose the random effects model for analysis.

According to the results of the performed tests for model type comparison, we constructed a panel regression with random effects. This model was tested for multicollinearity. On the basis of the obtained VIF values (all indicators are less than 5), one may conclude that there is no multicollinearity problem in it, and that parameter estimates are rather stable. The Wald statistic of the obtained regression indicates that the regression is generally significant since this indicator is rather high (Wald chi2 = 222).

**Table 2.** Results of the random effects regression

Variable	Sign	Coefficient	<i>P-value</i>
Board members' average age	–	–0.16*	0.067
Dividend tax	+	3.45***	0.000
Executive chairman	+	0.74	0.341
Q Tobin	–	–1.68**	0.030
Debt to equity previous	–	–0.06**	0.050
ROA previous	+	0.11***	0.006
Log ( <i>Market Cap</i> )	+	0.68	0.111
Oil and gas	–	–2.10*	0.098
Metals and mining	+	2.91***	0.008
CAPEX to CFO	–	–0.46**	0.029
Year14	+	3.01***	0.000
Year15	–	–1.28**	0.022
Wald chi2		222.13	

*p-value*: \*\*\* – 1%; \*\* – 5%; \* – 10%.

The variable of the personal income tax rate on dividends turned out to be **statistically significant and exerts a positive influence** on dividend yield. This conclusion correlates with the results of previous studies in developed markets: when the **personal income tax rate on dividends** is increased, according to the agency theory, companies are more prone to raise dividend yield in order to satisfy the investors' yield requirements that increased as a result of the tax rate growth [12; 13].

Among the **control variables** the indicators of the metallurgical industry, return on assets and dummy 2014 exerted the expected positive influence that is correlated with scientific literature. The **metallurgical industry** indicator across the data sample has a generally higher dividend yield than the mean value for all industries. A dispute may be caused by the effect obtained for **2014**, which marked the beginning of the new economic crisis of 2014–2015

We also decided to apply the robust estimator method to ensure an efficient and quick elimination of outliers in order to improve the model when building the regression model with random effects. Since the Hausman test is not suitable for robust type models, we once again conducted similar diagnostics that has been used for robust estimator regressions – the Sargan-Hansen test. Its result is virtually similar to that of the Hausman test for the model without robustness. The test also confirmed the need to use the random effects model.

**Let us continue to the interpretation** of the results of the obtained linear regression model with random effects (Table 2).

that probably should have had a negative effect on dividends. However, a potential explanation of the positive influence may lie in the fact that the decision on the amount of dividend payments is made by companies based on the financial reports for the previous reporting year. In 2013 the Russian economy was at its peak in terms of GDP growth.

The average board age and investment opportunities (Tobin's Q) turned out to be the variables that are **statistically significant and exert a negative influence** on dividend yield. The result related to the **corporate investment opportunities** variable is consistent with earlier studies in developed and emerging markets within the context of an inverse dependence. This conclusion stems from the fact that with greater investment opportunities companies are more prone to funnel larger cash flows to them than to pay dividends [19; 20].

Dependence of dividend yield on the *average board age variable* had not been studied before, but we revealed a positive relationship between the probability of payout and age of BD members in the developed market, which may be due to greater conservatism of older BD members who are prone to insist on payouts instead of investing the cash flow in risky projects [21]. A *negative dependence of dividend yield* on this parameter may also be due to the conservatism of older BD members on the issue of payment amounts. The *control variables* that demonstrated a *negative* relationship are the *ratio of capital investment to operating cash flow, 2015, financial leverage and oil and gas industry*. These results correlate with the expectations and conclusions of the previous studies. The negative dependence of dividend yield on the oil and gas variable may be explained by a smaller average dividend yield of companies from this industry in comparison to other companies from the sample of enterprises selected for analysis (in the oil and gas industry the average yield in 2012–2019 amounted to 4.1%, while the total for all industries equaled 5.3%). The variable of *dual role of the BD chairman and the executive director (executive chairman)* turned out to be *insignificant* in the dividend yield model.

### Diagnosics and Interpretation of the Results of the Binary Choice Model

Two versions of the binary choice model were constructed: a logistic regression and probit regression. According to the Akaike criterion, the models differ insignificantly, therefore for further data analysis we chose the probit regression, whose pseudo- $R^2$  is slightly greater than that of the logistic model.

The obtained model was examined for validity by means of a series of special tests. First, we verified the model's explanatory power by pseudo- $R^2$ . The acceptable values of this indicator are within the 0.3–0.4 interval [22]. The value of our probit regression is 0.41, which is indicative of its good explanatory power.

**Table 3.** Results of the binary choice model – probit

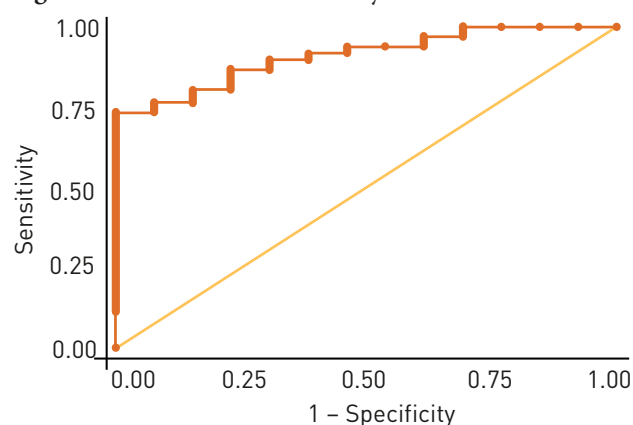
Variable	Sign	Coefficient	P-value
Shares CEO holds, %	+	5.82*	0.096
Board members' average age	+	0.15**	0.035
Executive chairman	+	1.11*	0.087
Shares held by institutions, %	+	0.02**	0.037
Debt to equity previous	–	–0.05***	0.002
ROA previous	+	0.05**	0.031
Current ratio previous	–	–0.69**	0.029
Metals and mining	+	2.64***	0.000
Maturity	+	1.27**	0.021
Russian market cap to GDP	–	–0.04**	0.011
Board size	–	–0.25***	0.008
Pseudo $R^2$		0.3958	

*p*-value: \*\*\* – 1%; \*\* – 5%; \* – 10%.

We then verified the model by means of the Hosmer-Lemeshow test statistic. As a result of the conducted diagnostics, the Hosmer-Lemeshow statistic turned out to be sufficiently large in terms of the *P*-value (0.99). For this reason, we may assert that it is correct to choose this model type for the available data.

The last stage of diagnostics of the obtained binary choice model is the analysis of the ROC-curve for regression sensitivity. After plotting the ROC-curve (Figure 1), the area under it equals 91%, which is indicative of excellent model sensitivity (90–100% interval) [23].

**Figure 1.** ROC-curve of the binary choice model



Source: Author's calculations.

In addition, we applied the clustering method in the construction of this model to improve its explanatory power – companies served as clusters in our case. When comparing models with and without clustering, we made the conclusion in regard to the higher quality of the logistic regression with clusters.

**Let us get on to interpret** the results of the obtained model (Table 3).

Among the studied independent variables, the board members' average age, dual role of BD chairman and executive director, ownership stake of the CEO and institutions and the maturity life cycle stage are the *statistically significant variables that produce a positive influence* on the decision regarding dividend payments.

A positive influence of the *average board age* correlates with the result of analysis in papers dedicated to developed markets and is explained by the conservatism of older directors. For this reason, they are prone to insist on dividend payments instead of using the whole cash flow for risky investments [21]. In emerging markets this determinant has not been studied in terms of influence on the probability of payments.

The result concerning the variable of *dual role of the BD chairman and the executive director* correlates with the majority of previous scientific papers in terms of the positive relationship between the dual role of the CEO and dividend payments when various measuring methods are applied [24; 25]. Since we have not discovered any research that examines the same specific determinant, we initially presumed the likelihood of a similar relationship between those parameters and dividends. The positive dependence may be due to a decline in the efficiency of the BD's monitoring function, which, in turn, causes an increase in agency costs. Therefore, in order to enhance monitoring efficiency and limit the cash flow available to them, company investors are prone to demand dividend payout [25].

The result obtained for the variable of the LC's maturity stage is also comparable with the earlier studies of dividend payment determinants. The positive dependence is due to the fact that mature companies have fewer investment opportunities for investing the cash flow and are more inclined to dividend payouts [5; 26; 27].

The positive relationship of the probability of dividend payments with the *CEO ownership stake* determinant is more consistent with the conclusions obtained in emerging markets. This result is due to the fact that the CEO, being a shareholder of his/her company, bears financial risks for which he/she wishes to be compensated by dividend payments [28].

We also determined a positive dependence of the probability of payments on the determinant of the *stake of institutional shareholders*. This phenomenon is due to the agency theory effect – in the sample of companies used for this analysis, firms with a significant share of corporate owners meet the criterion of the zero-rate income tax on dividends. Such companies will try to satisfy the need for dividends of their shareholders with a special tax treatment by paying them out [7; 8].

The *control variables of return on assets* and *metallurgical industry* showed a positive relationship. This aligns with the conclusions of previous studies and general expectations. In the data sample used for analysis, metallurgical companies paid dividends in almost all periods.

The *current liquidity ratio* turned out to be a *statistically significant variable that produces a negative impact* on

the decision regarding dividend payouts. This is consistent with the results of some studies, especially in emerging markets [29; 30]. Among the cited reasons are the striving of more liquid companies to use debt financing as an instrument to mitigate agency conflict as well as the generally more conservative policy of such firms concerning distribution or retaining of the cash flow, which may be related to a larger debt.

We revealed a negative dependence of the probability of dividend payments on the *number of the BD members* variable. This conclusion is aligned with the results of some previous studies, mainly in emerging capital markets, and is due to the fact that the probability of communication problems and intensification of the conflict of interests grows along with the number of BD members. This causes a rise in agency costs and a decrease in dividend payments [31].

The conclusion of the negative dependence of payment probability on the *financial leverage control variable* is consistent with the results obtained by other researchers earlier. When this indicator grows, the corporate debt load increases as, consequently, does the risk. This leads the company to retain the cash flow and not to use it for dividend payouts in order to maintain its business solvency. In addition, the negative relationship of the *Buffet indicator control variable* is aligned with the logic of this indicator and earlier studies: the higher the indicator, the more overestimated is the stock market and, consequently, the companies' need to send out signals using dividends.

## Comparison of Results and Conclusions from Empirical Analysis

Summarizing the conducted empirical analysis using two statistically significant regression models – a linear one with random effects and a probit regression, we made general conclusions in regard to the confirmation of the advanced hypotheses that have been structured according to the key theories of dividend payment motives studied in the paper and united in groups.

**Group 1.** Determinants resulting from the study of the agency theory of dividend payment motives:

**1.1.** The hypothesis of a positive influence of the *dual role of the BD chairman and the executive director* variable is partially confirmed. The statistically significant positive relationship with the probability of payments has been revealed, significance has not been achieved in the dividend yield model. We may conclude that the agency effect of this dual role is present in the Russian market.

**1.2.** The hypothesis of the negative dependence of dividend payments on the *number of BD members* is partially confirmed. We revealed a statistically significant negative influence on the probability of payments, the relationship with dividend yield is insignificant.

**1.3.** The hypothesis of a positive influence of the *ownership stake of the CEO* is partially confirmed. We revealed a statistically significant positive relationship with the probability of payments, the relationship with dividend yield is insignificant.

**1.4.** The hypothesis of a negative relationship between *liquidity* and dividend payments is confirmed partially. We revealed a statistically significant negative relationship between the probability of payments and the current liquidity ratio, while the determinant showed no significance for dividend yield.

**Group 2.** A determinant on the junction of the agency and behavioral theories of dividend payment motives:

**2.1.** The hypothesis of a positive influence of the *board members' average age* is partially confirmed and partially rejected. A positive influence of this determinant on the probability of payments has been proven and a negative relationship with dividend yield has been revealed.

**Group 3.** Determinants resulting from study of the client theory of dividend payment motives:

**3.1.** The hypothesis of a positive relationship between dividend yield and the *personal income tax rate on dividends* is confirmed. As a result of the constructed dividend yield model, we revealed a strong statistically significant positive dependence on this determinant. This leads to a conclusion about a significant client effect that defines the dividend yield of Russian firms.

**3.2.** The hypothesis of a positive relationship between dividends and the *ownership stake of institutions* is partially confirmed. A statistically significant positive relationship with a probability of payments has been detected, while no significant relationship with dividend yield has been revealed.

**Group 4.** Determinants resulting from study of the business LC theory:

**4.1–4.2.** The hypotheses are confirmed. Within this theory we studied two determinants – the *LC's maturity stage* according to Victoria Dickinson's method, as well as the *Tobin's Q ratio*. Both parameters demonstrated identical levels of influence on payments – firms with worse investment opportunities (maturity stage) are more inclined to use the cash flow for dividends and vice versa. However, the significance of variables in various models differed. In the dividend yield regression Tobin's Q proved significant, while in the probability of payments model the maturity stage defined according to Victoria Dickinson's method was significant. The results are consistent with previous studies in both markets.

Summing up, we may confirm the presence of the agency, client and business LC theory effects in the Russian market. In addition, the obtained specifications of two models show the influence on dividend yield exerted to a greater extent by determinants of financial nature, and the influence on probability of payments – by non-financial determinants.

## Conclusion

The Russian stock market is the leader in dividend yields among emerging countries. For this reason and owing to the generally risky nature of emerging markets, the aspect of dividend payments and yield is of special importance for investors in Russian companies. In order to understand

the nature of dividend policy of Russian companies and to have an opportunity to competently form an investment portfolio with regard to dividends, it is necessary to understand which determinants define this policy and in which area.

The study of determinants of dividend payments relies on the theories of dividend payment motives – classic (agency, client, signaling, LC) and behavioral ones. Based on the analysis of the theoretical framework, we generated research hypotheses grouped on the basis of key theories of dividend payment motives.

We subsequently present the methodology of using empirical models to study the determinants of dividend payments in the Russian market. We use two types of regressions in this paper – the linear regression with random effects and the probit model of binary choice.

As a result of empirical analysis, all hypotheses are confirmed completely or partially in terms of probability of payments or dividend yield.

Presence of the *agency effect* in the decisions of Russian companies about dividend payments is confirmed by a significant positive dependence on the indicators of dual role of the BD chairman and the executive director and CEO's ownership stake, as well as by a significant negative relationship with the indicators of the number of BD members and company liquidity. This is consistent with conclusions of previous studies in emerging markets.

The simultaneous presence of both *agency* and *behavioral effect* is confirmed by a positive dependence of the probability of payments on the board members' average age and a negative dependence of dividend yield on this determinant in Russian companies.

The influence of *client effects* in the Russian market is confirmed by a statistically significant positive relationship with the personal income tax rate on dividends and the ownership stake of institutions.

Finally, the *business LC* theory is also confirmed by a significant positive relationship the dividend yield and the investment opportunities defined by Tobin's Q obtained using a sample of Russian companies.

In general, as a result of the research we managed to confirm the presence of the effects related to the agency, client, behavioral and business LC theories in the Russian market. There is also a significant influence of non-financial variables on the probability of dividend payments and a greater influence of financial indicators on profitability. The majority of conclusions on determinants studied in the papers dedicated to emerging markets and covered by this research are confirmed for the Russian market.

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JEL classification: G33, G21, C51



# Default Prediction Model for Emerging Capital Market Service Companies

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## Abstract

The author tested the hypothesis that default prediction based on financial data may be inapplicable to Russian service sector organizations by analyzing the differences in the accuracy of models based solely on financial data for service providers from Russia and developed European countries.

Logistic regression, Random Forest and K-nearest neighbors machine learning methods were used as modeling tools on a sample of 404 Russian firms and 304 firms from developed European countries.

The results suggest that the prediction error is significantly higher in the case of Russian firms than in the case of firms from the control group (European service firms). Thus, the use of financial ratios for default prediction for service firms in Russia seems insufficient.

These findings can be used by organizations that provide credit scoring, and by any other market participants interested in the financial stability assessment of their counterparties.

**Keywords:** service sector, default prediction, credit risk, machine learning algorithms

**For citation:** Afanasev, V. Default Prediction Model for Emerging Capital Market Service Companies. *Journal of Corporate Finance Research*. 2023;17(1): 64-77. [https://doi.org/ 10.17323/j.jcfr.2073-0438.17.1.2023.64-77](https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.64-77)



## Introduction

The conventional approach to default prediction implies using financial ratios as determinants of defaults. Since the late 1960s numerous researchers have demonstrated that financial ratios are good default predictors, starting with the famous paper of Edward Altman [1] and ending with some recent papers of both foreign [2] and Russian researchers [3; 4].

Over the course of these 60 years, default prediction using financial ratios has developed along with the advancement of statistical techniques, underlying it. Simple linear classification algorithms, like Multiple Discriminant Analysis [1], Logistic Regression [5–8] or Probit Regression [9; 10] are now partly substituted with more precise non-linear Machine Learning algorithms [11–17].

The set of financial ratios used as default predictors has also expanded. The researchers have added non-trivial predictors, such as the growth rate of income [18] or the standard deviation of stock returns [19]. Some researchers also prove that non-financial predictors can improve prediction accuracy [20–26]. However, there are still very few papers that deal with non-financial predictors of default in general and related to Russian firms in particular. One possible explanation of this fact could be the high predictive power of conventional default prediction models (based on financial ratios).

At the same time, using only financial ratios for default prediction seems to be inefficient in case of developing economies, and namely in case of the Russian service sector. It seems that the financial reporting of service firms in Russia does not always reflect the real condition of the business. First of all, some operations may be undisclosed, or there may be certain falsifications. Secondly, one firm may comprise several legal entities, and the managers are free to distribute revenues, expenditures, debt and capital between legal entities at will. These factors may make financial reporting biased and, hence, irrelevant to default prediction. Thus, the prediction accuracy may turn out to be low.

In this paper I compared the prediction accuracy of Logit Regression, K-Nearest Neighbors and Random Forest classification algorithms, trained on a set of Russian service firms, as well as on service firms from developed European markets. The algorithms were trained on the financial ratios of defaulted service firms, reported for the year preceding the year of default, and the financial ratios of non-defaulted firms. The firms from developed European markets were used as the control group. It was expected that the accuracy of prediction will be lower for Russian service firms, because of the likely bias in financial reporting, caused by shadow operations and business disaggregation, than for developed European markets' firms, which seem not to have the mentioned features. Hence, the purpose of this study is to estimate the potential default prediction accuracy for Russian service firms if only financial data is used as predictors and to compare it with that for developed European markets' firms. After performing such an analysis,

it would be possible to judge whether financial ratios can be used for predicting the default of Russian service firms.

In the next section I provide a review of literature related to default prediction, and subsequently explain why the service sector was selected for this analysis. In the Theoretical framework section I provide a more detailed explanation of why financial ratios do not seem to be reliable default predictors for Russian service firms, and in the Research methods section I describe the data and the algorithms used. Finally, I present and discuss the results of modelling in the “Results” section.

## Literature review

Default prediction for firms has existed for over 50 years, starting from the first credit risk model developed by W. Beaver [27]. In an attempt to increase prediction accuracy, it has been evolving in two major domains: methods and explanatory variables.

Firstly, following the development of statistical techniques and econometrics, the researchers started to use more advanced modelling techniques, starting with Edward Altman [1], who implemented Multiple Discriminant Analysis approach, proceeding with James Ohlson [5], who was probably the first to use Logistic Regression to create a default probability assessment model. Logistic Regression (Logit) and a similar algorithm – Probit Regression – were commonly used by the 20th century researchers and are still used nowadays [4; 8; 10; 17], mostly because of their simplicity, given that these are linear algorithms. However, the currently used Machine Learning algorithms seem to be the leading framework in default prediction studies.

There are many different Machine Learning algorithms that are used for default prediction purpose, however, based on the analyzed literature, the most popular are Artificial Neural Networks [14; 28] and Support Vector Machine [18; 25].

One of the contributions of this paper is the implementation of the Random Forest Algorithm as the underlying default prediction technique. This algorithm seems to be underused in default prediction studies, despite its high performance demonstrated by previous researchers [29; 30].

A separate area of research within default prediction is credit rating modelling [31; 32]. The models are based on financial data for corporations and macroeconomic data and is applicable mostly to public firms, because of the significant influence of market capitalization on the credit rating.

The second development vector for default prediction is expanding the set of explanatory variables – going beyond the use of only financial data. This development vector is relatively new, a “novel trend in this field” [21]. According to Altman [23], there was no research in this field for small and medium enterprises at all before 2010.

There are no restrictions on the use of any data available for analyzed firms to predict defaults, and the researchers

are starting to utilize these available data. The examples of such variables are indicators related to text published in news or disclosures of a firm (e.g. sentiment level or the use of certain words) [25; 26], as well as legal claim-related [21], corporate governance [20], CSR measures [22], and audit report (e.g. sentiment level, number of auditor's comments, etc.) indicators [24].

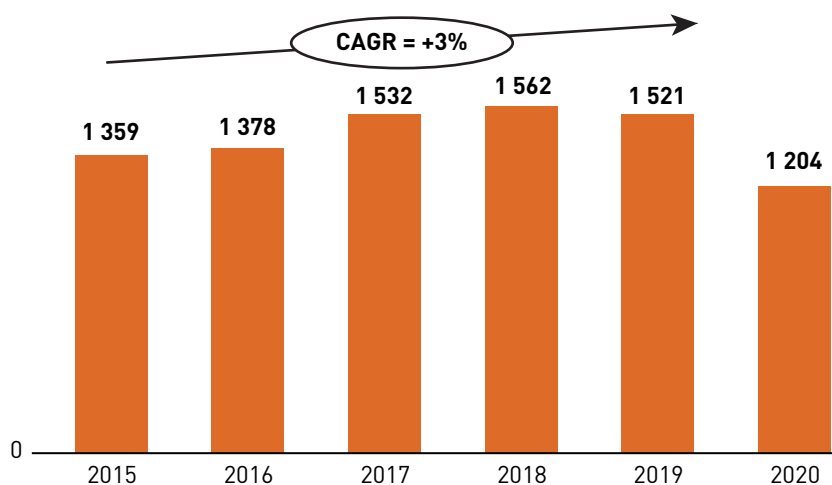
Based on the analyzed literature use of non-financial data does not seem to replace conventional approach (based on financial data), especially since there are few papers related to Russian firms. This fact can potentially be explained by the high accuracy of default prediction based on financial data. However, as it is demonstrated further in this paper,

the approach based on financial data may show poor performance in regard to Russian firms, and in this case the use of non-financial data may prove to be a good solution.

## Defaults in the Russian service sector

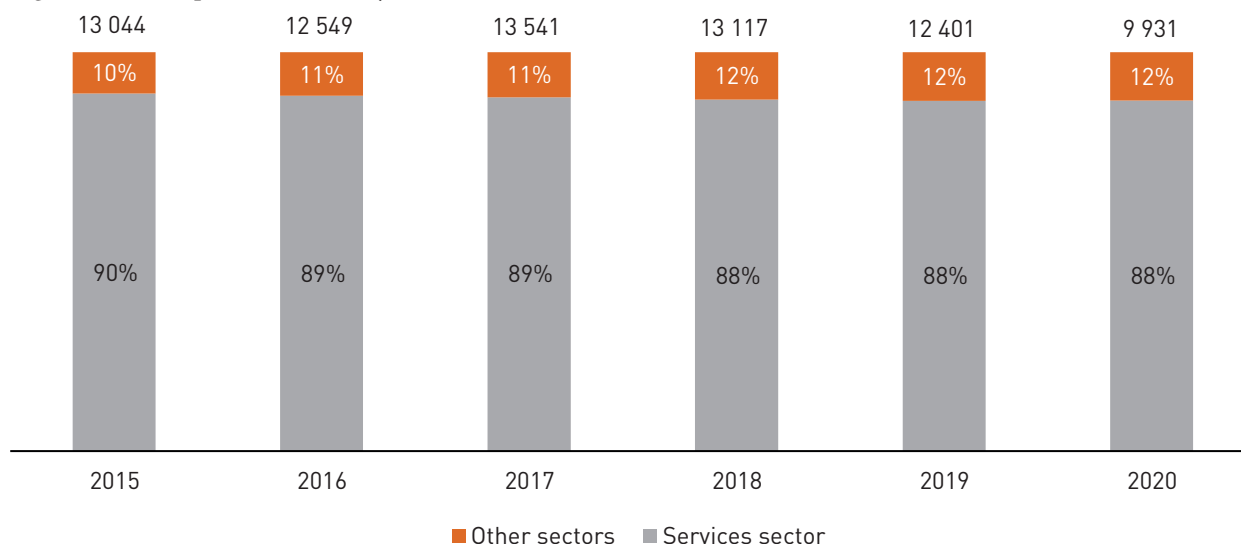
I chose the Russian service sector for this analysis because the need for accurate default prediction is especially relevant in this sector. First of all, in 2015–2020 the overall number of bankruptcies has decreased, while the share of service sector bankruptcies in the overall number of cases increased (see Figures 1 and 2).

**Figure 1.** Bankruptcies in the Russian service sector, 2015–2020 (number of cases)



Source: Fedresurs. URL: <https://fedresurs.ru/news/5343e0f4-bf32-4fef-b293-cc752e65f491> (accessed: 15.06.2021).

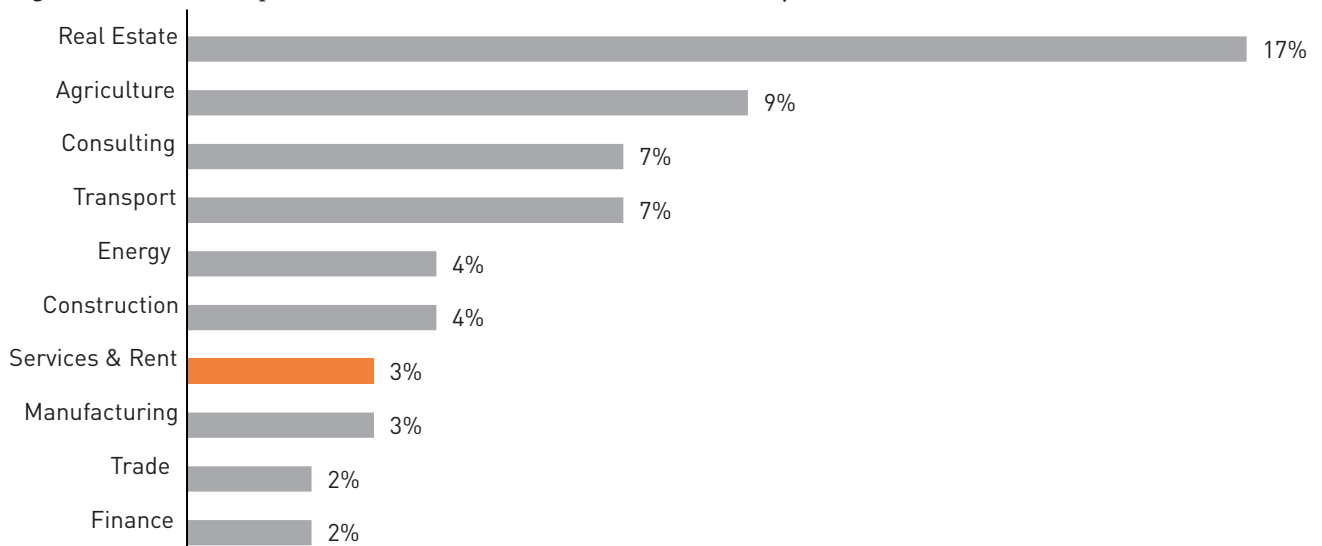
**Figure 2.** Bankruptcies structure by sector, 2015–2020 (% , number of cases)



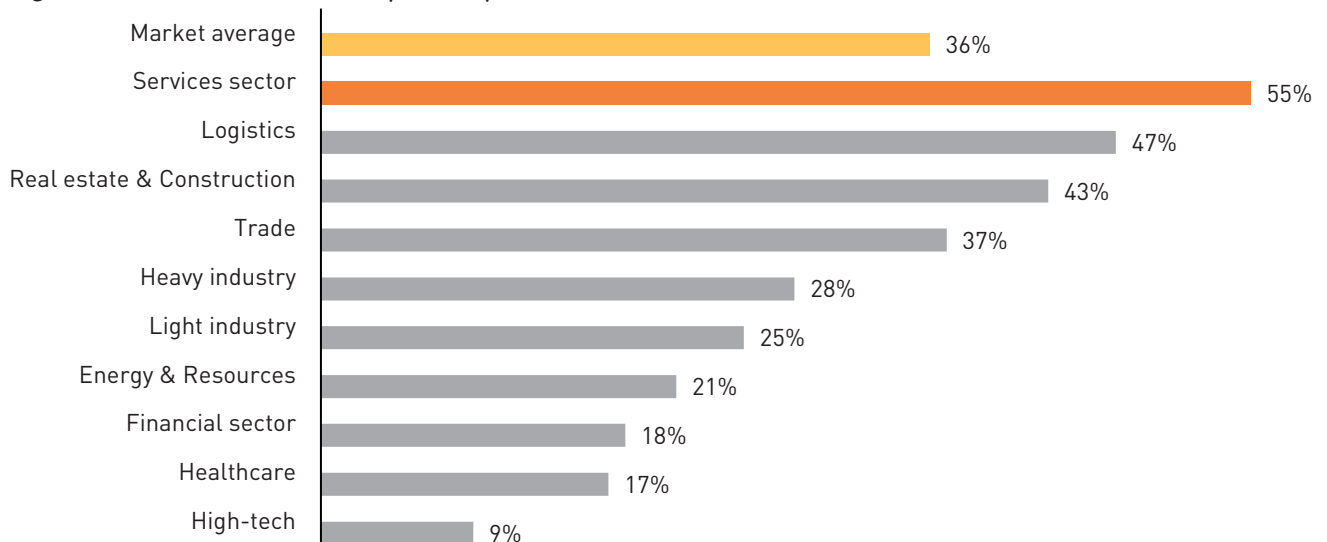
Source: Fedresurs. URL: <https://fedresurs.ru/news/5343e0f4-bf32-4fef-b293-cc752e65f491> (accessed: 15.06.2021).

Hereinafter, the year 2020 is not taken into account because of the bankruptcy moratorium in Russia due to COVID-19 pandemic. Secondly, the share of debts paid out to the creditors during default procedures in the service sector is

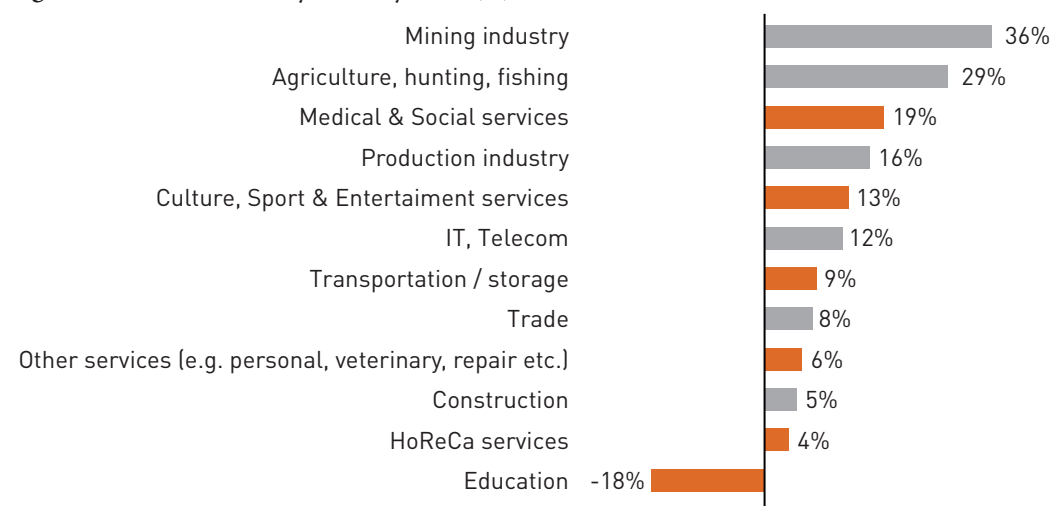
among the lowest across industries. In 2019 this ratio was only 3,4% (less than than the average of 4,7%) (Figure 3). It means that in the case of default the expected amount of debt repayment per 100 RUB borrowed is only 3,4 RUB.

**Figure 3.** Share of debt paid out in case of default in TOP-10 industries by number of default cases, 2019 (% of total debt)

Source: Fedresurs. URL: <https://fedresurs.ru/news/5343e0f4-bf32-4fef-b293-cc752e65f491> (accessed: 15.06.2021).

**Figure 4.** Share of firms with debt by industry, 2020 (%)

Source: Center for Strategic Development.

**Figure 5.** Return on sales by industry, 2021 (%)

Source: Rosstat. URL: <https://www.fedstat.ru/indicator/58261> (accessed: 17.03.2023).

Also, the firms in the service sector tend to have debts more often than those in any other industry. According to the research conducted by Centre for Strategic Development<sup>1</sup>, 55% of service firms have debts, while the market average is 36% (Figure 4). This may be an indicator of the higher credit risk of service sector industries compared with other industries.

The increasing number of defaults and the low rate of debt repayment in case of a default are driven by the specificities of the service sector. The sector consists of mostly B2C businesses, which means a high competition level, and therefore low margins. The average profitability of service sector is lower compared to other industries, like production, agriculture, or mining, or even negative (see Figure 5). This statement is less relevant for the medical services sector, but very relevant for such huge markets as HoReCa services and personal services (which include everyday services, i.e., repairs, hairdressing, etc.).

The last but not the least argument to focus on a specific sector of economy, like the service sector, is the gap in the research related to credit risk modelling, which is expressed in the lack of industry focus in such studies as described in [31]. This study aims to contribute to filling the gap for the service sector.

## Theoretical framework

The statement that the financial reporting of Russian service firms does not reflect the real condition of the firms is based on two main reasons:

### Business disaggregation (artificial separation) make the financial ratios biased

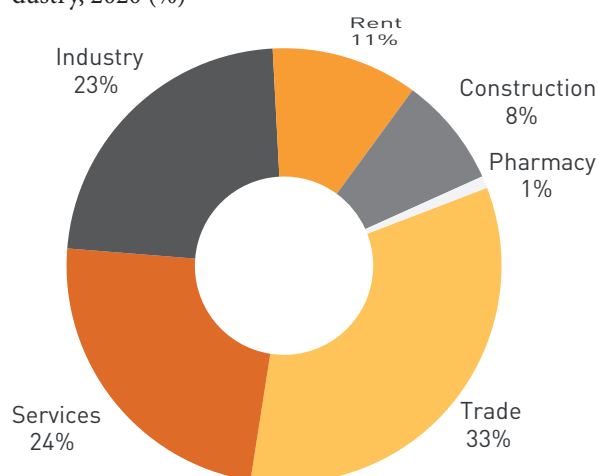
If a firm is divided into several legal entities, it means that it is necessary to obtain the consolidated financial reports in order to judge the condition of the entire business. On the one hand, it is not always possible to get the reports for a group of legal entities, on the other hand, some parts of a group can be presented as sole proprietors or legal entities that use the simplified taxation system and are not required to provide comprehensive reports. That is why one usually has to use data for one legal entity to analyze a firm, and it seems that this data may be biased.

The problem of business disaggregation is highly relevant for the Russian market. Small legal entities have an opportunity to reduce their tax burden using the simplified taxation system. That is why the owners often split their

business into several small entities, hence, reducing the tax burden [33]. The relevance of the business disaggregation problem is confirmed by the active prevention measures undertaken by the government. Since 2017, Federal Tax Service and the Investigative Committee of Russia have been actively pursuing a relevant crime detection policy, which includes continuous development and updates to disaggregation criteria [34].

The business disaggregation problem is relevant for every economic sector in Russia, including the service sector. According to a survey conducted by TaxCoach<sup>2</sup>, 24% of legal claims on business disaggregation in 2020 were related to service firms (Figure 6).

**Figure 6.** Legal claims on business disaggregation by industry, 2020 (%)



Source: TaxCoach.

### Shadow operations lead to bias in the financial ratios

In the Soviet period, there were no legal private firms in Russia that could provide services for the population. At the same time, government-backed entities did not provide certain everyday services. Thus, the needed services were provided by individuals, including repairs, transport, tutoring, etc. It was an illegal, but the sole way to get the needed services. The prolonged involvement in the shadow economy affected the concept of business culture in the minds of Russian citizens [35]. Moreover, the effect is still apparent.

According to the survey by The Forum for Research on Eastern Europe and Emerging Economies (FREE Network)<sup>3</sup>, the volume of the shadow economy in Russia is estimated to be almost 45% of GDP. The two major types

<sup>1</sup> Papchenkova, E. (2020, December 24). *Бизнес-климат России. Итоги 2020 года. Банкротство.* (Business climate in Russia. 2020 year summary. Bankruptcy). URL: <https://www.youtube.com/watch?v=cF98nMjWSbs> (accessed: 29.05.2021).

<sup>2</sup> TaxCoach. (2021). *Остаться в живых. Гид по обвинениям в искусственном дроблении бизнеса на основе анализа 450 арбитражных дел* (Stay alive. A guide for legal claims for artificial business separation, based on 450 legal proceedings). URL: [https://www.taxcoach.ru/taxbook/droblenie\\_biznesa](https://www.taxcoach.ru/taxbook/droblenie_biznesa) (accessed: 01 June 2021).

<sup>3</sup> Putniņš, T., & Sauka, A. (2020). *The Shadow Economy in Russia: New Estimates and Comparisons with Nearby Countries.* URL: <https://freepolicybriefs.org/2020/03/16/shadow-economy-russia/> (accessed: 03.06.2021).

of shadow operations are the underreporting of profits and “envelope wages” (according to Tatiana Golikova<sup>4</sup>, Deputy Prime Minister of the Russian Federation, about 15 millions of Russian citizens receive wages off the books). According to Russian Longitudinal Monitoring Survey (HSE) 2020<sup>5</sup>, 16% of Russian citizens confess being paid off the books, and 51% of them receive their entire salary unofficially.

If a firm is involved in some type of shadow operations, the official financial reporting for a legal entity will be biased: the revenues may be underreported, the costs may be exaggerated etc.

Additional indirect evidence of biased financial reporting by Russian firms is offered by the weak auditing and accounting standards. According to The World Bank Global Competitiveness Index data<sup>6</sup>, Russian Federation is in the 100th position out of 137 countries by the strength of auditing and accounting standards (4 out of 7 points earned for the question “In your country, how strong are financial auditing and reporting standards? (1 = extremely weak; 7 = extremely strong)).

Thus, these factors lead us to believe that the available financial ratios of Russian services firms may be biased, hence, use of only financial information is not sufficient to assess the credit risk in case of Russian service firms.

## Research methods

### Data description

It is necessary to specify the industries I consider to be parts of the service sector, because there is no single definition of it. According to *Great Russian Encyclopedia*<sup>7</sup>, the service sector includes cultural, educational and domestic services. Russian Federal State Statistics Service<sup>8</sup> identifies postal, telecommunication, housing and utilities, medical and care, tourism, educational, cultural and legal services to be part of public service sector. In this study, I worked with firms from the following industries, which are definitely elements of the service sector:

- Tourism, Accommodation and Passenger Transportation Services;
- Dining & Catering;
- Education;
- Medical & Social Services;
- Culture, Sport & Entertainment Services;
- Other services (personal services, veterinary services, repair services).

The OKVED-2 classification was used to select Russian firms to be included in the analysis, and the NACE Classification was used to choose the European firms. The number of firms by service category is provided in Appendix 1.

I prepared two datasets. The first dataset contains information for Russian service firms, which faced financial failure from 2017 to 2020. The year when the creditor sent out the notice of intent to file an application for default, was used to identify the year of the financial failure. The data was collected from the SPARK-Interfax database,<sup>9</sup> and the dataset consists of 202 failed firms. Each of these firms is paired with a “healthy” one – a firm that has not defaulted. The matching criteria is the value of total firm assets. This matching criteria is commonly used by the researchers [8].

The dependent variable is a dummy variable: 1 stands for defaulted firms, 0 for “healthy” ones. The independent variables are the financial ratios of the firms (calculated for the year preceding the financial failure for defaulted firms).

The most popular financial ratios used by the researchers to create default prediction models, are the following:

- Turnover ratios;
- Profitability ratios;
- Liquidity ratios;
- Assets, equity or debt structure ratios, debt coverage ratios [36].

It turned to be impossible to include debt coverage ratios, because the value of interest payments is not available for the majority of the Russian firms in the dataset. The final list of independent variables used is provided in Table 1.

**Table 1.** List of independent variables

Turnover ratios	Net assets turnover
	Stock turnover
	Collection period
	Credit period
Profitability ratios	Profit margin
	ROA
Liquidity ratios	Current ratio
	Liquidity ratio
Assets, equity or debt structure ratios	Shareholders' funds / Total Assets

Source: Prepared by the author.

<sup>4</sup> Golikova, T. (2019, June). *Interview with Tatiana Golikova for IZVESTIA*. URL: <https://iz.ru/886870/elena-loriia-elena-likhomanova/deistvie-sotckontrakta-ne-dolzno-ogranichivatsia-mesiatcem-ili-godom> (accessed: 03.06.2021).

<sup>5</sup> Russian Longitudinal Monitoring Survey (HSE) 2020. URL: <https://www.hse.ru/rlms/spss> (accessed: 19.02.2022).

<sup>6</sup> Competitiveness Rankings. (2017). Global Competitiveness Index 2017-2018. URL: <http://wef.ch/2wcVUt8> (accessed 21.09.2021).

<sup>7</sup> Big Russian Encyclopedia. URL: <https://bigenc.ru/economics/text/3546082> (accessed: 10.06.2021).

<sup>8</sup> Rosstat. URL: <https://rosstat.gov.ru> (accessed: 10.06.2021).

<sup>9</sup> SPARK Interfax. URL: <https://spark-interfax.ru> (accessed: 12.06.2021).

**Table 2.** Descriptive statistics of variables for the two datasets

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>European data, defaults</b>					
Profit margin [%]	145	-11.382	21.112	-97.23	48.447
ROA using Net income [%]	141	-13.629	20.021	-89.8	28.26
Net assets turnover [X]	112	9.984	22.4	.042	183.346
Stock turnover [X]	104	90.301	138.37	2.66	924.534
Collection period [days]	148	51.385	85.619	0	688.013
Credit period [days]	149	61.669	92.285	0	654.728
Current ratio [X]	151	.833	1.069	.005	12.263
Liquidity ratio [X]	148	.755	1.78	.005	12.263
Shareholders' funds / Total Assets [X]	152	-.117	.921	-9.207	.899
<b>European data, non-defaults</b>					
Profit margin [%]	152	4.194	15.772	-83.884	94.162
ROA using Net income [%]	152	5.459	9.087	-20.883	35.16
Net assets turnover [X]	152	5.325	8.147	.06	70.2
Stock turnover [X]	93	122.626	146.115	1.87	845.75
Collection period [days]	152	29.849	36.799	0	213.023
Credit period [days]	152	18.533	19.88	0	108.371
Current ratio [X]	152	2.228	7.108	.014	80.151
Liquidity ratio [X]	152	2.104	7.1	.014	80.151
Shareholders' funds / Total Assets [X]	152	.36	.263	-.607	.987
<b>Russian data, defaults</b>					
Profit margin [%]	201	-937.1	8705.9	-102 815-1	100
ROA using Net income [%]	202	-462.1	5971	-84837.1	1907.9
Net assets turnover [X]	190	7.961	55.255	-352.55	400.299
Stock turnover [X]	176	372.208	1478.422	0	14753.5
Collection period [days]	199	6600.915	50 664.473	1	579 366
Credit period [days]	195	26 474.502	330 690.63	2.57	4 618 755.6
Current ratio [X]	200	5.654	19.806	.005	180.6
Liquidity ratio [X]	200	4.635	15.212	.003	122.56
Shareholders' funds / Total Assets [X]	200	-5.684	53.369	-750.114	1
<b>Russian data, non-defaults</b>					
Profit margin [%]	202	.051	.302	-2.902	100

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA using Net income [%]	200	-.182	10.05	-132.3	4765.2
Net assets turnover [X]	184	304.016	1554.744	-620.513	16 101/7
Stock turnover [X]	172	1042.513	9181.763	.2	117 718
Collection period [days]	190	182.779	1472.473	1	20 240
Credit period [days]	194	1436.098	18 422.058	.42	256 678.65
Current ratio [X]	202	4.169	11.505	.012	140.883
Liquidity ratio [X]	200	3.361	11.143	.007	140.883
Shareholders' funds / Total Assets [X]	202	-1.259	9.951	-81.2	.993

Source: Prepared by the author.

The second dataset is the control group. It contains the same information, but for service firms from the developed European Union economies (152 defaulted and 152 “healthy” firms). The date of the start of insolvency proceedings was used to identify the year of the financial failure. The data was collected from the Amadeus database<sup>10</sup>.

I chose firms from the developed European Union countries as a control group, because the problems of shadow operations and business disaggregation are far less relevant for them. While the shadow market volume in the Emerging & Developing European countries is estimated to be around 27%, the same ratio for the European Union is two times lower (only about 14%)<sup>11</sup>. The countries with the lowest shadow economy ratios are: Austria, Luxembourg, Great Britain, Netherlands, France, Ireland, Island, Germany, Denmark, Sweden, Slovakia, Finland, Spain, Norway<sup>12</sup>. Firms from these countries are used to form the control dataset.

As for business disaggregation, it seems that there are no statistics for European Union, but one still can state that this problem is less relevant for the European market. Given that business disaggregation is a tool for reducing the tax burden, the attitude of the business community to tax rates can be a proxy for the level of disaggregation. According to the World Bank data<sup>13</sup>, 22.6% of Russian firms consider tax rates the biggest obstacle for their business. The same indicator for Austria is only 20.6%, Denmark – 6.4%, Luxembourg – 5.7%, Netherlands – 7.4%, Ireland – 13.6%, Sweden – 13.4%, Slovakia – 17.7%, Finland – 9.5%. There is no data

for other European countries on the list, but presumably they are less concerned with the business disaggregation problem, being at a higher “development level.” GDP per capita is used as a proxy for the countries’ “development level.” GDP per capita in the rest of the countries with no data for attitude to taxes is much higher than in Russia,<sup>14</sup>

The variables’ descriptive statistics for the two datasets are provided in Table 2. One may notice that Russian financial reporting data has some specificities, e.g. extremely low profitability ratios or extremely high collection and credit periods for defaults. These specificities may be also an indicator of biased financial reporting. A decision was made not to treat the firms with extreme values as outliers, because these extreme values are taken from real financial reporting (the reporting for these firms was checked manually).

### Machine Learning algorithms

I used three Machine Learning algorithms to train the data: Logistic Regression, K-Nearest-Neighbors (KNN) and Random Forest. Logistic Regression is a linear classification algorithm that is often used for the purpose of default prediction [5–8]. One of the advantages of Logistic Regression is the ability to interpret the contribution of every independent variable to the prediction. KNN was chosen as probably the most simple machine learning algorithm that is frequently used in studies related to default prediction [37]. The Random Forest classifier was chosen as one of the most powerful algorithms used for default prediction and scoring, as shown in the previous studies [29; 30].

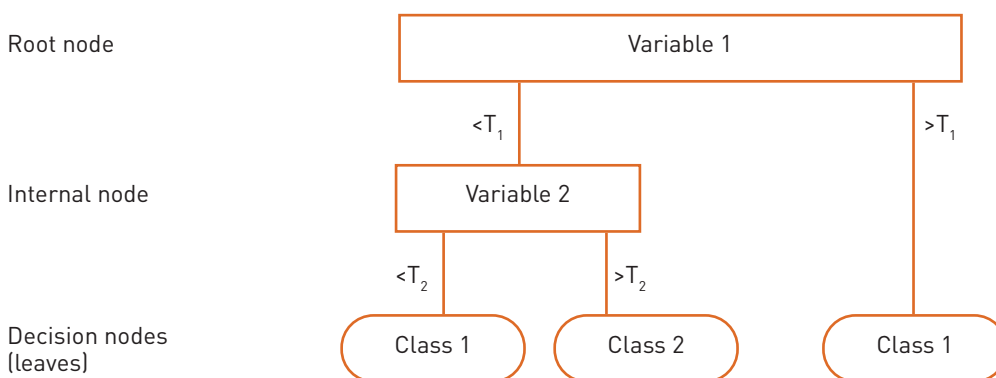
<sup>10</sup> Amadeus Database. (2021). URL: <https://amadeus.bvdinfo.com> (accessed: 15.07.2021).

<sup>11</sup> Boumans, D., & Schneider, F. (2019). Ifo World Economic Survey (No. 18; p. 2)]. Leibniz Institute for Economic Research at the University of Munich. URL: [https://www.ifo.de/DocDL/WES\\_4\\_19\\_0.pdf](https://www.ifo.de/DocDL/WES_4_19_0.pdf) (accessed: 08.08.2021).

<sup>12</sup> Kelmanson, B., Kirabaeva, K., Medina, L., Mircheva, B., & Weiss, J. (2019). Explaining the Shadow Economy in Europe: Size, Causes and Policy Options [IMF Working Paper]. International Monetary Fund. URL: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjHiM3o4dvzAhVFPpIsKHaXvDLoQFnoECAGQAQ&url=https%3A%2F%2Fwww.imf.org%2F-%2Fmedia%2FFiles%2FPublications%2FWP%2F2019%2FWpiea2019278-print-pdf&usq=AOvVaw3112V7M9BqTYQptaO-Xh1z> (accessed: 10.08.2021).

<sup>13</sup> Enterprise Surveys (The World Bank Data). URL: <https://www.enterprisesurveys.org/en/custom-query> (accessed: 15.09.2021).

<sup>14</sup> GDP (The World Bank Data). URL: <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD> (accessed: 15.09.2021).

**Figure 7.** An example of a simple decision tree (CART)

Source: Prepared by the author.

Logistic Regression is an algorithm that is similar to ordinary linear regression. The difference is that the predicted dependent variable can vary only from 0 to 1, while in the case of ordinary linear regression it can assume any values. For making predictions we use the logistic function (logistic curve):

$$P(x) = \frac{e^{B_0 + B_1 X_1 + \dots + B_n X_n}}{1 + e^{B_0 + B_1 X_1 + \dots + B_n X_n}}$$

$P(x)$  in the case of this study is the estimated probability of default and  $B_0 - B_n$  are the linear coefficients for the independent variables (financial ratios). To transform the regression into a classification algorithm, I set the cutoff probability value (50% in this case). The observations are classified into the default group if the estimated probability is higher than 50%.

Logistic Regression is fitted using the maximum likelihood method. The optimal coefficients are chosen in order to maximize the likelihood function:

$$LF = \prod \left( P(x_i)^{y_i} \cdot (1 - P(x_i))^{1 - y_i} \right), i \in (1; n).$$

which is the product of probabilities, estimated for defaults, and multiplied by the same for non-defaults [38].

The L1 type of regularization is used to limit the number of variables. It means that the sum of absolute values of coefficients is added to the minimized function

The K-Nearest Neighbors classifier is one of the simplest classification algorithms. The classification is based on the classes of several (k) most similar firms from the training set. The observation is classified on the basis of a majority vote. The classification procedure consists of three steps:

- Choosing the number of “neighbors”.

The number of “neighbors” should not be very small (may lead to low accuracy) or very high (most of the observations in the test set will be classified as one class, which has more representatives in the training set). I used the square root of the number of observations as k, following the ap-

proach recognized by researchers [39].

- Assessing distances between training and test data and identifying the “neighbors”.

I use Euclidian distance to choose the nearest “neighbors”, calculating it as the following:

$$\sqrt{\sum \left( \frac{\text{Value of variable } i \text{ for the observation in the test set} - \text{Value of variable } i \text{ for the observation in the train set}}{\text{Total number of observations}} \right)^2}$$

- Classifying the test observation on a majority vote basis, in other words, assigning a class based on the most popular class among the “neighbors”<sup>15</sup>.

Due to the fact that Euclidian distance is used, data needs to be normalized before modelling.

The Random Forest classifier is an ensemble Machine Learning algorithm – an ensemble of Classification and Regression Trees (CART). An illustration of a simple CART is shown in Figure 7.

While the tree is trained, the training data is split into 2 subsamples on every node. The split is made based on a particular variable’s value. The Gini index is used to choose the variables (Variable 1, Variable 2 on Figure 7) and the threshold for splitting ( $T_1$ ,  $T_2$  on Figure 7) – the core idea is to minimize this index. The Gini Index reflects the inverse accuracy of splitting:

$$\begin{aligned} \text{Gini index} &= \frac{\text{Number of observations in } L}{\text{Total number of observations}} \\ &\cdot \left( 1 - \sum \left( \frac{\text{Num. of observations of class } i \text{ in } L}{\text{Total number of observations in } L} \right) \right) + \\ &+ \frac{\text{Number of observations in } R}{\text{Total number of observations}} \\ &\cdot \left( 1 - \sum \left( \frac{\text{Num. of observations of class } i \text{ in } R}{\text{Total number of observations in } R} \right) \right) \end{aligned}$$

<sup>15</sup> Laszlo, K. (2008). K Nearest Neighbors algorithm (kNN). Special Course in Computer and Information Science. URL: <http://www.lkozma.net/knn2.pdf> (accessed: 15.08.2021).



L and R refer to subsample 1 and subsample 2 (left and right), i refers to the class (1 – defaulted, 0 – “healthy”) [40]. “Forest” stands for a combination of simple decision trees, “Random” – for the fact that each tree is trained on a randomly chosen subsample from the training sample and the “splitting” variables are chosen randomly. The subsamples are formed using bootstrap. The idea underlying this method is that repeated samples are taken from the initial training sample. For every tree, the variables (Variable 1 and Variable 2 on Figure 7) are chosen from a random list of k variables, taken from the whole list of determinants. Thanks to this, the trees are not similar to each other<sup>16</sup>.

**Table 3.** Fractions of missing values in the datasets (%)

	Defaulted		Non-defaulted	
	Russian data	European data	Russian data	European data
Net assets turnover	6	26	9	0
Stock turnover	13	32	15	39
Collection period	1	3	6	0
Credit period	3	2	4	0
Profit margin	0	5	0	0
ROA	0	7	1	0
Current ratio	1	1	0	0
Liquidity ratio	1	3	1	0
Shareholders' funds / Total Assets	1	0	0	0

Source: Prepared by the author.

I divided each of the samples (Russian and European firms) into training and test sets. Subsequently, I trained the classification algorithms on the training sets, then applying the trained algorithms to test sets and calculated prediction accuracy. To make sure that the result is not an outlier that occurred because of specific train-test dataset split, I made 100 random train-test splits for every dataset and then trained the algorithms on every training set and calculated the accuracy on every corresponding test set.

The main hypothesis is that the mean accuracy for Russian service firms is going to be lower than for European service firms. This hypothesis was tested using the Mann-Witney test.

## Results

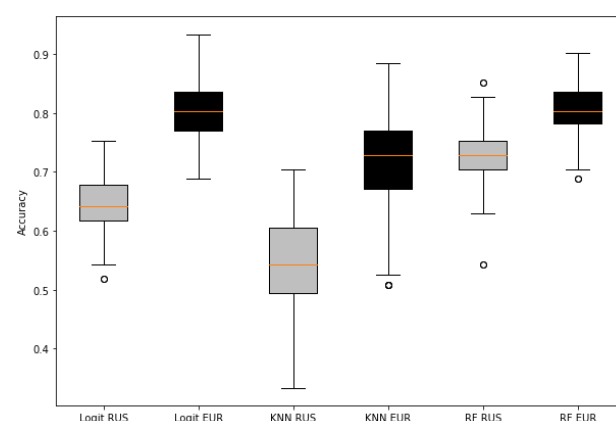
The results demonstrate that prediction accuracy is much lower for Russian firms. The results for the three classification algorithms are provided in Figure 8.

It is necessary to limit the number of trees and internal nodes in every tree. It was decided to train 100 trees for each training set and set the maximum number of split layers at 2.

## Data preparation and modelling

The datasets contained some missing values. To get rid of them I imputed the data with mean values of the corresponding variables. Table 3 shows the fractions of missing values for every variable in two datasets. There are some differences, but it seems that the quality of the collected data is similar for Russian and European firms.

**Figure 8.** Classification results for Logit, KNN and Random Forest algorithms

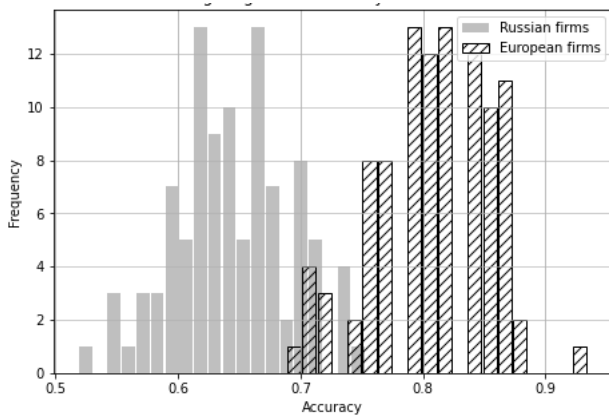


Source: Prepared by the author.

<sup>16</sup> Steorts, R. (2014). Bagging and Random Forests. URL: [http://www2.stat.duke.edu/~rcs46/lectures\\_2015/random-forest/slides\\_lecture15.pdf](http://www2.stat.duke.edu/~rcs46/lectures_2015/random-forest/slides_lecture15.pdf) (accessed: 15.08.2021).

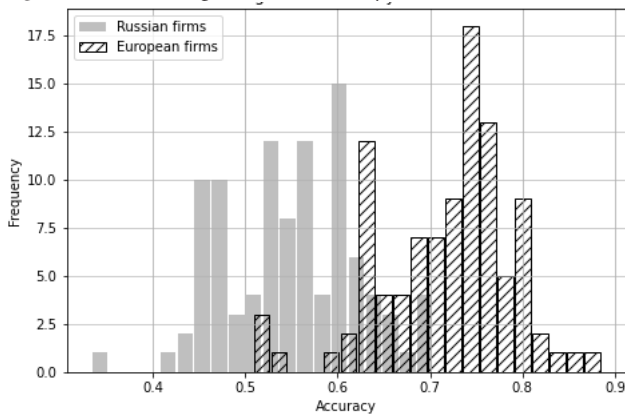
Firstly, I applied Logistic Regression to the datasets. The mean accuracy of classification is 64.4% for Russian service firms and 80.7% for the firms from the European dataset. Figure 9 shows the distribution of Logit algorithm accuracy calculated on the randomly formed test sets for Russian and European service firms. The distribution is visually close to normal in case of both Russian data and European data, but the Shapiro-Wilk normality test result suggests that the accuracies for European firms are not distributed normally (the p-values for Russian and European sets are 0.386 and 0.04 respectively). For instance, the Mann-Witney non-parametric test was used instead of the conventional Student test to test whether the mean accuracies differ. The Mann-Witney test p-value is close to zero ( $1.35 \cdot 10^{-33}$ ), which means that there is a very low probability of getting such a test statistic if the mean accuracy is the same for Russian and European firms.

**Figure 9.** Logit algorithm accuracy distribution



Source: Prepared by the author.

**Figure 10.** KNN algorithm accuracy distribution



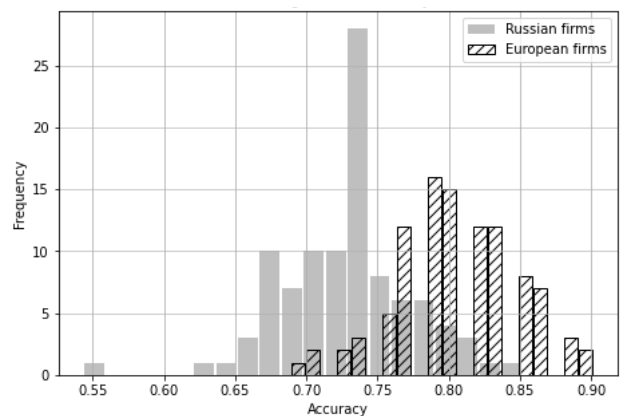
Source: Prepared by the author.

KNN algorithm accuracy is lower in both cases: 54.8% for

Russian firms and 71.7% for European firms. Classification accuracy can be considered insufficient for European firms, but it is still significantly higher than the mean accuracy for Russian firms. Figure 10 shows the distribution of KNN algorithm accuracy, calculated on randomly formed test sets for Russian and European service firms. Accuracy distribution is normal in the case of Russian firms, but not in the case of European firms (Shapiro-Wilk test p-values are 0.389 and 0.008 respectively), that is why the Mann-Witney test was used for estimating the significance of the difference in mean accuracies (Figure 10). The p-value of the Mann-Witney test is close to zero ( $4.40 \cdot 10^{-28}$ ), which means that there is a very low probability of getting such a value if the mean accuracy is the same for Russian and European firms.

The Random Forest algorithm turned to be the most accurate classifier for both Russian and European firms (Figure 11). The mean accuracy of classification is 72.7% and 80.6% for Russian and European service firms, respectively. Figure 11 shows the distribution of Random Forest algorithm accuracy, calculated on randomly formed test sets for Russian and European service firms. The Shapiro-Wilk test results suggest that accuracy distribution is not normal for Russian firms (p-values are 0.019 for Russian firms and 0.18 for European firms), hence I used the Mann-Witney test to assess the significance of the difference in mean accuracies. The p-value of the test is close to zero ( $6.14 \cdot 10^{-23}$ ), which means that there is a very low probability of getting such a value if the mean accuracy is the same for Russian and European firms.

**Figure 11.** Random Forest algorithm accuracy distribution



Source: Prepared by the author.

It can be also useful to consider Type I and II errors along with overall accuracy. Table 4 provides the means of Type I and Type II errors for Russian and European datasets according to the algorithm used. The outcomes obtained through overall accuracy analysis are consistent here: both Type I and II errors are bigger in case of Russian service firms, compared with European service firms.

**Table 4.** Sensitivity, specificity, and Type I & II errors of classification (%)

		Sensitivity	Type I error	Specificity	Type II error
Logit	Russian dataset	72.3	27.7	57.2	42.8
	European dataset	74.9	25.1	86.3	13.7
KNN	Russian dataset	60.5	39.5	51.0	49.0
	European dataset	76.7	23.3	68.7	31.3
Random Forest	Russian dataset	73.4	26.6	72.5	27.5
	European dataset	76.6	23.4	84.6	15.4
Average	Russian dataset	68.7	31.3	60.2	39.8
	European dataset	76.1	23.9	79.9	20.1

Source: Prepared by the author.

## Conclusions

Given such results, we can state that default prediction based on financial data is less effective in the case of Russian service firms than in the case of service firms from developed European markets. The accuracy for Russian firms is 55–73%, depending on the algorithm, compared to 72–81% accuracy for the firms from developed European markets. The results for the European dataset in terms of overall accuracy are consistent with the results of previous research [23], while the results for Russian dataset are far behind.

Thus, in case of Russian firms one should expect a higher probability of error while predicting default based on financial indicators. In other words, the results suggest that the financial ratios are worse indicators of future financial failures for Russian firms than for firms from developed markets.

The financial reporting of Russian legal entities does not reflect the real condition of firms due to two possible reasons discussed in this paper: business disaggregation and undisclosed operations. Thus, it may be beneficial to use non-financial factors, which can act as proxies for financial ratios, to improve the accuracy of classification, which can be a starting point for further research related to default prediction in Russia.

Moreover, I believe that the findings of this paper can be generalized in a sense that the conventional approach to default prediction may be inapplicable not only to Russian service firms, but for firms in other developing economies, which are facing the problem of biased financial reporting.

An additional outcome of this study is the comparison of classification algorithms' predictive power. The Random Forest algorithm demonstrates the best performance, supporting the findings of previous research [29; 30]. Despite being a linear classification algorithm, the Logistic Regression classifier can also be used for default prediction (81% accuracy on average for European firms). However, the K-Nearest-Neighbors algorithm seems to be the least accurate (only 72% accuracy on average for European firms and only 55% on average for Russian firms, which means that the predictive power of the algorithm for Russian firms is close to zero).

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## Appendix 1

### Number of firms in the datasets by services category

Services category	European data		Russian data	
	Number of firms	Fraction of firms, %	Number of firms	Fraction of firms, %
Dining & Catering	91	30	172	43
Other services	52	17	45	11
Medical & Social services	49	16	58	14
Tourism, accomodation and passenger transportation services	72	24	53	13
Culture, Sport & Entertainment services	21	7	66	16
Education	19	6	10	2

The article was submitted 25.12.2022; approved after reviewing 23.01.2023; accepted for publication 20.02.2023.

DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.78-89>

JEL classification: G30, G41



# CEO's Education Level and Investments in R&D

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## Abstract

The paper evaluates the influence of a CEO's education level and their experience on the amount invested in R&D in the pharmaceutical industry. The sample consists of 270 high-tech pharmaceutical companies from the S&P BMI index in 1999–2018 from 23 countries, both developed and emerging. The pharmaceutical industry is of particular interest since the projects in this sphere require specialized education to understand and manage business processes. Therefore, the investment payback period is long. As a result, there is a high rate of intangible assets in pharmaceuticals compared to other sectors.

At the first glance, according to the results of regression analysis, a degree in business, finance, management and economics has no significant impact on investments. However, education in a specific sphere, i.e., physics, chemistry, biology, or mathematics, has a significant positive impact on R&D expenses. We can see a similar effect for CEOs with two or more degrees in different fields. These results are in line with the findings of previous studies regarding CEO's education.

At the next stage, a CEO's educational level and major are analyzed simultaneously. A degree obtained in an industry-specific field or a degree supplemented by a degree in finance or management education has a positive impact on R&D expenses, while a standalone financial degree, on the contrary, has a negative effect.

Thus, this study contributes to academic literature by introducing the concept that to get unbiased results in similar studies we should account not only for the degree, but also for the major. In the practical sphere, the results may be useful for those choosing the educational track on their career path to a CEO position, as well as for HRs, boards of directors, and other stakeholders who are making a decision on CEO turnover. Moreover, the results provide insights that could be useful for market analysts' and investors' predictive models.

**Keywords:** CEO, CEO's education, R&D, investments, MBA, PhD, management**For citation:** Khmeleva, P. CEO's Education Level and Investments in R&D. *Journal of Corporate Finance Research*. 2023; 17(1): 78-89. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.78-89>

## Introduction

A CEO's personality, in particular the observed characteristics and the decisions made by them personally (stock buyback/purchase, interviews, etc.) are often used by researchers to explain internal corporate decisions. Education as an observed characteristic allows not just to evaluate the cognitive capacities of a person, but is also used as a variable capable of explaining risk attitude. In these cases, the primary emphasis is placed not so much upon the educational level [1–5], as on the major [6–7]. For instance, C. Yang et al. [8] used the Chinese market as an example to demonstrate how CEOs' financial education decreased corporate innovative activity by 17.5%, explaining it by a lower proneness of CEOs with a financial degree to make risky decisions. At the same time, some authors assert that neither the education level nor the major is of importance, while the quality and status of the CEO's higher education institution prove essential [9].

Based on the current information about CEOs of pharmaceutical companies with the highest revenues (top 50), one may conclude that business has no prevailing opinion concerning CEO's education, which ranges from incomplete higher education to doctoral degrees in medical sciences. The prevalent education is an MBA degree followed by a Doctor of Science, Doctor of Medicine and Doctor of Law. As the CEO vacancy market grows, the issue of the optimal characteristics of candidates for this position becomes increasingly relevant. Thus, while it is common to assign specialists in a particular sphere and/or those who have experience in the company to this position, the idea of the need for a degree in management is gaining popularity. It allows to direct the team instead of delving into technical details, which often leads to missing the company's primary objectives – building a successful team and establishing effective teamwork [10]. At the same time, the issue of choosing the optimal education of a CEO (degree, major and their combination) that influences their behaviour patterns and decision-making models remains undetermined for the pharmaceutical sector.

On the basis of the conclusions made in previous studies, we start our analysis with a separate study of the educational level and major, verifying the hypotheses of the previous studies, and subsequently creating a complex indicator that takes into consideration both aspects of education: its level and major.

## Literature Review

Modern economic science is increasingly shifting away from the reasonable individual paradigm, blurring the boundaries of its subjects which allow its models to be augmented with increasingly more parameters that may be more characteristic of sociological and psychological sciences than of conventional economics with strict mathematical models. Behavioural economics and finance, which were hardly heard of half a century ago, have already gained their place among scientific disciplines, and are strengthening their position in the programs offered

by the leading universities and heralding a new epoch in economic theory with new Nobel Prize winners who are researching this cross-disciplinary subject.

Such changes were inevitable. As the amount of data available for analysis increased and technical facilities for its processing improved, the issues of model residuals became more obvious, requiring a more detailed analysis of the phenomena that used to be explained by "culture" and other notions previously undefined, let alone quantified by the science of economics. Apart from that, explicit contradictions were revealed with the fundamental decision-making model – a reasonable individual relying on a clearly defined utility function, who always evaluates all available information accurately in order to achieve the only correct resolution. Analysis of investors' behaviour in the financial market, decisions of top managers and boards of directors on risky investments and many other things finally proved that non-inclusion in the model of human "irrationality" in all its multiplicity provides the results that alienate us from real life.

In management and finance, the CEO's personality is often the main explanation for the decisions made by the company. Their experience, preferences, skills and specific approaches to decision-making influence the attitude to risk within the business, thus, exerting impact on the amount and quality of investments made by the company, among other things [11].

Education is often added to the analysis as a variable that helps to assess a CEO's human capital and risk proneness. Apart from an expansion of knowledge, which indisputably influences the capability and desire to consider and accept new ideas for development, in the researchers' opinion one of its aspects, namely, the major, may have an impact on the attitude to decision-making [12].

The increasing popularity of adding a CEO's education to analysis is explained by a relative availability of data (unlike special behavioural characteristics and other factors measured by means of direct interviews, educational data is often available on corporate websites and in reports), the possibility of evaluation and comparison of the educational level and higher education institutions' rank, as well as by the possibility of widespread use.

The upper echelon theory presumes that a CEO's actions are conditioned by their limited rationality. Thus, a well-educated CEO is more likely to monitor market trends and invest in innovation development, while CEOs with a narrow area of expertise with vast experience prefer more conservative way of enhancing efficiency of the already functioning processes [3; 11; 13].

## CEO's Education and Risk Attitude

What is the CEO's role in corporate decision-making? We will try to answer this question based on the results of previous studies.

Apart from the apparent role in the transfer of knowledge and fundamental skill formation, education plays an important role in creating the thinking pattern of future can-

didates for the CEO's position. The selected education type may assist the CEO in the future to get a grasp on the details of a business and to mitigate the potential inefficiency in decision-making caused by other factors, as well as lead to the selection of non-optimum strategies, i.e., when the obtained knowledge stimulates a focus on only one part of the issue (technical or commercial), overlooking the other part. Therefore, the issue of a CEO's education provokes a particular interest of researchers, entailing the optimal choice of a major, or a possible combination of majors and the role of the degree in the future work in a particular business sphere.

Recent research by S.N. Kaplan and M. Sorensen [14] dedicated to study of selection of CEO candidates showed that interviewers considered candidates with an MBA degree to be less attractive and more prone to risk. A.J. Daboub et al. [15] also indicate that a business degree (MBA, business schools) causes a decline in moral values, making the graduates more inclined to pursue personal goals, which often results in fraud and illegal activity. M. Bertrand and A. Schoar [16] in their research also arrive at the conclusion that an MBA degree forecasts a more "aggressive" CEO's behaviour.

However, the paper by S.N. Kaplan and M. Sorensen [14] emphasizes that appointed CEOs with an MBA degree are more talented and more oriented to the strategic result. At the same time, research conducted by T. King et al. [6] showed that if there was a certain contract and incentive format, CEOs with a management degree managed banking companies more efficiently. Additionally, A.Yu. Manyushis [10] states that a degree in management is mandatory for companies' heads because an industry-specific profession and experience does not make up for the absence of people management and decision-making skills.

On the basis of conclusions made in previous studies, we presume that a CEO's MBA degree leads a director to choose a riskier strategy that is also more personally rewarding. On the other hand, this may cause a decrease in the amount of investment in development due to the pursuit of short-term goals in order to obtain a greater personal benefit i.e., increased premiums and improved reputation in the market. This is in line with the results by S. Bhagat et al. [17], wherein one of such results shows a positive influence of hiring a CEO with an MBA in the short term and no results on a long-term horizon.

On the one hand, financial education provides skills for the efficient management of complex companies (such as banks), which allows to achieve better results [18]. At the same time, results are often achieved by decreasing excessive investments in innovation [8]. C. Custódio and D. Metzger [19] confirm that financial experts acting as CEOs handle the corporate financial policy more efficiently, attracting external capital even in difficult economic conditions, and ensure the optimal investment of such capital. The same explanation may be applicable in case of smaller amounts of investment in R&D among CEOs with a degree in management. Based on the above, our hypothesis is as follows:

*H1. A CEO's financial degree or an MBA degree leads to decreased investments in research and development in the company they manage.*

In spite of the wide availability of management education, companies are often headed by technical professionals who typically have a good knowledge of the industry where their company operates. Irrespective of a possible lack of team management skills, technical professionals have a better understanding of the practical aspects of business (technical nuances, marketability, probable risks), which simplifies communication, interaction and decision-making procedure on investment in high-priced and high-risk R&D projects [20].

Technical experience (measured by the authors as experience in senior positions according to the selected major and in the selected industry) has a positive influence on the readiness to invest in innovation, and in this case both engineering and scientific experience is taken into consideration. At the same time, technical expertise also expands the CEO's planning horizon, which is of particular importance for research activities where projects may last longer than a typical director's tenure [21].

*H2. A CEO with a technical/science degree is more involved in internal corporate processes and has a greater desire to undertake research projects, thus bringing about increased investments in research and development within the company.*

*H3: A CEO with a technical/science degree and financial/management education has a better understanding of a company's processes and goals, and is more effective in organizing and financing its operations. Due to this, the amount of investment in research and development in their company will be higher than in the companies managed by a CEO with only a technical/science degree.*

Higher education is often used as a measure of an individual's cognitive capacities [1]. A doctoral degree as the highest level of the educational system, and should presumably be indicative of greater intellectual abilities in comparison with those without such a degree. For instance, the paper by D. Gounopolous et al. [22] states that this degree is a positive signal for investors in case of IPO.

A study of Chinese companies by L. Wang et al. [23] showed that academic experience has a positive impact on a company's sustainable growth due to innovation and internal control within the company.

Thus, our next hypothesis is as follows:

*H4. CEO's academic degree entails an increase in investment in research and development in a company.*

## Other (Non-educational) Characteristics of CEO's Experience

### Role of International Experience

The current globalization trend leads to a greater number of people graduating from foreign higher education insti-



tutions and increases the probability of appointment of a CEO from another country or with training or experience obtained in another country. As long as foreign experience frequently entails a CEO's training, we believe that the addition of this variable to the analysis when studying the role of education is logical, as it clarifies the role of education in the formation of a CEO's personal qualities and attitude to risk.

Managers with foreign experience usually have better education, more developed skills, are more innovative and deal more easily with long-lasting failures which are often characteristic of the innovative process [21]. At the same time, the effect of foreign experience is similar in cases of both foreign education and foreign experience [24]. The most recent papers show that contrary to popular belief, a CEO's foreign experience results in a reduction of risks of fraud and financial collapse and an improvement of corporate performance [25–26].

*H5. A CEO with foreign education or experience is more likely to consider financing of innovative activity, which leads to increased investments in research and development in the company they manage.*

#### Company Founders

One of the variables frequently added to the analysis is the role of the CEO in company foundation. There is a belief that making a company founder its CEO or appointing them CEO again ensures a better understanding of a company's strategic objectives by its head and results in a better economic performance of the company [27]. A study of high-tech companies' management demonstrated that founders are more enthusiastic about investing in development [28].

At the same time, the next generations of the founders' family face the risk of being psychologically biased in the role of the company head. Anchoring and the desire to preserve the company's current state for passing it on to heirs are among the most common problems [29]. Assuming that the presence of a CEO who is also the company founder leads to a better understanding of objectives by top managers, ensuring more effective teamwork and better performance, and also considering that company founders typically have an entrepreneurial mindset and in case of listed companies – have the skills to organize the work and convince the board of their efficiency – we hypothesize a positive influence of this situation on the amount of investments irrespective of education.

*H6. Companies managed by their founders will invest more than others in research and development.*

*H7. The next generations performing the functions of a CEO will invest less in innovation than the founder, but investments will remain at the market level in order to retain the company's current position.*

## Data and Methodology

In this empirical study, we sought to analyze the impact of different aspects of education: the level, the major and the combination of these factors. We use the standard STATA regression analysis tools, version 12.1.

#### Data

The research material comprises the data on 261 pharmaceutical and biotechnology companies from the S&P Global BMI index from 23 developed and emerging countries. Companies' financial indicators were obtained from Capital IQ, while the data on CEO's education, their participation in the company foundation and foreign experience was collected manually from corporate web sites, annual reports, interviews and other publicly available sources. After we eliminated the companies with unavailable information (both financial and partial information on CEO's education and other characteristics relevant to our research), we obtained 3485 observations for 1999–2018. The data is an unbalanced panel, i.e., there may be no information on some companies within the period indicated.

#### Study Design

The dependent variable in this research is the logarithm of the ratio of the funds invested in research and development to the last year's revenue which, according to our assumption, is indicative of the company's fund allocation decisions and the readiness to accept risks of investing shareholders' funds in new projects that are not always successful.

$$RDRev = \log \left( \frac{R \& D \exp}{Revenues_{t-1}} + 1 \right), (1)$$

where  $RDRev$  is the dependent variable that equals the logarithm of the ratio of R&D investments ( $R \& D \exp$ ) to the last year's revenue ( $Revenues_{t-1}$ ).

We used a series of dummy and categorical variables that characterize a CEO's education, their affiliation with the founder's family, foreign experience and a range of control variables: quantitative and dummy variables that characterize the company (company's age, revenue logarithm to control for company size, operation in the developed or emerging market, debt load level) as explanatory variables (Table 1).

**Table 1.** Variables, used in studies

Independent Variables	
Phd	The dummy takes on the value of 1 if the CEO has a doctoral degree
PhD spec	Categorical variable 1 – management/financial degree if the major is not indicated, 2 – technical/science degree

### Independent Variables

Educ	Categorical variable: 0 – no degree, 1 – major is not indicated, 3 – management and financial, 4 – technical/science sphere, 5 – combination of the degree with a technical/science major and management education
MBA	The dummy takes on the value of 1 if the CEO has an MBA degree OR has other financial, business or management education
Found	The dummy takes on the value of 1 if the founder is also the CEO, 0 – otherwise
Internexp	The dummy variable, 1 – if the CEO has worked or studied abroad, 0 – otherwise

### Control Variables

Age	Logarithm of company's age (as control of the life cycle stage)
Duality	The dummy variable, 1 – if the CEO is the chairman of the Board of Directors, 0 – otherwise.
CEOonplace	CEO's tenure
rev	Logarithm of the prior period revenue, USD mln.
DEq	Logarithm of the ratio of debt to share capital
RD	Logarithm of previous year's investment in research and development in USD mln.

In order to verify the proposed hypotheses, the following model was used in the regression analysis:

$$RDRev = \alpha_0 + \alpha_1 education + \alpha_2 founder + \alpha_3 intern.exp + \alpha_4 age + \alpha_5 rev + \alpha_6 emerg + \alpha_7 DEq \quad (2)$$

where *RDRev* is the dependent variable that equals the logarithm of the ratio of R&D investments (*R & D exp*) to the last year's revenue (*Revenues<sub>t-1</sub>*); *education* – the explanatory categorical variables responsible for the degree and (or) education level; *founder* – the categorical variable which takes on the value of 1 if the CEO is the company founder and 2 – if the CEO is a representative of the founder's family next generations; *intern.exp* – the dummy variable which takes on the value of 1 if the CEO has foreign education or foreign experience; *age*, *rev*, *emerg*, *DEq* – control variables responsible for the company's age (company's age logarithm), size (revenue logarithm), a dummy for emerging and developed markets and the leverage ratio.

### Descriptive Statistics

As Table 2 demonstrates, CEOs with an industry-specific degree prevail in pharmaceutical companies: CEOs with a doctoral degree related to their job profile without an additional management and/or financial education are most common, followed by CEOs with non-technical/science degree and with a master's degree in management or finance or an MBA, CEOs with both technical/science and management or financial education are less numerous. In addition, when we summed up various education levels, we did not reveal a significant difference between the shares of CEOs with only industry-specific degree and CEOs with only management and/or financial degree (shares of both amount to ~37% of the selection), only the share of CEOs with combined education (15%) or an irrelevant profession (~11%) is smaller. Combined shares of CEOs with an MBA or a similar degree (master's degree in management or finance) amount to 26% of observations. This exceeds the share of CEOs with only an industry-specific education and advanced degree, which is indicative of the trend detected when considering CEOs of top 50 pharmaceutical companies in terms of revenue.

**Table 2.** Characteristics of CEOs in the sample

Level and major	Number of observations	Share in the sample, %
Bachelor's degree, major unknown	388	9.15
Master's degree and/or bachelor's degree in an irrelevant profession (linguistics, philosophy, arts etc.)	63	1.49
Bachelor's degree in management/finance	250	5.89

Level and major	Number of observations	Share in the sample, %
Bachelor's or master's technical/science degree	534	12.59
Master's degree in management/finance or an MBA	756	17.83
Bachelor's or master's technical/science degree and an education in management/finance and MBA	385	9.08
A doctoral degree in management/finance	84	1.98
A doctoral technical/science degree (including biology and medicine)	1036	24.43
A doctoral technical/science degree and a management/finance degree	261	6.15
A degree in law or the major has not been indicated	380	8.96
A degree in law or the major has not been indicated and a management/finance degree	104	2.45
<i>Others</i>		
A person studied or worked abroad	2571	57.76
Company founders	1623	36.44
The next generations of the founders' family	198	4.45

## Results

In order to test the hypotheses regarding the correlation between education and the share of investments in revenue, we used linear regression tools with panel data with adjusted panel standard errors (adjusted standard deviations for heteroscedasticity taking into consideration the correlation between panels and general autocorrelation of AR-1 order). In order to verify the results, we calculated separate models for developed (column 2 in Tables 3–6) and emerging (column 3 in Tables 3–6) markets, as well as with random (column 4 in Tables 3–6) and fixed (column 5 in Tables 3–6) effects. In all versions of regression models, the logarithm of the share of the amount invested in research and development in the previous year's revenue serves as the dependent variable.

First, we tested the models to assess the first three hypotheses concerning the degree major. CEOs' technical/science degree has a positive impact on their readiness to invest large amounts in research and development, while an additional degree in management/finance enhances the effect, which may be related to skills of efficient allocation and raising investment funds. See the analysis results in Table 3: a business degree turned out to be insignificant for all five specifications (first line, columns 1–5), while a technical/science degree showed a significant positive influence on investment in the models with adjusted standard errors in general (column 1) and separately in developed and emerging markets (columns 2–3) and with random effects (column 4) confirming Hypothesis 2. The significance of positive coefficients of the dummy responsible for a combination of majors – a technical/science degree plus a degree in management/finance for specifications with adjusted

standard errors (columns 1–3) – also allows not to reject Hypothesis 3 on enhancement of the positive influence of a technical/science degree when a person also has theoretical and practical team management skills and a relationship with the team.

Further on we examine the results of testing Hypothesis 4 on the role of a science degree (PhD) using an additional dummy variable that controls for the presence of a degree, but does not take into account the major of the CEO's entire education (Table 4). Since the data on the CEO's major is not always publicly available, adding a CEO's education to the analysis often results in stating the fact of the presence or absence of a scientific degree because it is a factor more accessible to observation. Analysis shows that education had a significant positive effect only in the linear regression models with panel data with adjusted panel standard errors without division into developed and emerging markets (column 1) or addition of random effects (column 4). In this case, the dummy for emerging countries had a significant negative value surpassing the effect of education, which is indicative of an ambiguous nature of the obtained conclusions. The obtained results may be explained by the conclusions made earlier regarding the non-homogeneous influence of various educational patterns (choosing a major, combination and education irrelevant to the industry).

In order to verify the hypothesis in more detail and to avoid ambiguous results due to model simplification, further on we introduce to the model a categorical variable, which takes into consideration the specialization of the obtained degree (technical/science or otherwise) (Table 5). In this case, a technical/science education in the industry relevant for the company had a significant

positive effect in the linear regression models on panel data with adjusted panel standard errors accompanied by the addition of developed and emerging regions (column 1), as well as separately (columns 2–3). At the same time education unrelated to the company's industry had a significant positive effect only in the random effects model (column 4). Thus, ignoring the difference in majors when analyzing education based on the presence or

absence of a scientific degree leads to ambiguous results. The results confirm a positive influence of the CEO's scientific degree related to the company's industry on the share of investment in R&D. At the same time, the ambiguity is preserved when considering the remaining group with a degree, which comprises CEOs with a business education, as well as those with an unknown major.

**Table 3.** Results of regression analysis with CEO's major as the explanatory variable

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
Spec. Business	0.0116 (0.0409)	0.0119 (0.0612)	0.0636 (0.0720)	-0.0254 (0.0606)	-0.0465 (0.0735)
Spec. industry	0.115*** (0.0400)	0.102* (0.0532)	0.188*** (0.0635)	0.127** (0.0588)	0.0674 (0.0714)
Spec. industry+business	0.131*** (0.0425)	0.122** (0.0539)	0.108* (0.0645)	0.102 (0.0713)	0.0983 (0.0857)
1.internep	0.157*** (0.0323)	0.0912** (0.0430)	0.289*** (0.0363)	0.150*** (0.0472)	0.0502 (0.0625)
1.Found	0.118** (0.0510)	0.164*** (0.0614)	0.0377 (0.0615)	0.120** (0.0554)	0.202*** (0.0771)
2.Found	-0.0480 (0.0417)	-0.0569 (0.0643)	-0.0873* (0.0524)	-0.0679 (0.119)	-0.00550 (0.173)
Duality	-0.0413 (0.0445)	-0.0459 (0.0585)	-0.0324 (0.0440)	-0.106** (0.0503)	0.00623 (0.0658)
CEOonplace	-0.00239 (0.00174)	-0.00505* (0.00305)	-0.000993 (0.00175)	-0.00127 (0.00237)	-0.00334 (0.00287)
cage	-0.000776 (0.000499)	-0.000866* (0.000513)	-0.000652 (0.000468)	-0.000655 (0.000660)	0.00982*** (0.00308)
lrev	-0.378*** (0.0419)	-0.390*** (0.0431)	-0.318*** (0.0668)	-0.367*** (0.0123)	-0.279*** (0.0132)
ldeq	-0.0118* (0.00620)	-0.000643 (0.00688)	-0.0377*** (0.0110)	-0.00665 (0.00611)	0.0116* (0.00645)
1.emerg	-0.221*** (0.0457)			-0.180*** (0.0652)	
Constant	3.407*** (0.286)	3.506*** (0.293)	2.810*** (0.491)	3.331*** (0.109)	2.159*** (0.171)
Observations	3430	2266	1164	3430	3430
R-squared	0.405	0.397	0.367		0.128
Number of nocomp	252	159	93	252	252

\*\*\* –  $p < 0.01$  – highly significant influence; \*\* –  $p < 0.05$  – significant influence; \* –  $p < 0.10$  – statistically significant influence.

**Table 4.** Results of regression analysis with a dummy responsible for existence of CEO's scientific degree as an explanatory variable

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
PhD	0.0625* (0.0329)	0.0451 (0.0384)	0.0925 (0.0577)	0.0984** (0.0418)	0.0596 (0.0523)
1.internexp	0.138*** (0.0278)	0.0842** (0.0376)	0.232*** (0.0362)	0.136*** (0.0450)	0.0423 (0.0604)
1.Found	0.112** (0.0488)	0.152*** (0.0582)	0.0594 (0.0609)	0.124** (0.0533)	0.209*** (0.0735)
2.Found	-0.0175 (0.0392)	-0.0444 (0.0639)	-0.0330 (0.0516)	-0.0586 (0.117)	-0.0204 (0.170)
Duality	-0.0272 (0.0421)	-0.0384 (0.0545)	0.000927 (0.0433)	-0.102** (0.0486)	0.00624 (0.0631)
CEOonplace	-0.00192 (0.00177)	-0.00464 (0.00282)	0.000176 (0.00188)	-0.000722 (0.00227)	-0.00319 (0.00274)
age	-0.000832 (0.000508)	-0.000944* (0.000545)	-0.000710 (0.000445)	-0.000736 (0.000645)	0.00981*** (0.00293)
lrev	-0.379*** (0.0419)	-0.393*** (0.0432)	-0.322*** (0.0662)	-0.366*** (0.0120)	-0.279*** (0.0128)
ldeq	-0.0107* (0.00620)	-0.000516 (0.00668)	-0.0380*** (0.0108)	-0.00576 (0.00588)	0.0124** (0.00621)
1.emerg	-0.228*** (0.0488)			-0.168*** (0.0636)	
Constant	3.459*** (0.291)	3.565*** (0.296)	2.896*** (0.494)	3.321*** (0.0999)	2.136*** (0.160)
Observations	3600	2436	1164	3600	3600
R-squared	0.408	0.404	0.369		0.127
Number of comp	261	168	93	261	261

\*\*\* –  $p < 0.01$  – highly significant influence; \*\* –  $p < 0.05$  – significant influence; \* –  $p < 0.10$  – statistically significant influence.

**Table 5.** Results of regression analysis with a dummy responsible for existence of CEO's doctoral degree and its major as an explanatory variable

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
PhD in business/ not stated	0.0234 (0.0337)	0.0129 (0.0441)	0.00957 (0.0651)	0.0954** (0.0451)	0.0572 (0.0571)
PhD industry	0.196** (0.0805)	0.136** (0.0639)	0.458* (0.243)	0.109 (0.0721)	0.0670 (0.0869)

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
Internexp	0.138*** (0.0278)	0.0817** (0.0380)	0.251*** (0.0351)	0.136*** (0.0453)	0.0415 (0.0609)
1.Found	0.120** (0.0479)	0.159*** (0.0570)	0.0936 (0.0664)	0.125** (0.0536)	0.210*** (0.0737)
2.Found	-0.0106 (0.0387)	-0.0393 (0.0633)	-0.0173 (0.0529)	-0.0574 (0.118)	-0.0187 (0.171)
Duality	-0.0377 (0.0440)	-0.0476 (0.0545)	-0.0160 (0.0463)	-0.102** (0.0486)	0.00642 (0.0631)
CEOonplace	-0.00178 (0.00176)	-0.00460 (0.00283)	0.000198 (0.00185)	-0.000696 (0.00228)	-0.00316 (0.00275)
age	-0.000782 (0.000506)	-0.000912* (0.000544)	-0.000358 (0.000450)	-0.000738 (0.000646)	0.00978*** (0.00294)
lrev	-0.379*** (0.0416)	-0.392*** (0.0430)	-0.323*** (0.0634)	-0.365*** (0.0120)	-0.279*** (0.0129)
ldeq	-0.0112* (0.00619)	-0.000722 (0.00665)	-0.0386*** (0.0110)	-0.00573 (0.00588)	0.0124** (0.00621)
l.emerg	-0.223*** (0.0510)			-0.168*** (0.0637)	
Constant	3.455*** (0.289)	3.561*** (0.295)	2.883*** (0.471)	3.320*** (0.0999)	2.137*** (0.160)
Observations	3600	2436	1164	3600	3600
R-squared	0.411	0.405	0.382		0.127
Number of nocomp	261	168	93	261	261

\*\*\* –  $p < 0.01$  – highly significant influence; \*\* –  $p < 0.05$  – significant influence; \* –  $p < 0.10$  – statistically significant influence.

At the last stage, we provide a more precise definition of the nature of the obtained degree and combination of different types of education using the Educ variable, which controls both for the major and determines the group of holders of an industry-specific scientific degree who combined it with an MBA or a similar qualification which, according to the hypotheses put forward earlier, should be distinguished positively among others (Table 6). Based on the results of the majority of models, financial and management education without an additional degree with a technical/science major has a significant negative influence on investments (the conclusion is significant for all offered models except for the model that assesses the developed market separately. At the same time, in the developed markets there is also a negative value of the coefficient for the category of CEOs who have an advanced degree in management or finance). However, one should take into account the fact that our sample contains only 84 observations with CEOs

who have an advanced degree in management or finance, which amounts to just 2.5% of the sample.

There is also a positive influence of the industry-specific advanced degree in pharmaceuticals both standalone and combined with an MBA in the random effects model, as well as in the general model with adjusted standard errors. The absence of significance for developed and emerging markets considered separately is related both to difference of the shares of CEOs with the selected education strategy in the sample among countries, and to the characteristics of the local corporate governance and the market (share of industry-specific experts on the board of directors, its influence on strategic decision-making related to investments in research and development).

In all applied specifications, CEO's foreign experience (internexp) and role of the founder as CEO of the company (Found) showed a positive influence on the share of investments in research and development and were significant

for the majority of models (significance of the coefficient of the CEO's international experience was not revealed in the fixed effects model, while its value remained positive), as was assumed in proposed Hypotheses 5 and 6 (Tables 3–6). CEO's international experience is indicative of their open-mindedness and readiness to consider and come up with innovative ideas, which is also a characteristic feature of better educated CEOs. A CEO with an experience in establishing a company, in turn, not only better understands the internal company processes, having worked in it since its foundation, but also has the characteristics necessary for successful creation of business, its survival and convincing the corporate management of the effectiveness of being a CEO continuously since the foundation of the company. At the same time, the coefficient of the dummy responsible

for the next generations of the founder's family (2.Found) is insignificant, which also confirms Hypothesis 7 and the idea that the founder who is also a CEO of a listed company has the characteristics that influence decision-making on investments in research.

Thus, the importance of a CEO's education in the decision-making process regarding the amount of investment in research and development is confirmed by the obtained results. At the same time, there is also proof of a multidirectional influence of majors (a positive influence of industry-specific education on the share of investments and a negative influence of standalone management or financial education) and a positive role of combining knowledge and skills both in an industry-specific field and in management/finance.

**Table 6.** Results of regression analysis with an explanatory variable of the presence of CEO's degree and major (including a combination of qualifications). Coefficients for industry-specific education, as well as for its combination with a degree in management, are significant and positive

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
PhD spec not stated	0.0733 (0.0592)	0.0333 (0.0621)	0.259*** (0.0913)	0.0329 (0.0689)	0.00230 (0.0842)
PhD business	-0.245*** (0.0564)	-0.0366 (0.0524)	-0.448*** (0.0719)	-0.308** (0.154)	-0.338* (0.183)
PhD industry	0.0664* (0.0369)	0.0542 (0.0490)	0.110* (0.0597)	0.157*** (0.0544)	0.0945 (0.0698)
industry PhD+MBA	0.157*** (0.0554)	0.131** (0.0542)	0.123 (0.131)	0.153* (0.0847)	0.122 (0.102)
1.internexp	0.142*** (0.0303)				
1.Found	0.119** (0.0496)	0.181*** (0.0596)	0.0402 (0.0705)	0.116** (0.0556)	0.194** (0.0768)
2.Found	-0.0121 (0.0403)	-0.0512 (0.0701)	0.0582 (0.0500)	-0.0805 (0.121)	-0.0442 (0.176)
Duality	-0.0296 (0.0448)	-0.0232 (0.0587)	0.0308 (0.0504)	-0.0997** (0.0505)	0.00387 (0.0661)
CEOonplace	-0.00227 (0.00182)	-0.00707** (0.00290)	0.00225 (0.00179)	-0.00153 (0.00237)	-0.00359 (0.00287)
age	-0.000768 (0.000498)	-0.000844* (0.000509)	-0.000936** (0.000463)	-0.000620 (0.000667)	0.00978*** (0.00310)
lrev	-0.378*** (0.0420)	-0.389*** (0.0434)	-0.328*** (0.0674)	-0.363*** (0.0123)	-0.278*** (0.0132)
ldeq	-0.0108* (0.00626)	0.00158 (0.00681)	-0.0386*** (0.0114)	-0.00515 (0.00613)	0.0121* (0.00646)

VARIABLES	(1) L.lrdrat	(2) L.lrdrat	(3) L.lrdrat	(4) L.lrdrat	(5) L.lrdrat
l.emerg	-0.227*** (0.0496)			-0.181*** (0.0659)	
Constant	3.445*** (0.291)	3.588*** (0.299)	3.029*** (0.499)	3.403*** (0.0989)	2.190*** (0.163)
Observations	3430	2266	1164	3430	3430
R-squared	0.405	0.394	0.363		0.129
Number of nocomp	252	159	93	252	252

\*\*\* –  $p < 0.01$  – highly significant influence; \*\* –  $p < 0.05$  – seriously significant influence; \* –  $p < 0.10$  – statistically significant influence.

## Conclusions

Education certainly plays a significant role in the formation of a CEO's personality and produces an impact on his/her future decisions, in particular, on the acceptance or rejection of research projects and their initiation. In spite of the fact that various educational parameters are often added to studies, there is no clear idea of the general role of education – neither the level of education, nor its sphere. Thus, for example, the conventional concept of the importance of a degree in management for efficient team management contradicts that of excessive riskiness and frequent cases of fraud among people with degrees in management. In pharmaceuticals, where business is based on constant risky investments in research with a long payback period and depends on patents it seems optimal to appoint a person with an industry-specific degree who is capable of understanding the initiatives in detail, evaluating the probability of their implementation and creating a patent portfolio, thus ensuring successful operation. However, the current practice among market leaders suggests otherwise – the majority of CEOs in pharmaceuticals do not have an industry-specific degree, rather, the majority have an MBA qualification.

Based on the results of our research, it is difficult to analyze the influence of education on the amount invested in development while relying on only one characteristic – degree or major. A compound addition of a variable to analysis allows to explain the results which are often contradictory. Based on the results of regression analysis, we can state that control for the presence of a degree only may provide no significant results because the nature of influence of the degree depends on its field – an industry-specific degree, as well as a degree in management/finance supported by a basic technical/industry-specific education provides a positive effect, while a standalone managerial background entails a significant decrease in the amount invested. A positive influence of a degree in management or finance that supplements a technical/science degree confirms the importance of knowing management theory and acquiring skills. At the same time, the negative role of a degree in finance/management, if it is the only degree held by a CEO (no industry-specific degree), remains unrefuted. Thus, in the pharmaceutical industry, where the complexity of investment strategy de-

velopment depends not just on the compound nature of the studied object, but also on long payback periods characteristic of this business, it is important for a CEO to be knowledgeable in the field and possess the skills of management and evaluation of financial decisions.

Summarizing the above, we believe that when considering the education of a potential or current CEO as a factor forecasting their strategy, one has to take into consideration a combination of parameters – the field of education (including the change of majors in the course of studies), as well as its level (as an indicator of persistence and cognitive capacities). These conclusions may be useful to company managers when selecting candidates for the CEO position, as well as to analysts and investors involved in corporate performance forecasts.

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**Acknowledgement.** The author extends her gratitude to the Research and Training Laboratory of Corporate Finance and the Higher School of Economics where this study was conducted as a part of its Fundamental Research Programme. Also, we express special gratitude to the reviewer of this paper Anastasiia Stepanova and to the professors and organizers of academic seminars who assisted in the elaboration of certain parts of this research.

The article was submitted 20.12.2022; approved after reviewing 22.01.2023; accepted for publication 24.02.2023.

DOI: <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.90-100>

JEL classification: G30, G31, Q01



# Non-Financial Factors in Creation and Preservation of Company Value in Telecommunication Industry

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## Abstract

This paper investigates the impact of financial and non-financial factors on the value of companies in the telecommunications industry. Such variables as the debt ratio, tangibility, return on assets, etc. were selected as financial factors. ESG indicators were used as non-financial factors. The research topic is relevant for decision-making and the development of recommendations for companies, as it assesses the level of companies' involvement in solving environmental, social, and governmental problems. The work uses data from two databases (Bloomberg and Capital IQ) for 94 companies in the telecommunications industry between 2011 and 2021. The results suggest that the companies' disclosure of information about the overall ESG ratio and the "G" indicator has a positive effect on the company's value, while the disclosure of "E" and "S" indicators does not affect the value of a business.

**Keywords:** value of companies in the telecommunications industry, non-financial factors, ESG indicators, financial factors, debt ratio, tangibility, return on assets

**For citation:** Nikolaeva-Aranovich, A. Non-Financial Factors in Creation and Preservation of Company Value in Telecommunication Industry. *Journal of Corporate Finance Research*. 2023;17(1): 90-100. <https://doi.org/10.17323/j.jcfr.2073-0438.17.1.2023.90-100>

## Introduction

The current shifts are among the crucial challenges of our time as we work to transition to a sustainable, inclusive, and resilient business world in the nearest future. Today the business sphere is being transformed by such enormous processes as climate change, continuous calls for racial and gender equality, depletion of natural resources, an increasing demand for improvements in working conditions, COVID-19, and changing expectations of the role of corporations.

To continue succeeding in value creation processes, companies need to operate with greater commitments that embrace the broader demands of both people and nature. The World Economic Forum, Deloitte and other organizations “urge business leaders to pause and consider how ESG transparency and mandatory reporting will impact them, and what they can do to contribute” [1].

This paper contributes to the topic of ESG disclosure, which is a major component of company value in the telecommunication sector. The abbreviation stands for Ecological, Social and Governance, which are the main elements of the sustainable development concept.

Sustainable development is one of the major global trends that affect the success of modern companies. The concept requires companies to develop and implement managerial methods and tools to achieve ecological, social, and governmental development goals. Nowadays, many companies seek to succeed in sustainable development and disclose their ESG results to be assessed at a higher value.

The conversation about environmental, social, and governmental (ESG) is rapidly progressing. The importance of ESG is now recognized in the discussion of long-term value creation, the number of boards that are focused on this concept is increasing, and they are disclosing how their sustainability parameters are evolving. The integration of ESG into company strategy and its disclosure help to demonstrate the significance and prioritization of ESG efforts of the top management to both investors and shareholders. As investors update and finalize their proxy voting guidelines for 2022, “there is the potential for more votes to be cast against board directors who do not demonstrate an adequate understanding of ESG and sufficient disclosure” [1].

In this paper, the specific influence of ESG disclosure on company value is studied using the Tobin Q concept as an indicator of the value of a company. This indicator allows to identify the factors underlying the creation of value of telecommunication companies by taking investors’ expectations into account.

An understanding of the influence of these factors contributes to building a motivation system in organizations that are willing to meet the growth of the value, promoting efficient asset use and considering long-term economic benefits when making managerial and financial decisions.

Purpose: to investigate the effect of ESG rating disclosure and its individual components, which is expressed by Tobin Q coefficient, on value when controlling for debt ratio, tangibility and return on assets.

There are several questions that this paper seeks to investigate in order to contribute to the existing literature. The most important one is the connection between value and ESG disclosure. Very few studies explore the effect of ESG disclosure, thus, this research paper augments them. Another important feature is the focus of this study on the telecommunications industry.

The research provides the results regarding the role of ESG disclosure factors in the process of creating value by analyzing individual and common disclosure factors.

An analysis of the influence of ESG and its components’ disclosure is conducted using the Tobin Q indicator, which is utilized here as a measure of the value created.

The study seeks to identify the factors that assist managers of telecommunications companies in the process of creating value and making decisions regarding external and internal company policy. The results could subsequently be extrapolated to the entire business sphere, providing useful input and suggestions for managers about the importance of ESG disclosure.

The study incorporates a review of the results of existing research on the topic and a regression analysis of the impact of ESG disclosure characteristics on the value of telecommunication companies in 2011–2021. The work uses data from two databases (Bloomberg and Capital IQ) for 94 companies in the telecommunications industry for the 2011–2021 period.

## Related Literature and Research Hypothesis

### ESG development in telecommunication industry

It is important to start with the definition of ESG<sup>1</sup>, as it is one of the key concepts in this work. Environmental, social, and corporate governance (ESG) is an important measure of corporate sustainable development, and it also extends and enriches the concept of socially responsible investment (SRI) [2].

According to the RBC article (2021) [3], the modern form of ESG principles was first formulated by former UN Secretary General Kofi Annan. He suggested that the leaders of large global companies should include these principles in the strategies of their firms, especially the intention to resist climate change.

Sustainable development is the idea that human societies must live and meet their needs without compromising the ability of future generations to meet their own needs. The phenomenon has spread around the globe only in the last

<sup>1</sup> In this paper, the term ESG is interchangeably used with CSR (corporate social responsibility). Both terms are widely used in both the academic literature and in corporate practice.

several years, but it has already gained worldwide traction. According to Tinkoff Vice President Neri Tollardo, global funds will soon stop investing in companies that ignore sustainable development principles. Therefore, companies must pay attention to society and nature, rather than exclusively to their profits.

The environmental pillar includes major issues, such as climate change, biodiversity, waste, natural resources, and pollution (both air and water). In this sense, environmental principles stand for the level of companies' involvement in protecting the environment and trying to reduce the damage it brings to the habitat. For example, the global lifestyle footwear brand Timberland collaborates with tire manufacturer and distributor Omni United. The purpose of the collaboration is the utilization of recycled tires in the footwear production [4].

Social principles represent companies' relations with staff, consumers, manufacturers, and suppliers. The major issues in this sphere include human rights, health, local and indigenous community engagement, and workforce diversity. To comply with the standards, a company must be diverse, gender-balanced, offer high-quality working conditions, and make regular investments in social projects, including charity. For example, the American outerwear brand Patagonia does not own its production factories, so it has no influence on the workers' wages. To resolve this situation, Patagonia is channeling a proportion of its sales proceeds to factories as part of its Fairtrade program to raise employees' wages to the living wage level.

The governance principle refers to the quality of companies' governance estimated by the level of information disclosure, salary, and absence of corruption. Its major themes are business ethics, politics, executive payouts, tax approach, and cybersecurity. However, the importance of factors varies by industry: for example, in the oil and gas industry the environmental principle is the most significant; for the service industry, social parameters play the most important role; and in the financial sector the governance principles receive the most attention.

The telecommunications industry is emerging in a rapid manner, and it's difficult to figure out which of the three factors should receive particular attention, since the sector does not produce excess emissions, have major gender biases, or cause growing inequality.

However, the industry is still facing problems related to its compliance with the CSR standards. For example, in addition to connecting people to the Internet, it is important to educate those without any network experience.

Since 2012, Russian operator MTS has launched the Mobile Academy project, which allows over 30,000 pensioners in 30 regions to learn the basics of Internet literacy. This reduces the digital division in the society.

Also, the AK&M rating agency studied the 300 largest companies with published sustainability reports for 2019 from the industrial, energy, transport, trade, and telecommunications sectors. 26 companies from this sample fell into the first two top groups, and their reports were characterized

by the completeness and content of the main indicators of their activities in the public interest. The emphasis in the AK&M research was placed on the companies' information transparency and the completeness of the provided information. The best practice is to complete the annual sustainability report in accordance with the standards or include the sustainability section in the annual report. Rostelecom, Rosseti and Russian Railways were the most precise in their disclosure; the first company is one of the largest Russian providers of digital services.

Thus, telecommunication companies are apparently engaged in the CSR trend, but the question is whether the ESG rating has an influence on company value in this sector.

Larry Fink, the chairman of multinational investment management company BlackRock, has noted that mutual and exchange-traded funds invested 288 billion dollars in sustainable assets worldwide in 2020, which was a 96% increase compared with 2019. He stated that BlackRock investments take into account companies' ESG goals, particularly environmental ones, because stakeholders are most likely to lose confidence in the companies that do not respond to the need to control climate change.

Many practice-oriented works confirm the growing interest in the ESG trend. Bloomberg Intelligence expects the value of ESG exchange-traded funds to increase from 35 trillion dollars in 2020 to 50 trillion dollars by 2025. In a survey of 200 asset owners conducted by Morgan Stanley Capital Investments (MSCI), 62% claimed ESG measurement as one of the top 3 significant trends for the next 3–5 years and 73% planned to increase ESG investments. Another MSCI study revealed that 1136 billion dollars invested in telecommunications were funneled to ESG funds. Besides, half of the funds was based in Europe where, as MSCI notes, ESG adoption has been long established.

Specifically, within the telecommunications industry, there has been an increase in the issuance of green bonds by such companies as NTT, Orange, Telefónica, Verizon and Vodafone. Investors understand that by integrating ESG standards in their businesses, companies can: boost employee motivation, attract talented staff, align with consumer demands for sustainable products, reduce operational costs, and take part in diversification opportunities.

The GSMA, the mobile operators' industry association, conducted research that demonstrated that ESG reduces the cost of capital, provides better operational performance, and has a positive influence on stock prices.

In general, ESG reports promote the long-term and sustainable approach that is attractive to investors. This resilient thinking is especially valuable today as industries face serious and unpredictable challenges. ESG reports also reduce risks that are associated with poor ESG development, including reputational damage and social stigma.

### **ESG impact on firms' value: overall and by components**

Even though the trend is relatively new, numerous studies have been conducted to test the relationship between

environmental performance and company value, and the results are still inconclusive. The adoption of ISO 14001 seems to have a negative effect on company value, according to the cross-country analysis conducted by I. Miroshnychenko et al. (2017) [5].

Similarly, F. H. Verbeeten et al. (2016) [6] suggest the adverse impact of environmental parameters on the financial performance of German companies. M. Friedman (1970) [7] states that it is due to the maximization of owners' profits being the firm's only social responsibility. The underlying assumption is that the payoffs of ESG activities do not exceed their costs.

The cost-concerned school argues that environmental investments only increase costs, resulting in decreased earnings and lower market value. The value-creation school doubts that environmental efforts are a way to increase competitive advantage and improve financial returns to the investors. The L. Hassel et al. (2005) [8] research supports the stance of the cost-concerned school, since the results indicated that environmental performance has a negative influence on the market value of firms.

Although some research studies report a neutral or even negative relationship, most demonstrate that environmental performance strengthens financial performance. For example, the analytical results of J. Endrikat et al. (2014) [9] reveal a positive relationship between the environmental factor and accounting, and market-based corporate performance. J. Derwall et al. (2005) [10] studied the relationship of the share prices with corporate environmental performance in 1995–2003 and found that companies with better corporate environmental performance gained higher returns.

Secondly, it has also been argued that socially responsible behaviour has a net positive impact on performance and firm value (Fatemi et al., 2015) [11].

Within the framework of the stakeholder theory (Freeman, 1984) [12], it can be argued that socially responsible behaviour better satisfies the interests of nonowner stakeholders (e.g., debtors, employees, customers, and regulators), allowing for more efficient contracting (Jones, 1995) [13] and opening new paths to further development and risk reduction (Fatemi & Fooladi, 2013) [14].

As for the governance component, many studies have also investigated this factor's impact on firm value (using the Tobin's Q and price-to-book ratio parameters). As for the results, good governance seems to lead to an increase in investor confidence, which, in turn, results in greater firm value. Analysis by R. Bubbico, M. Giorgino and B. Monda (2012) [15], which uses 2010 data, proves that there is a positive and statistically significant correlation between corporate governance and performance: this finding supports the hypothesis that governance creates value for companies and that investments in the implementation of effective governance systems provide a net positive benefit and should therefore be pursued. Hence, financial institutions should be encouraged to improve their corporate governance systems.

In general, most research papers find a positive relationship between sustainability and firm value. However, some

authors, i.e., K. Fisher-Vanden and K. Thorburn (2008) [16], discover negative relationships between sustainability measures and stock price performance. They also found that firms with weak corporate governance standards that give managers the discretion to make voluntary environmentally responsible investment decisions are more likely to become Climate Leaders.

Several studies have found either a negative or a nonsignificant association between ESG performance and financial performance or firm value (e.g., Horváthová, 2010 [17]). Others have found a positive association (Fatemi et al., 2015) [11].

Despite the many years of research on the relationship between corporate environmental performance and corporate financial performance, there is no generally accepted theoretical framework that explains the contradictory results that have emerged.

This unsatisfactory status may, however, be attributed to the fact that linear models dominate the research works. Based on the research by C. Trumpp and T. Günther, which was conducted on an international sample of 2361 firm-years in 2008–2012, the empirical evidence of a non-linear, specifically a U-shaped, relationship was found [18].

Similar results were presented after their investigation of the non-linear models, which provided evidence of a U-shaped relationship, suggesting that in the longer run corporate social performance effects are positive. Most prominent among these results is that fact that by disentangling the ESG Disclosure score into its environmental, social and governance sub-components, they found that a U-shaped relationship exists only with the governance sub-component.

Moreover, G. Moore (2001) [19] finds a correlation between corporate social performance and the value in the UK using a sample of eight supermarkets. The data sources of the study are the annual company reports. The results of the study indicate a negative correlation between social performance and company value, and a positive correlation between the social and lagged financial performance of the firm. Thus, according to this, investments in sustainable growth bring results in the future. Similar results were presented by S. Chen et al. (2019) [20], who demonstrated that the social responsibility of listed enterprises had a lagged impact on their economic performance, specifically, a negative impact on the short-term and a positive impact on the long-term indicators.

A straightforward implication of the findings suggests that, given that the expenditure pays off only after a certain threshold of corporate social performance, a long-term plan and assessment of resources are required. Furthermore, the fact that governance is the key driver affecting the relationship suggests that investments should be funneled to this component.

## ESG disclosure

Another important topic is the impact of ESG reporting, or disclosure, on a firm's financial performance and its val-

uation. The issue reflects the fact that there may be various motives for reporting.

Using voluntary disclosure theory, developed by R. Verrecchia (1983) [21], among others, it can be argued that a firm's ESG disclosure is a predictor of its ESG score: firms with positive ESG performance would choose to report their complete ratings, while those with a negative ESG performance would choose to report minimally.

According to this framework, firms disclose their ESG performance to present themselves as good performers and thus avoid the consequences of adverse selection.

This argument is supported by S. Cahan et al. (2015) [22], who find that good ESG performance generates favorable publicity, and that firms with good ESG performance achieve a higher firm value (or lower cost of capital) only if they also have favorable media coverage.

Alternatively, a firm may use ESG disclosure to influence the public's perception by explaining the changes in its ESG-related policies. For example, it may disclose its ESG information to prevent the adverse effects of environmental damage on its reputation and market value (Cho & Patten, 2007) [23].

The third important issue is called "the theory of information costs." It helps managers make decisions about information disclosure, while taking cost advantages into consideration (Verrecchia, 2001) [24]. Investors assess a firm's financial performance using regulated and non-regulated disclosure.

As for D. Cormier and M. Magnan (2007) [25], there is a working strategy that results in a compromise between the economic benefits of disclosure, the associated risks arising from shareholder pressure and various regulatory constraints. The value relevance of non-financial disclosure is consistent with companies often revealing much more about their social and environmental activities than is required by law. M. Plumlee and T. Yohn (2009) [26] linked voluntary communication on environmental issues to companies' performance. Based on a study performed on a small sample of American companies, they identified a positive correlation between environmental disclosure and company valuation.

Moreover, D. Cormier, M.-J. Ledoux and M. Magnan (2011) [27] investigated whether social disclosure and environmental disclosure have a substituting or a complementing effect in reducing information asymmetry between managers and stock market participants.

Voluntary disclosure reduces information asymmetry among investors. From an empirical perspective, there is widespread evidence that confirms the positive effect of enhanced voluntary disclosure, both in terms of enhancing firm value and stock market liquidity.

Research conducted by Y. Tan and Z. Zhu (2022) [28] demonstrates that ESG-rated companies are associated with a 6.45% increase in the number of green patent applications and a 9.35% increase in the number of green patent citations.

Moreover, the results indicate that the positive promotion effects are statistically and economically significant.

The article by Fatemi et al. (2017) [11] demonstrates that ESG disclosure helps companies to lower the negative valuation effects of concerns regarding its ESG performance. Furthermore, the findings show that for firms with strong ESG, disclosure is negatively related to firm value.

Empirical research has produced conflicting findings regarding the nature of the relationship between ESG performance and ESG disclosure. Some earlier studies find no significant relationship between firms' ESG performance and the intensity of their ESG disclosure [29]. Others find a negative relationship between environmental performance and environmental disclosure (Patten, 2002) [30].

More recent studies report positive associations.

Finally, A. Fatemi et al. (2017) [11] finds that when evaluating the relevance of disclosure, investors differentiate among the three components of ESG scores in regard to the nature of their informational content.

In addition, telecom companies are not the main antagonists of sustainable development: they do not produce excess emissions, do not have significant gender bias, and are not a source of increasing inequality.

The largest companies in the sector generate positive momentum and are involved in sustainable development projects, both through traditional corporate social responsibility programs and through the use of technology [4].

D. S. Dhaliwal et al. (2014) [31] examined the relationship between ESG disclosure and cost of equity capital in an international sample that included 31 countries. They divided these countries into two groups: more and less shareholder-oriented. They generally found a negative association between ESG disclosure and the cost of equity capital, with this relationship being more pronounced in shareholder-oriented countries.

Finally, M. Plumlee et al. (2015) [32] found no significant association between the overall level of voluntary ESG disclosure and the value of the firm, its component cash flows, or its cost of capital. However, after controlling for ESG performance and differentiating between the nature (positive, negative, neutral) and the type (soft, hard) of ESG disclosures, they found that high-quality soft disclosure is significantly associated with both the cash flows and the cost of capital components of firm value.

Building upon the findings and the insights of this literature, we proceed to develop the research hypothesis.

## Main goal and Research Hypothesis

The aim of this work is to estimate the effect of the overall and specific ESG indicator disclosure on company value. Following the results of prior research, the relationship of ESG factors with firm value in this study is hypothesised as follows:

**H1:** *There is a positive relationship between company value and its ESG rating disclosure in the Telecommunication sector.*

**H2:** *There is a non-significant relationship between company value and the disclosure of the E-component of its ESG rating in the Telecommunication sector.*

**H3:** *There is a non-significant relationship between company value and the disclosure of the S-component of its ESG rating in the Telecommunication sector.*

**H4:** *There is a positive relationship between company value and the disclosure of its G-component of its ESG rating in the Telecommunication sector.*

## Data and Methodology

### Model Specification

In this study, panel data over the eleven-year period (2011–2021) from Capital IQ and Bloomberg is used to estimate the effect of ESG disclosure on company value. A longitudinal dataset follows the same firms over time and changes over time can be analyzed. The definition and the description of variables can be found in Tables 1 and 2 (Appendix 1).

A panel regression model is used to assess the impact of ESG disclosure on firm value in terms of Tobin's Q. The regression model to test the hypothesis 1 is estimated as follows:

$$TQ_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 ROA_{it} + \beta_3 TANG_{it} + \beta_4 DEBT_{it} + \varepsilon$$

The regression model to test the hypothesis 2–4 is estimated as follows:

$$TQ_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 S_{it} + \beta_3 G_{it} + \beta_4 ROA_{it} + \beta_5 TANG_{it} + \beta_6 DEBT_{it} + \varepsilon$$

where  $TQ_{it}$  – Tobin's Q for company  $i$  in period  $t$ ;

$\beta_i$  – corresponding coefficients;

$\beta_0$  – constant variable;

$ESG_{it}$  – ESG disclosure score for company  $i$  over period  $t$ ;

$E_{it}$  – Environmental disclosure score for company  $i$  over period  $t$ ;

$S_{it}$  – Social disclosure score for company  $i$  over period  $t$ ;

$G_{it}$  – Governance disclosure score for company  $i$  over period  $t$ ;

$ROA_{it}$  – Return on Assets for company  $i$  over period  $t$ ;

$TANG_{it}$  – Tangibility for company  $i$  over period  $t$ ;

$DEBT_{it}$  – Debt ratio for company  $i$  over period  $t$ .

Tobin Q is market indicator and was selected as an expression of the value to assess investor expectations. It was calculated as the sum of market capitalization, total liabilities, preferred equity and minority interest divided by total assets.

The common ESG disclosure score, and individual Environmental, Social, and Governance disclosure scores were calculated as dummy variables. The value of the variables equals 1 when the information was disclosed, and 0 otherwise.

In the sample, the mean value for the ESG disclosure score is 0.88, the mean value is 0.75 for the Environmental disclosure score, 0.81 – for the Social disclosure score, and 0.88 – for the Governance disclosure score. So, a decision was made to disclose all the four disclosure scores for the greatest number of years.

The control variables are: Return on Assets, Debt ratio, and Tangibility.

The Return on Assets control variable was calculated by dividing net income by total assets, resulting in a mean value of 6.1%.

The Debt ratio control variable was calculated by dividing total debt by total assets, resulting in a mean value of 39.5%.

Tangibility was measured by dividing Net fixed assets by total assets, resulting in a mean value of 79.0%.

### Data

In this research panel data is used for the period between 2011 and 2021. The dataset is longitudinal as it includes the same corporations over the same 11-year period between 2011 and 2021. Longitudinal data, or panel data, tracks the same sample at different points in time, and it has been selected because of a number of advantages, for example, it allows for the measurement of intra-sample change over time.

Company screening was conducted through Capital IQ, an American company that provides information and analytical services to investment companies, banks, corporations, consulting firms and universities around the world, with the following search criteria:

- Industry Classification: Telecommunication Services;
- EBITDA (LTM in \$USD) is strictly greater than 0;
- Total Enterprise Value (Latest in \$USD) is strictly greater than 0.

The screening resulted in a dataset of 306 companies, from which top-100 were selected by their market value. All the financial data (Balance sheets, Income Statements, Market Capitalization analysis, etc.) was downloaded from Capital IQ for every year.

Subsequently, a search for these companies was conducted in Bloomberg Terminal, which is a computer system provided by Bloomberg, and their ESG scores (or absence thereof) were downloaded (ESG score, Environmental score, Social score, Governance score). Bloomberg's Environmental, Social & Governance (ESG Data) dataset offers ESG metrics and ESG disclosure scores for more than 11,800 companies in 100+ countries for over 410,000 active securities. The product includes as-reported data and derived ratios, as well as sector and country-specific data points.

However, to be able to perform our analysis, we required company data on net fixed assets, total assets, total debt, sales, and net income, Tobin's Q, ESG disclosure data, environmental disclosure data, social disclosure data and governance disclosure data, thus, we had to reduce the sample from 100 to 94 companies by excluding all the companies

with missing data. Ultimately, the total sample consisted of 1034 observations.

## Regression Results

Table 1 (Appendix 2) demonstrates that the combined ESG disclosure score is significant at a 10% confidence level and increases company's value by increasing the Tobin's Q coefficient. Individual information disclosure scores of both Environmental and Social performance are all statistically insignificant in influencing Tobin's Q. These results could be contingent on the limited sample of companies studied (94 companies) over a relatively short period of time (11 years). For example, I. and S. Eccles (2014) [33] argued that the relationship between sustainability and financial performance is only significant in the long term and not in the short term. And C. Cho et al. (2012) [29] stated that this may sometimes be explained by the immaterial nature of the activities undertaken to develop social and environmental behavior. The result also coincides with the earlier papers by A. Fatemi et al. (2017) [11], which revealed that when evaluating the relevance of disclosure, investors differentiate among the three components of ESG scores, and, finally, M. Plumlee et al. (2015) [32], which stated that there is no significant association between the overall level of voluntary ESG disclosure and the value of the firm.

Moreover, most studies suggest that a positive correlation is observed between the factors in wider samples and over longer periods. This issue was discussed in I. and S. Eccles's study entitled "The Impact of Corporate Sustainability on Organizational Processes and Performance," where the authors use a sample consisting of 90 companies over a 20-year period [33].

The findings from this work coincide with the results of the preceding papers that analyze the link between corporate social performance and market value, using the same indicator as in this research – Tobin Q. Their results showed that the social performance indicator had no significant effect on company value.

However, the Governance performance appears to be significant at 10% confidence level, depending on the Fixed Effect regression. Governance-related disclosures have a more substantial effect on corporate performance, which is consistent with the current literature, especially P. Velte's (2017) [34] research, where governance performance had a stronger impact on company value than environmental and social performance, and A. Fatemi et al. (2017) [11], who discuss the differences in investor behaviour towards different ESG components.

The analysis by R. Bubbico et al. (2012) [15] produced similar results in regard to the connection between company value and corporate governance. They claimed that there is a positive and statistically significant correlation between corporate governance and performance, and the study confirmed the hypothesis about corporate governance creating value for companies. Therefore, investments are required to implement effective governance systems,

hence, financial institutions should be encouraged to improve their corporate governance systems.

This trend can also be explained by the specifics of the telecommunications sector, where investors pay particular attention to the level of governance culture. Meanwhile, debt ratio and return on assets (ROA) both positively and significantly increase Tobin's Q. These results imply that a company with higher leverage will have higher firm value; and the same trend works for firms with high profitability.

Tangibility has the opposite effect: it negatively and significantly decreases Tobin's, which coincides with the findings in the article by J. Lei et al. (2017) [35] about firms with a smaller proportion of tangible assets growing faster, as "rising intangible assets on corporate balance sheets around the world could limit borrowing capacity and consequently hinder growth if firms must preserve cash and forgo investment opportunities".

This study conducted the Hausman test to identify the best estimator among the three. The Hausman test confirms that the fixed effect (FE) estimator is the most efficient one, thus, the study focuses on the FE estimators to explain the results.

## Conclusion

The main explanatory variables are the ESG disclosure score and its components. Besides the mandatory requirements for basic disclosure, ESG disclosure is usually voluntary and, from a regular shareholder's point of view, is regarded as an expression of transparency and accountability. Thus, the ESG disclosure score reflects a company's specific level of disclosure.

Fortunately, Bloomberg provides ESG disclosure scores for large public firms. The ESG disclosure score proprietary provided by Bloomberg is based on the extent of a company's ESG disclosure, the data being compiled from all available firm information, including websites, CSR reports, annual reports, and Bloomberg surveys.

In this paper the influence of ESG parameters disclosure on company value in the telecommunications sector was investigated by examining their Tobin's Q.

The ESG trend pervades various sectors, including Oil & Gas, Mining, Pharmaceuticals and so on; investors from all around the globe have started to pay attention to a company's involvement in corporate social responsibility.

However, the question about the real impact of ESG parameter disclosure, and the special attention to the effect of its components on the business value in telecommunications industry is dual, and we have managed to answer both of its parts.

The results of OLS, Fixed and Random effects models confirmed some significant implications, such as the disclosure of the overall ESG factor and individual Governance factor being important drivers of telecommunication companies' value, while Environmental and Social factors disclosure having no significance.



The previous papers about these determinants are controversial. They did not investigate either overall or individual effects of ESG disclosure parameters, besides, they did not exclusively study the telecommunications sector.

However, the results coincide with those of the preceding research papers, which describe the telecommunications industry as being more vulnerable because of governance disclosure. Investors pay greater attention to this particular factor out of the three, as the sector does not have to deal with such environmental issues as the Oil & Gas sector, and or major social biases such as financial institutions. Governance seems to contribute to increased investor confidence, which, in turn, results in greater firm value.

The examination of the individual components reveals that investors discriminate among the three different dimensions of ESG scores. Governance score disclosure leads to higher valuation than social concerns or environmental score disclosure. The effect may also be explained in terms of differences in opacity.

Governance-related disclosures are often mandated and regulated by institutions, and investors can assess their veracity with relative ease and confidence. On the other hand, disclosures related to social and environmental concerns are mostly voluntary and are therefore more opaque and more difficult to verify.

ESG score disclosure has a significant positive effect on company value, which confirms the hypothesis about ESG score disclosure positively affecting market value and the hypothesis about Governance score disclosure positively affecting market value.

This implication may serve as an additional incentive for governments, organizations, and financial institutions to spend their financial and non-financial resources on engaging in activities related to corporate social responsibility. Also, the results can be a driver for future research of ESG in other sectors and in larger samples.

Moreover, the second and the third hypothesis about Environmental and Social score disclosure having no significant effect on the value are also approved.

This study is limited by the time period during which ESG disclosure has been presented in Bloomberg, which is since 2011.

Also, the regressions used in this paper did not separate the effect of the disclosure of the ESG itself and its components into two groups – short term and long term; also, the possibility of a U-shaped relationship was not studied.

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## Appendix 1

**Table 1.** Definition of variables

Value	Description
<b>Dependent variables</b>	
TQ	The sum of market capitalization, total liabilities, preferred equity and minority interest divided by total assets.
<b>Independent variables</b>	
ESG	ESG score disclosure
E	E-score disclosure
S	S-score disclosure
G	G-score disclosure
<b>Control Variables</b>	
Tangibility	Net fixed assets divided by total assets.
Debt ratio	Total debt divided by total assets.
ROA	Net income divided by total assets.

Source: Author's calculation.

**Table 2.** Descriptive Statistics

N = 1304	Mean	St. Dev.	Min	Max
Debt ratio	0.395	0.403	0	9.860
Tangibility	0.790	0.092	0.220	0.990
ROA	0.061	0.179	-0.32	5.320
ESG	0.882	0.323	0	1
E	0.748	0.435	0	1
S	0.806	0.396	0	1
G	0.882	0.323	0	1

Source: Author's calculation.

## Appendix 2

**Table 1.** Regression outputs

Variable	Pooled OLS	FE	RE	Pooled OLS	FE	RE
ESG	0.117* (0.116)	0.149* (0.088)	0.152* (0.089)			
E				-0.056 (0.161)	-0.274 (0.167)	-0.217 (0.160)
S				0.054 (0.204)	0.102 (0.163)	0.089 (0.182)
G				0.169* (0.175)	0.273** (0.136)	0.244* (0.137)
Debt ratio	0.914*** (0.094)	0.984*** (0.092)	0.964*** (0.089)	0.916*** (0.945)	1.006*** (0.093)	0.978*** (0.090)
Tangibility	-1.582*** (0.458)	-2.073*** (0.549)	-1.996*** (0.508)	-1.567*** (0.460)	-2.046*** (0.549)	-1.970*** (0.508)
ROA	1.669*** (0.212)	0.476*** (0.160)	0.629*** (0.161)	1.673*** (0.212)	0.470*** (0.160)	0.623*** (0.161)
Observations	1 034	1 034	1 034	1 034	1 034	1 034
R-squared	0.140	0.306	0.146	0.140	0.309	0.148
Number of companies	94	94	94	94	94	94

\*\*\*, \*\*, \* indicate the value is significant at 1%, 5% and 10% level.

Source: Author's calculation.

**Table 2.** Hausman test

	(1)	(2)
FE-OLS	58.08 (0.000)	65.27 (0.000)
RE-OLs	5.02 (0.485)	7.53 (0.127)
FE-RE	53.03 (0.000)	60.04 (0.000)

Source: Author's calculation.

The article was submitted 25.12.2022; approved after reviewing 23.01.2023; accepted for publication 10.02.2023.