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The Impact of Disclosure Sentiment on the Share Prices of Russian Companies

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Abstract

Information about companies published in a news feed is invariably tinted by emotional tonality. As such, resulting perceptions may influence the opinion of market players, and consequently affect the dynamics of a company's share price. This study aims to evaluate various hypotheses about the impact of the tone of news items regarding dividends, capital expenditures, and development on the stock prices of Russian companies. Information disclosure is extensively studied, and there have been limited studies on the effect of disclosures on Russian companies. However, until now, there have been no research studies which verify hypotheses on the influence of news sentiment on corporate share prices in the Russian market.

This analysis was conducted using data from 49 Russian public companies included in the Moscow exchange index over the period from the end of 2017 to the beginning of 2019. To account for the proximate impact of news items on consequential market phenomena, an event study methodology was applied in order to estimate and construct the models of dependency of cumulative abnormal return (CAR) on news tone level, and control for financial and non-financial factors.

Our results provide evidence for the positive impact of the tone of news texts on the share prices of Russian companies. The increase in news tone by one standard deviation leads to a cumulative abnormal stock return increase of 0.26 percentage points. This result is consistent with previous research conducted on data from developed stock markets. Moreover, the relationship between the tone or sentiment level of a news item and the stock price reaction is linear, without the diminishing marginal effect.

Our conclusions should prompt companies to invest effort in delivering information in a tonally positive way, highlighting the most positive news. Investors, in turn, should rationally approach the interpretation of published information.

Key words: corporate finance, sentiment analysis, event study, corporate disclosure, stock markets, financial report, news analysis.

Introduction

Recent years have seen a growth in the amount of news about companies in the financial world. Such information, which traders get from various sources, assists them in constructing their trade strategies. The information providers are often companies involved in the industry themselves, including independent analysts, investment bank analysts, etc. However, the investors' expedience, especially when parsing such a vast amount of published information, remains disputable. In order to make a greater impact on market players, such news is often bestowed with a certain tone which may influence opinion about the news, and consequently the investors' response to new information.

The Russian stock market differs significantly from the more often analysed markets of the USA and Great Britain, having a significantly smaller number of companies, smaller amount of capital, and smaller trade volume. According to the World Bank, as at the end of 2018, the market capitalisation of companies in Russia equaled 576 billion US dollars, which accounts for just under 35% of GDP. By way of comparison, similar indicators in the USA amounted to 30 trillion US dollars and 148% of GDP [1]. Apart from that, within the period under observation, many large Russian companies had a need for outside financing due to economic sanctions employed against Russia and certain organisations since 2014. Also, while distinctive features of the Russian stock market include a large number of public companies with public capital and an extremely low involvement of population in financial markets, the degree of population involvement grows every year. Thus, in 2018 the number of proactive individual investors increased from 94 thousand to 133 thousand persons, and the amount of assets doubled and attained 2 trillion roubles [2]. So, in spite of the great inclination of Russian economics towards bank financing, the stock market may potentially be a significant fund raising source for Russian companies. As long as shares are a risky investment tool, the response of the growing part of investors to the sentiment of events, and as a consequence, share prices of companies, are of special interest for research. Therefore analysis of investor behaviour as regards information disclosure, and in particular regarding the sentiment of conveyed text, is of relevance in the Russian stock market, and the results may differ from the conclusions of previous research [3–5].

In this research we consider the degree of influence of news sentiment on the share price of a company within the period from the fourth quarter of 2017 to January 2019 using the selection of companies from the Moscow exchange index.

The structure of this paper is as follows. First, we consider the results of theoretical and empirical research dedicated to the influence of information disclosure on share prices of companies. Then we analyse empirical research studies which show the influence of the news text sentiment on share prices. Further, we consider the ways of measuring the sentiment of information disclosure. Afterwards we present the selection of the research, and describe data and methodology stages. Finally, we define the results of empirical analysis and make conclusions.

Influence of Information Disclosure on Corporate Share Prices

Information disclosure is an extensively studied sphere. As a company activity it facilitates the reduction of information asymmetry between the management and investors [6], and helps investors to place capital in accordance with their preferences.

Companies may be interested in information manipulation in order to control share price dynamics. We identify such opportunities of control using disclosure as choice of the publication time, distortion, biased nature and concealment of information [7; 8]. The emotional 'colouring' of news may also be a part of the strategy of information disclosure of a company, or an intended act of analysts intended to manipulate the prices of corporate securities.

In empirical studies, information disclosure is often considered as a separate information signal to which investors respond. Therein, fewer than all information signals cause response of the market.

Considering the influence of information disclosure on the stock markets of developed countries, T.D. Berry and K.M. Howe [9] assume that all information events in the aggregate may influence the share prices of companies. However, their hypothesis was not confirmed. Partly, they were forced to such a conclusion because they analysed all news for all time. Nevertheless, they found a positive influence of information disclosure on share prices in certain categories. H. Lee, E. Kweon, M. Kim and S. Chai [10] considered specific news events, divided them into categories, and evaluated the influence of disclosure of information on the use of big data analysis in a company on the share prices of such a company. As a result, they found a positive response of the stock market on news about the application of big data analysis by a company. Against this background, it may be noted that in the stock markets of Western countries the influence of information disclosure by categories was confirmed.

We also conducted research into the Russian stock market, dedicated to analysis of the influence of information disclosure on share prices. However, these results are controversial [11]. For example, I. Naidenova [12] proposed that players of the Russian stock market on average do not respond to R&D news. She used as an example voluntary information disclosure on R&D by pharmaceutical companies. The research by A.V. Yavorskaya [13] showed a serious positive response to cross-listing news. The results of further study by A.V. Yavorskaya and V.M. Yavorskii [11] also showed a statistically significant response to the news only on the ninth day after publication, on the issue of depositary receipts. However, there are no research studies which verify hy-

potheses on the influence of news sentiment on corporate share prices in the Russian market. Probably, it is due to the fact that it is difficult to assess the news about companies because the majority of news is published in Russian. Absence of such research may also be related to a low interest of the market players in using such technology in the Russian stock market. However, there exist companies which exhibit the proper indicator of the average daily trade volume for such research.

The Text Sentiment and its Influence on Share Prices

'Text sentiment analysis' has come into use relatively recently. One of the first papers in this regard is the research by W. Antweiler and M.Z. Frank [14]. Using the text mining approach, which divides news into 'bad' and 'good' categories, they found a positive dependence between the sentiment of financial news at Yahoo Finance and trading volatility.

As part of an assessment of the influence of news on the stock market, Y.C. Soon [3] applied the 'emotions analysis' method. As a result, the research confirmed the existence of a significant interrelation between the negatively-assessed news and the share price of the S&P index companies. Thus, it may be noted that players in Western stock markets respond to the emotional colouring of events.

G. Ranco et al. [4] studied news from the Twitter social network from the point of view of emotional colouring. They found out a significant interrelation between the emotional colouring of news published in Twitter and the abnormal return of a security. Their results turned out to be relevant not just for expected peak amounts of publications in Twitter (for example, quarterly reports), but also for peaks which correspond to events less significant for the market. Consequently, we can draw the conclusion that information disclosure in social networks and its emotional colouring may influence corporate share prices even when it comes to a voluntary information disclosure.

As far as Russian research is concerned, the sentiment of information disclosure has a relatively minor effect on share prices. Nevertheless the results of the research by E.A. Fedorova et al. [15] confirmed a significant influence of the sentiment of the company's general directors' speeches addressed to shareholders on corporate share prices. Another research study by E.A. Fedorova et al. [16] showed a positive interrelation between the level of optimism in a CEO's speeches in annual corporate reports and the share prices of such companies. Consequently, we can make an hypothesis / suppose that Russian market players also tend to respond to information sentiment.

Measuring of the Information Disclosure Sentiment

An important part of this research is the choice of the methodology for defining the 'emotional load' of the news.

There are several ways of assessing the emotional colouring of a text. In earlier papers, the text sentiment was defined by three categories: positive, negative and neutral, and most often it was defined by experts [17; 18]. Alternatively, a more detailed classification may be applied. For example, N. Tabari, P. Biswas, B. Praneeth et al. [5], in a research study aimed at analysis of influence of news sentiment on Twitter, ask four experts to define the emotional colouring of events from −2 to 2, where −2 is an extremely negative colouring, and 2 is an extremely positive one. On average the experts agree with each other in 82.8% of cases [5]. This shows the necessity to engage a range of experts in order to obtain a more objective estimation.

In further papers, analysis is focused on classification of emotions at the level of news articles using predetermined lexicons of emotional load. For the first time, the method was applied in the financial sphere by W. Antweiler and M.Z. Frank [14], who used language algorithms to analyse stock exchange blogs from Yahoo Finance.

In research by G. Ranco et al. [4], a controlled machine learning method was applied to find texts' emotional colouring. The resulting data set is a time series of negative, neutral and positive events for each day of disclosure. In the Russian research by E.A. Fedorova, I.S. Demin, L.E. Khrustova et al. [15] a multi-layer neural network was also used. This method is the most resource-consuming, because it requires computer-based knowledge and considerable computation capacities. Application of computer-based education methods helps to obtain a more objective evaluation of the text sentiment.

Thus, in the papers indicated above it was found out that the sentiment of published information may influence corporate share prices [3–5], *inter alia*, in the Russian stock market [15]. Therefore, we can suggest that when analysing the influence of corporate news sentiment on share prices, the news with more positive emotional colouring will result in a rise in share prices. Thus, the following hypothesis is proposed:

Hypothesis 1. The sentiment of news about a company positively influences its share prices.

If we compare a continuous indicator of sentiment to division into categories, such as positive, neutral, and negative news, in the second case it is assumed implicitly that any positive news results in identical growth of share prices. In other words, at the threshold value at which the sentiment is defined as positive, the impact of the sentiment does not increase significantly. Therefore, we additionally test the hypothesis of the diminishing marginal effect of sentiment.

Hypothesis 2. The news sentiment impact on share prices diminishes when the sentiment indicator increases.

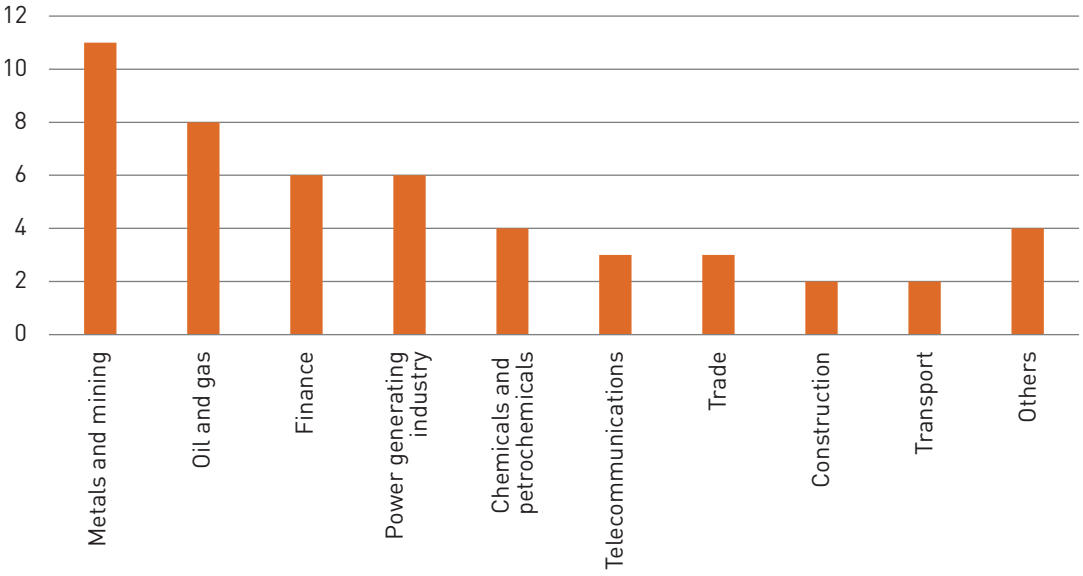
It is presumed that the sentiment impact on the response of market players may be positive but diminishing, and investors and speculators tend to trust extremely positive news to a lesser degree. It should be noted that the following of share prices is guided according to securities' profitability. Transfer to profitability allows to study the influence of factors on

share prices and to make a correct comparison of events and companies [19; 20]the authors want to see if a surprise (originating from macroeconomic news and GFC events.

Data

In order to test the influence of the news sentiment on share prices, we collected news about companies included in the Moscow exchange index from the middle of 2017 to the beginning of 2019 (49 companies). These particular companies have been chosen because the Moscow exchange index represents the most liquid securities of the Russian stock market. Securities liquidity is a part of the foundation of this research because due to liquidity we have an opportunity to observe the short-term response of market players to various events. Apart from liquidity, one of the characteristic features of the compiled selection is the existence of available quotes for the period analysed in the research. Initially the selection consisted of 65 securities, however, to make the results more reliable we excluded preferred shares and shares of the companies which have been taken off the quotation list of the Moscow Exchange. See the distribution of companies, which comprised the final selection, arranged by industry, in Figure 1.

Figure 1. The distribution of companies by industry in the final sample



The selection comprises news on dividends and opportunities for the growth of a company, because this type of news is published for the majority of companies, and is the key one for investors. Thus, we ensure the uniformity of a selection. The data on news was collected via the Thomson Reuters information resource. In accordance with the news classification used by Thomson Reuters, we selected news from five categories: capital expenditure, corporate valuation, dividends, revenue drivers, and scalability. The final selection comprised 4,517 news items from about 49 companies. See the distribution of news into categories in Table 1.

Table 1. Distribution of news into categories

Type of news	Thomson Reuters tag	Number of news items
Capital Expenditure	CAPX	572
Corporate Valuation	CVALU	2
Dividends	DIV	2,340
Revenue Drivers	REVDRV	452
Scalability	SCALE	1,151
Total		4,517

For each considered company we collected data on security returns on share as well as the company key performance indicators which characterise the company size, profitability, and financial structure. We also collected data return the Moscow Exchange index (IMOEX) necessary to implement the methodology described below.
Considering financial and non-financial indicators (Table 2) one can notice that on average the companies from the sample have more than a quarter of free float with a small variation. The financial leverage coefficient, on average, amounts to 1.38 for the companies from the selection. However, it should be noted that there are companies which have debt capital in excess of their equity capital by a factor of 26 which means that the company status is unstable and highly risky. There are also companies with a negative financial leverage, due to their negative equity capital.

Table 2. Descriptive statistics of financial and non-financial indicators

Variable	Average value	Standard deviation	Minimum value	Maximum value
Free Float	29%	0.19	2%	96%
Leverage	1.38	8.51	−55.22	26.04
ROA	0.23	0.22	0.00	1.97
dTot.Ass	0.07	0.12	−0.22	0.79
Div/EBIT	0.32	0.24	0.00	1.33
dRevenue	0.07	0.12	-0.32	2.03

Methodology

Our methodology for studying the influence of the sentiment of disclosed information on share prices is divided into three stages. At the first stage, we estimate of the news text sentiment with the use of dictionaries. At the second stage, we calculate the abnormal return as an indicator of investors' response to the news by using of the event study method. At the third stage of the analysis, we build a multiple linear regression in which the abnormal return is the dependent variable and the explanatory factors are news categories, and financial and non-financial characteristics of a company which may potentially influence the investors' response.

Sentiment analysis. The algorithm of text sentiment analysis comprises several steps. First, each text paragraph is divided into sentences and each paragraph and sentence is assigned a score. Each set of such sentences is divided into a structured bag of words and assigned a score. The obtained sets of words are purged of punctuation marks, except for commas, colons and semicolons, because they emphasise phrases which differ in sentiment. The second step consists of the search for and comparison of each word of the obtained selection to sentiment dictionary. Each negatively and positively evaluated word is marked with +1 and −1, respectively. Then the algorithm / the package (or passive voice) - we do not do it manually, it is done automatically divide the text into clusters according to the sentiment of phrases. At the end of the second step we have text clusters, and each of them has its characteristic features (neutral, intensifier or de-intensifier). At the third step, we calculate the general meaning of sentiment for the text. For this purpose we calculate the function on the basis of the number of words in a sentence, clusters in a sentence, and sentences in the text, and also take into consideration the punctuation. The obtained score of sentiment of each sentence of the text is the foundation for calculation of the value of the text sentiment as the weighted average of the score of sentences in the text of each news item under consideration.

Thus, each event's emotional loading is evaluated numerically, where 0 is neutral, greater than 0 is positive, and less than 0 is negative. This method allows us not merely to evaluate the emotional sentiment of news but also to indicate the intensity of such colouring. The bigger the csentiment score, the greater the event's emotional load is.

As noted previously, in this research we used the SentimentR package developed by T. Rinker [21] on the basis of the thesaurus by M. Hu and B. Liu [22] and M. Jockers [23] in order to define the sentiment of corporate news texts. Inasmuch as this tool is developed for English texts we considered news only in the English language.

Abnormal return calculation. The event study method implies observing the response of the stock market (abnormal return measured as) which was caused by the event and defining the statistical significance of the response. Using this method, the researchers focus on the abnormal return which takes place in a short period before and after the event, and is defined as the difference between the actual and normal return, i.e. the expected security return, provided the event has not taken place [17].

In this research, news regarding information on dividends

or plans related to company development is considered to be an event. For each news item the publication date and actual return on a corresponding security is defined. The normal return may be calculated in several ways, but the most widespread one is the market model in which the dependence between the return of a corporate security and the return of a corresponding stock market index is built. It is supposed that the market index is almost unaffected by a separate corporate event but it takes into consideration all other information in the market. In this research, the normal return model is estimated on the interval of [–60; –30], where 0 is the date of the news publication. As long as investors may take account of new information in the share price for a longer time, and also as long as the news publication date may be defined inaccurately, in this research we consider the cumulative abnormal return for 5 days within the interval of [–2; 2]. The cumulative abnormal return is calculated as the sum of abnormal returns for such time interval.

The factors of the abnormal return. At the third step we apply the regression analysis to assess the influence of the news sentiment on the cumulative abnormal return calculated at the previous stage. Company characteristics and news category are used as control variables of the model, and the impact of the company and year are also added. The change of revenue and assets of the company are included as indicators of the company size change. The revenue change also describes the category of expected revenue, while the assets change reflects - capital investments. The ratio of paid dividends to earnings before interest and taxes (EBIT) was chosen as the indicator which characterises the dividend policy of the company. Following the fundamental analysis theory, it is supposed that market players take a decision on investment mainly on the basis of information of the previous year. Thus, it should be specified that all the above listed indicators were taken with a one-year lag.

So, we get the following equation:

$$\begin{aligned} CAR_{ij} &= \alpha_0 + \alpha_1 \times Sent_i + \alpha_2 \times SCALE_{ijt} + \\ &+ \alpha_3 \times DIV_{ijt} + \alpha_4 \times CAPX_{ijt} + \\ &+ \alpha_5 \times REVDRV_{ijt} + \alpha_6 \times CVALU_{ijt} + \\ &+ \alpha_7 \times dREV_{ijt} + \alpha_8 \times dAssetsV_{ijt} + \\ &+ \alpha_9 \times DivEBIT_{ijt} + \alpha_{10} \times ROA_{ijt} + \\ &+ \alpha_{11} \times GOV_{ijt} + \alpha_{12} \times FF_{ijt} + \\ &+ \alpha_{13} \times LEV_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (1)$$

where

i – the index of the company;

j – the index of the news;

t – year of the news item publication;

$\alpha_i, \forall i$ – model parameters;

CAR_{ij} – cumulative abnormal return;

$Sent_i$ – event sentiment score;

$SCALE_{ijt}$ – dummy variable responsible for the news on the company expansion;

DIV_{ijt} – dummy variable responsible for the news on dividends;

$CAPX_{ijt}$ – dummy variable responsible for the news on capital expenditure;

$REVDRV_{ijt}$ – dummy variable responsible for the news on revenue drivers;

$CVALU_{ijt}$ – dummy variable responsible for the news on the company valuation;

$dREV_{ijt}$ – indicator of the annual change of revenue;

$dAssets_{ijt}$ – indicator of the annual change of assets;

$DivEBIT_{ijt}$ – ratio of dividends to EBIT;

ROA_{ijt} – return on assets ratio;

GOV_{ijt} – dummy variable government ownership;

FF_{ijt} – Free Float;

LEV_{ijt} – financial leverage;

ε_{ijt} – error term.

In order to test hypothesis 2 on the diminishing of the marginal effect of sentiment, the square of the sentiment score is added to the model, and an inverted U-shape dependency is presumed.

Results

As we see from the regression analysis results (Table 3) we discovered a positive influence on investor's reaction of the sentiment of news about the company. In case of increase of the sentiment score by one standard deviation (0.1225), the cumulative abnormal return of Russian companies' shares increases by 0.0026. It is an economically significant effect, because the average daily return on shares within the period under consideration amounted to 0.0002. Thus, hypothesis 1 is confirmed and the result is stable for the models under consideration. Consequently, Russian stock market players tend to respond to the news sentiment.

As for hypothesis 2, it is not confirmed: the sentiment square indicator is insignificant in all models. This proves that the effect of the news sentiment on investors' response does not diminish even at relatively high values of the sentiment indicator.

Analysis of the influence of control variables on the cumulative abnormal return shows that almost all ratios meet expectations. First, state participation in the company shareholding structure increases the cumulative abnormal return by 0.0320. Consequently, the market players on a short-term horizon respond more strongly to the news about a company with public ownership. This may be related to the fact that companies with public ownership are more exposed to country risk and sanctions risk, and this makes the investors respond to news on development more positively. Second, the Free Float part has an adverse effect on investors' response: when the Free Float indicator grows

by 1%, the cumulative abnormal return decreases by 0.326 or 0.06 per day, while the daily return on shares is 0.0002. Such an inverse correlation may be related to the fact that the market players trust more the companies with higher liquidity and more extensive capital in the free market because the companies with a small number of principal shareholders may act in favor of such majority shareholders, and to the disadvantage of minority shareholders. The indicator of the corporate assets change is significant at a 10% level of significance. So, we may note that in case of an increase of the rate of asset growth by one standard deviation, the cumulative abnormal return is higher by 0.0025. The dividend payout level (ratio of dividends to EBIT) has a positive impact in investors' response: in case of an increase in the dividend payout indicator by one standard deviation, the cumulative abnormal response of investors grows by 0.0002. Consequently, if a company develops and pays dividends it is indicative of the company's ability to attract internal and (or) external financing for both mentioned aspects of activity which increase the shareholders' profit. The indicators of return on assets and change of revenue for the previous year, contrary to expectations, have a negative effect on response. Probably, it is caused by the fact that these indicators are taken with a one-year lag and are indicative of the existing corporate development trends. Thus, the companies which previously have been developing quickly should meet the investors' expectations. Apart from that, dummy variables for 2018 and 2019 are positively significant and this testifies towards a more positive investors' response to news about the company development in these years in comparison to 2017. The financial leverage indicator and news categories turned out to be insignificant.

Table 3. Regression analysis results

Factor	Model without effects	Model with effects on news and years	Model with effects on news, years and company	Model with effects on news, years, company and company characteristics	Model without effects	Model with effects on news, years, company and company characteristics
Sentiment	0.0212*** (0.0054)	0.0229*** (0.0057)	0.0119** (0.0056)	0.0125** (0.0056)	0.0301** (0.0143)	0.0161 (0.0141)
Square of the sentiment indicator	-	-	-	-	−0.0190 (0.0242)	−0.0074 (0.0241)
News on capital investments		−0.0522** (0.0263)	−0.0278 (0.0299)	−0.0265 (0.0299)		−0.0265 (0.0299)
News on dividends		−0.0479* (0.0263)	−0.0206 (0.0298)	−0.0199 (0.0298)		−0.0199 (0.0298)
News on expected revenue		−0.0461* (0.0264)	−0.0233 (0.0299)	−0.0226 (0.0299)		−0.0226 (0.0299)
News on company expansion		−0.0535** (0.0264)	−0.0266 (0.0298)	−0.0256 (0.0298)		−0.0256 (0.0298)
2018		0.0105*** (0.0024)	0.0105*** (0.0024)	0.0080*** (0.0026)		0.0080*** (0.0026)
2019		0.0216*** (0.0050)	0.0203*** (0.0059)	0.0203*** (0.0059)		0.0350*** (0.0068)
Public capital				0.0319** (0.0136)		0.0318** (0.0136)
Free Float				−0.3262* (0.1931)		−0.3255* (0.1926)

Factor	Model without effects	Model with effects on news and years	Model with effects on news, years and company	Model with effects on news, years, company and company characteristics	Model without effects	Model with effects on news, years, company and company characteristics
Leverage				0.0000 (0.0007)		0.0000 (0.0007)
ROA				–0.1979*** (0.0489)		–0.1979*** (0.0489)
Change of assets				0.0210* (0.0127)		0.0211* (0.0127)
Ratio of dividends to EBIT				0.0178* (0.0105)		0.0178* (0.0105)
Change of revenue				–0.0185* (0.0112)		–0.0184 (0.0112)
Company effects				included		included
Constant	0.0002 (0.0012)	0.0398 (0.0264)	0.0186 (0.0304)	0.1111* (0.0597)	–0.0009 (0.0168)	0.1105* (0.0596)
R^2	0.0028	0.0141	0.0873	0.0945	0.0029	0,0945
Number of observations	4,114	4,114	4,114	4,114	4,114	4,114

***, **, * – significance at a 1, 5 and 10% level, respectively.

News on the study of companies' value, and 2017, have been taken as basic categories.

Conclusions

This research is dedicated to an analysis of the influence of sentiment of news about Russian companies on the security returns. Based on our research results, we may draw a conclusion as to a positive direct influence of news sentiment on share prices. Thus, the Russian stock market players are exposed to the influence of news sentiment. This result may be due to the fact that investors and speculators are psychologically predisposed to perceive information from the point of view of emotions. It may also be influenced by the economic and political state of the country, in accordance with which each news item may be perceived as either part of a new market decline, or the beginning of a growth phase. It is probable that serious uncertainty keeps the market players in a constant state of tension, and they start taking decisions unreasonably, and on the basis of emotions. Due to the fact that market players often overestimate companies and their prospects on the date that information is published, results may prove greater than expected, and the players quickly purchase the securities of companies where they expect even greater growth. This result may also be aligned with the global geopolitical environment. Each year a new set of sanctions is adopted against Russia, and they limit opportunities for development for different countries. In circumstances of such great uncertainty, the information contained in the news sentiment may prove to be grounds for taking decisions on the allocation of capital. Thus, the sentiment of published news is taken into consideration by Russian stock market players as a part of information, and it influences the dynamics of share prices statistically and economically. It is important to note that the marginal effect of news sentiment does not diminish. This is indicative of a high potential for the news sentiment effect to be used in order to influence market players' response via company management and information intermediaries.

Our results show that Russian public companies should put efforts into the delivery of emotionally positive information to investors. They also should not forget the general company efficiency. Otherwise, share prices may decrease minimally, on a short-term horizon.

Due to the fact that the result of the paper is a significant coefficient of sentiment in terms of specific events, the traders involved in algorithmic trading should include these coefficients in their trading algorithm, together with an analysis of company characteristics.

It should be noted that this research has a series of restric-

tions. First, we do not present a detailed analysis of news content because of the heterogeneity of disclosed information. Taking into consideration the qualitative and quantitative aspects of information contained in the news (and those factors related to its emotional colouring) may give a more accurate estimate of the effect of sentiment. We also considered news only in English, so this analysis may be insufficient due to a lack of knowledge of the English language by Russian market players. Second, deviation of data from normal distribution could result in inacurrate estimates. Aside from these factors, Russia has a tough economic situation due to sanctions, a dependence of the majority of industries on prices for hydrocarbons, and drops in living standards. Thus, the conclusions in this paper may be displaced with regard to the development of more "normal" economics.

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Signalling and Legitimacy Theories for Explaining Climate Information Disclosure by Russian Companies

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Abstract

This paper studies the factors influencing the level of climate-related disclosure by Russian companies. It has several distinctive features in comparison to previous works: 1) climate change disclosure by Russian companies is studied for the first time; 2) textual analysis is used to evaluate the level of disclosure, and a new Russian glossary on climate change is compiled; 3) a unique set of indicators is used to assess the impact of factors on climate change disclosure. Legitimacy and signalling theories are used to formulate the hypotheses. The sample consists of 47 Russian companies with the largest market capitalization. Their 235 annual and sustainability reports for 2015-2019 are analysed. Using regression analysis, we show that a company's absolute amount of greenhouse gas emissions, size, industry affiliation, and CDP rating positively affect its level of disclosure about climate change. In contrast, state ownership and a high debt burden have a negative impact. At the same time, the newness of assets, capital expenditures, interest coverage and company growth opportunities have no effect on climate change disclosure. Empirical results have confirmed the applicability of legitimacy theory to the Russian market. The present study will provide investors and regulators with tools for predicting a company's impact on climate based on its level of climate change disclosure.

Key words: climate change, greenhouse gas, information disclosure, textual analysis, signalling theory, legitimacy theory

Introduction

Climate change is one of the most important challenges facing society today on account of the gravity of its possible consequences: changing weather, natural disasters, falling harvests, sea level rise, growing flood hazard, etc. Climate change is having a global impact of an unprecedented scale on the planet and is bound to affect the international economy. In 2019, extreme weather conditions caused by climate change resulted in global losses of $100 billion [1]. By 2050, cumulative losses from climate change may amount to $8 trillion, reducing the global GDP by 3% [2]. Climate change may have an even more serious impact on the Russian economy: proliferating droughts, floods, forest fires, and permafrost thaw may result in the GDP falling by 3% even before 2030 [3].

Consequently, a lot of institutional investors take climate-related risks into account when making investment decisions. To this end, they ask companies to disclose climate information [4]. Moreover, a number of central banks and financial regulators have developed a system of requirements for climate-related disclosure to make the evaluation of climate-related risks more accurate. The growing demand for climate-related information encourages companies to consider its disclosure. Still, despite the universality of this trend, the disclosure of such information by companies is inhomogeneous.

The purpose of the present study is to identify the factors that influence the level of climate-related disclosure by Russian companies. It has the following research objectives: 1) revealing the theoretical concepts behind corporate information disclosure; 2) analysing previous empirical studies to identify the factors that influence climate-related disclosure in practice; 3) compiling a glossary on climate change; 4) analysing annual corporate reports concerning climate-related disclosure using the bag-of-words method; and 5) constructing a regression model to identify the factors of climate-related disclosure.

The present paper has several distinctive features compared to previous works: 1) climate change disclosure by Russian companies is studied for the first time; 2) textual analysis is used to evaluate the level of disclosure, and a Russian glossary of climate change is compiled; 3) for the first time, a unique set of indicators is used to assess the impact of factors on climate change disclosure.

Literature Review and Research Hypotheses

Most academic research has studied factors influencing voluntary information disclosure by companies [5–7]. In addition, many papers have described the factors influencing one of the most important spheres of voluntary information disclosure – environmental data [8; 9]. Some studies have considered the factors of information disclosure related to the narrower yet not less important problem of climate change [10].

Research literature uses two theories to explain the nature of information disclosure by companies: legitimacy and signalling theories. Legitimacy theory assumes that a company as a social institution operates on the basis of a social contract that ensures its legitimacy [11]. In order to maintain their legitimacy, companies have to observe laws and regulatory requirements as well as complying with ethical standards and societal values [12]. Public information about a company determines how it is perceived by society, and so information disclosure is an important tool for obtaining legitimacy. Company management may use this tool to manage its perception by society if legitimacy is lacking [11; 12]. The disclosure of information can show that a company is addressing important social problems and trying to facilitate their solution, which may help it to get approval for continuing its activities. The climate change problem is one of the key societal concerns today, which is confirmed by the close attention it gets in public

corporate materials. In addition, climate-related disclosure may help a company to improve its image for "prolonging the social contract" and reducing the public and regulatory pressure.

Signalling theory asserts that companies disclose information about themselves to send a signal to investors and society in general about their superiority over competitors. Such signals allow companies to distinguish themselves from others and to avoid the problem of adverse selection [13]. Thus, in accordance with signalling theory, climate-related disclosure is an indicator for investors and society in general about climate-related company activities and about company efforts to reduce climate-related risks and climate impact. Climate-related disclosure is an important tool to send signals that would attract investments, enhance reputation and obtain important competitive advantages [13].

Legitimacy and signalling theories offer different explanations for the influence of actual corporate climate impact on the level of information disclosure about this issue. The most frequent type of company climate impact is greenhouse gas emissions [14; 15]. Greenhouse gas emissions, most of which are produced by anthropogenic activity, accumulate in the atmosphere and cause the temperature on the planet to rise [16]. Legitimacy theory presumes that companies with large emissions attract more attention from society and therefore have to disclose more climate-related information in order to reduce public pressure and risks of legitimacy loss [11]. Thus, legitimacy theory predicts a positive relation between the amounts of emissions and climate-related disclosure [11; 12]. According to signalling theory, companies with less emissions increase information disclosure in order to provide information about their performance to investors and demarcate themselves from companies that have a serious impact on climate [13]. Consequently, signalling theory predicts a negative correlation between the amount of greenhouse gas emissions and the level of climate-related disclosure.

In this paper, we try to use both theories for making hypotheses about the influence of greenhouse gas emissions on climate-related disclosure:

H1a: *the amount of greenhouse gas emissions has a positive impact on climate-related disclosure (legitimacy theory).*

H1b: the amount of greenhouse gas emissions has a negative impact on climate-related disclosure (signalling theory).

Apart from the actual impact produced by a company on the climate, we consider two other qualitative factors which may influence climate-related disclosure – state ownership of company shares and industry affiliation. According to legitimacy theory, state-owned companies should attract greater attention from society and stakeholders, while the management of state-owned companies should be subject to greater control and monitoring. The assumption is that the government is more interested in a high-quality environment than private companies and so will require state-owned companies to disclose more information on this issue [17; 18]. For this reason, we make the following assumption:

H2: state participation in corporate equity capital has a positive influence on climate-related disclosure.

According to legitimacy theory, companies from industries with the greatest climate impact have to disclose more information in order to improve their social image and justify their activities to society. Oil and gas, electric power, cellulose fibre, chemical, transport and metallurgic companies are considered to have the most negative impact on climate [19]. These companies have greater climate-related risks and spend more money for reducing their influence on the climate. Therefore, they have to disclose more information about themselves in order to enhance transparency, prevent regular inspections and prolong their social contract [20]. This leads to the following hypothesis:

H3: the affiliation of a company with a "polluting" industry has a positive impact on climate-related disclosure.

We also propose to use the Carbon Disclosure Project (CDP) rating as a factor influencing information disclosure. This rating is assigned by an international non-commercial organisation that manages the largest global platform for the disclosure of climate-related information obtained voluntarily from approximately ten thousand companies all over the globe. CDP collects information from companies about their impact on the climate, climatic strategy, corporate governance system and management of climate-related risk. It then employs a sophisticated methodology to assign a rating indicative of the company's efficiency and transparency in the field of climate change. CDP ratings are in high demand among investors: over 500 investors which manage assets amounting to approximately $106 trillion require companies to disclose information using the CDP system. It is supposed that companies with high CDP ratings will disclose more information in their reports, because they have already collected, processed and analysed such information. Insofar as they have already made major expenditures on providing information to the CDP, companies with a high rating will not incur a lot of additional costs to disclose climate-related information in their reports. Therefore, we make the following assumption:

H4: companies with a high CDP rating will disclose more climate-related information.

In this study, we also use a series of control variables characterizing corporate financial indicators, including company size, profitability, debt burden, age of assets, capital expenditures, and growth opportunities.

According to legitimacy theory, large companies will use information disclosure in order to legalize themselves in the eyes of society [21]. The assumption is that such companies attract more attention due to their size and therefore have to disclose more information about themselves in order to justify their activities [20]. In addition, measures aimed at reducing their climate impact require significant financial resources. Large companies have more financial opportunities to cover such expenses. As a result, they will disclose more climate-related information because they

have made greater progress in reducing their impact on the climate.

From the standpoint of legitimacy theory, companies with higher profitability attract greater societal attention to the ways they make their profits. In order to mitigate public pressure and justify their high profitability, such companies have to disclose more information about themselves. This allows them to obtain legitimacy in society.

Companies with a high debt burden attract more attention from creditors, among others. The creditors of a company demand more information in order to assess risks, which explains the higher level of voluntary information disclosure by companies with a bigger debt burden [22].

Newer assets manufactured with the help of advanced technologies tend to release less emissions into the atmosphere [22]. Thus, companies with more advanced equipment produce a smaller negative effect on climate and, as a consequence, disclose more information on their climate impact [23].

Capital expenditures are normally used to purchase new assets or update and modernize old ones, and so companies with high capital expenditures reduce their emissions and disclose climate-related information more willingly [24]. Besides, companies with high capital expenditures disclose more information in order to justify their expenses by demonstrating the reduction of their impact on the climate.

As a company's growth opportunities expand, information asymmetry between managers and investors increases, which complicates the evaluation of the market value of corporate assets [19]. As a result, a company will be keen to reduce information asymmetry by means of a higher level of disclosures [26]. This leads to our next hypothesis:

H5: the financial indicators of a company influence climate-related disclosure, with company size, profitability, debt burden, capital expenditure, and growth opportunities having a positive impact and age of assets having a negative one.

Research Methodology

Many studies of voluntary information disclosure in the sphere of environment and climate impact use textual analysis as a research method [5; 27; 28]. Most of these papers employ the data of companies from developed economies such as the USA, Canada, Japan, Australia, and the EU, while only a few studies have been dedicated to companies from emerging economies.

In this paper, we also apply textual analysis using the bag-of-words method to assess the level of disclosure by companies. Several glossaries on climate change compiled by major international organisations such as Intergovernmental Panel on Climate Change (IPCC) [29], the UN (the glossary of terms used by the United Nations Framework Convention on Climate Change (UN FCCC) [30]), and the World Bank [31] were used by the authors to make their own glossary of 500 words related to climate. The words in the glossary have been adapted to the Russian language and our research objectives. First of all, we excluded words that are not directly related to climate change (e.g., "risk", "sustainability", and "impact"). Secondly, we translated these words into Russian and added their synonyms. Thirdly, we lemmatized the words (i.e., inflected them up to their lemma or base form [32]) in order to evaluate word frequency correctly and take all possible word forms into account. Special word form vocabularies were used for lemmatization. They helped to inflect search words and the text in which the search was performed. As a result, contextual search can now be used to find search words.

After lemmatization, we calculated the frequency of use of each word in the glossary and then summed it for all the words in the glossary to obtain the overall number of occurrences of words related to climate change in corporate reports. Finally, we normalized the number of occurrences of words from the glossary against the total number of words in the report in order to balance the size differences between corporate reports. As a result, the following formula was used to calculate the endogenous variable (1):

$$CD_{ij} = \frac{\sum \text{Climate words}_{ij}}{\text{Words}_{ij}}, \quad (1)$$

where CD_{ij} is the normalized number of climate-related words from the glossary that are used in the report;

$\text{Climate words}_{ij}$ is the number of repetitions of each climate-related word from the glossary;

Words_{ij} is the total number of words in a report.

We chose the amount of greenhouse gas emissions caused by a company's activities (scope 1 and 2 – direct and indirect energy emissions) measured in tons of CO_2-equivalent as the variable responsible for the company's direct impact on the climate. This indicator is very often used by studies to measure company impact on climate [14; 15]. To analyse the influence of this factor on the disclosure level, we used the amount of emissions both in absolute terms (GHG_{ij}) and relative to assets for the purpose of balancing company size (GHG_assets_{ij}).

Government ownership in corporate equity capital (Gov_{ij}) is expressed as a dummy variable (1 – the state is one of the company owners, 0 – otherwise). The dummy variable (Ind_{ij}) also shows that a company belongs to a polluting industry (1 – belongs, 0 – does not belong) such as the oil and gas, mining and metallurgic, electric power, transportation and chemical industries [19]. Companies from other industries such as telecommunications, consumer goods, and real estate have less impact on climate and are therefore considered to be non-polluting industries.

CDP assigns a rating to companies on the basis of the data they provide using a scale from A (highest result) to F (refusal to furnish data). We renumbered this letter-based

scale in an ordered manner (CDP_{ij}): an A rating corresponds to 5 points, B to 4, C to 3, D to 2, E to 1, and F to 0.

Many papers use a company's assets to assess its size [11; 22; 35]. In our sample, we used the normal logarithm of this indicator expressed in roubles ($\ln\_assets_{ij}$).

To describe profitability, we used the return on assets (ratio of net profit to assets - roa_{ij}) and the net profit margin (ratio of net profit to revenue – $margin_{ij}$), just as in other research on similar topics [33; 34].

To measure the corporate debt burden, we chose the ratio of debt to assets (DA_{ij}) and the interest coverage (ratio of operating profit to interest payments – $Interest\_cov_{ij}$) along the lines of previous studies [22; 34].

The age of assets ($Assets\_age_{ij}$) was defined as the ratio of the fixed assets on the books net of depreciation to the fixed assets regardless of depreciation. The higher the ratio, the newer the corporate assets [19]. We also made use of the capital expenditure amount ($Capex\_rev_{ij}$) normalized by the company's revenue as in [19].

Previous studies have used Tobin's Q to assess corporate growth opportunities [19; 22; 25]. This coefficient is equal to the ratio of a company's market value to the book value of its assets ($Tobin\_Q_{ij}$). An increment in this ratio implies an increase in the company's expected growth opportunities.

All of the above hypotheses were verified by means of regression analysis. The evaluated regression is fully represented by the following formula (2):

$$CD_{ij}=const+\beta_1 \cdot ln\_assets_{ij}+\beta_2 \cdot roa_{ij}+\beta_3 \cdot margin_{ij}+$$
$$+\beta_4 \cdot DA_{ij}+\beta_5 \cdot Interest\_cov_{ij}+\beta_6 \cdot Assets\_age_{ij}+$$
$$+\beta_7 \cdot Capex\_rev_{ij}+\beta_8 \cdot Tobin\_Q_{ij}+\beta_9 \cdot Gov_{ij}+\beta_{10} \cdot Ind_{ij}+$$
$$+\beta_{11} \cdot GHG_{ij}+\beta_{12} \cdot GHG\_assets_{ij}+\beta_{13} \cdot CDP_{ij},$$

where $const$ is the intercept term;

β_i are the regression coefficients;

$\ln\_assets_{ij}$ is the natural logarithm of the assets;

roa_{ij} is the return on assets;

$margin_{ij}$ is the net profit margin;

DA_{ij} is the debt per unit assets;

$Interest\_cov_{ij}$ is the ratio of operating profit to interest payments;

$Assets\_age_{ij}$ is the ratio of fixed assets net of depreciation to fixed assets with depreciation;

$Capex\_rev_{ij}$ is the capital expenditures per unit revenue;

$Tobin\_Q_{ij}$ is Tobin's Q;

Gov_{ij} is the government participation in equity capital;

Ind_{ij} is the affiliation with a polluting industry;

GHG_{ij} is the amount of greenhouse gas emissions;

GHG_assets_{ij} is the amount of greenhouse gas emissions per unit assets;

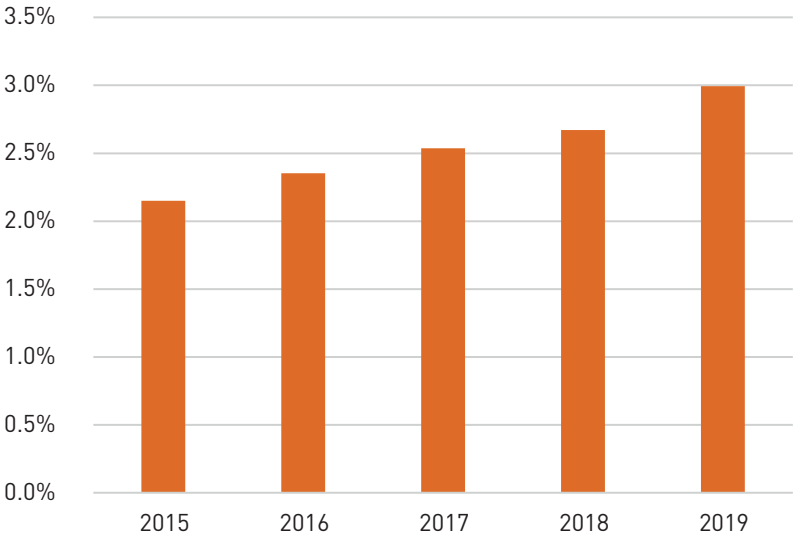
CDP_{ij} is the company rating assigned by the CDP.

Data Analysis and Research Results

Our sample was based on the annual and sustainable development reports of 47 Russian companies with the greatest capitalization from 2015 to 2019. We analysed 235 reports in all.

Figure 1 shows the annual dynamics of the dependent variable CD_{ij}. Amid the rising interest in climate change, Russian companies increased their levels of climate information disclosure from year to year.

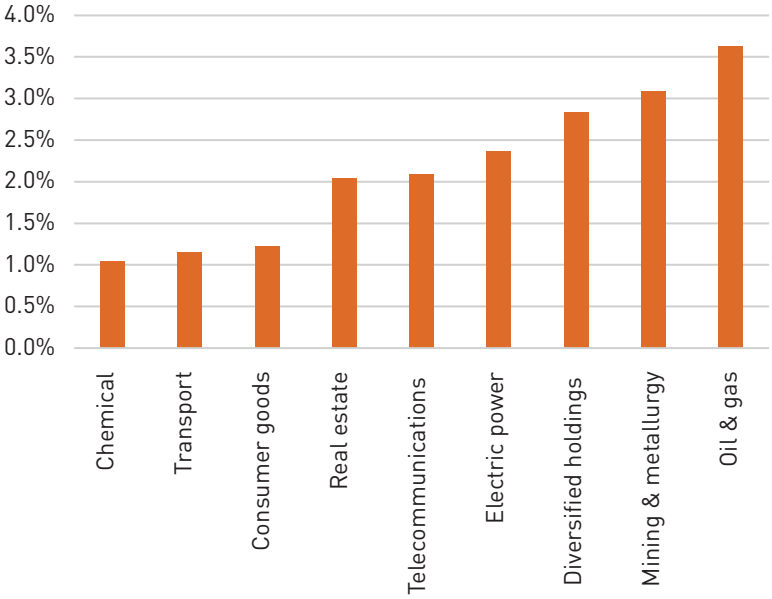
Figure 1. Level of climate information disclosure (CD_{ij}) in 2015–2019



Source: authors' calculations.

When we broke the companies down by industry, the highest level of climate information disclosure was observed in enterprises from the oil and gas and metallurgic industries (Figure 2). The lowest level of information disclosure was shown by companies from the chemical and transportation industries.

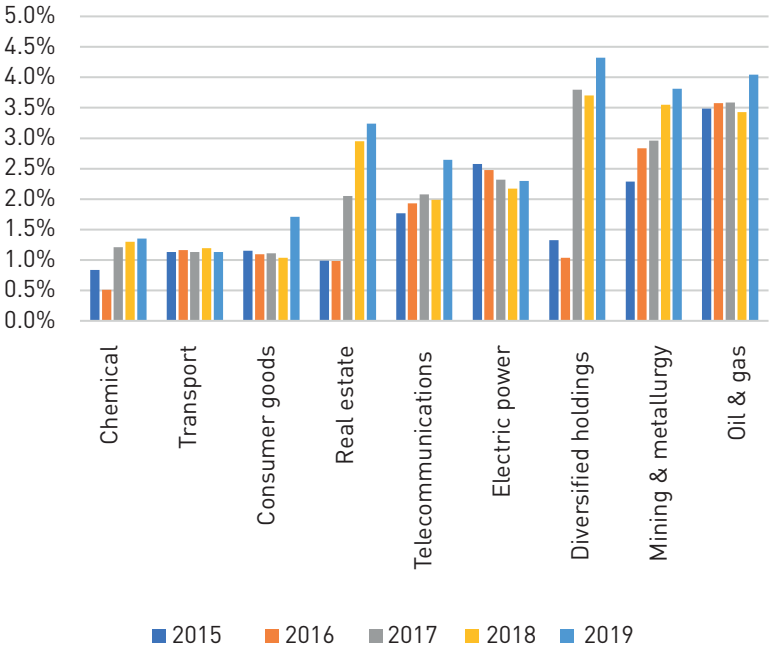
Figure 2. Average level of climate information disclosure (CD_{ij}) by industry in 2015–2019



Source: authors' calculations.

When we broke climate information disclosure down by year, it became clear that companies from almost all industries except for transportation increased their level of climate information disclosure in 2019, which shows the growing relevance of this issue for business (Figure 3). In 2015–2019, the greatest progress in climate information disclosure was observed for real estate companies and diversified holdings, which more than tripled their amount of disclosed information. Electric power companies showed a downward trend, reducing their climate information disclosure by 10%.

Figure 3. Level of climate information disclosure (CD_{ij}) by industry in 2015–2019



Source: authors' calculations.

In addition, we calculated the semantic distance between the ten most frequent words (phrases) from the authors' climate glossary. Table 1 presents the results of this analysis. The closest semantic distance was found between the words "atmosphere", "emissions", "pollution", "greenhouse gas", and "air".

Table 1. Semantic distance

	Atmosphere	Emissions	Pollution	Greenhouse gas	Air	Pollution	Climate	Temperature	Decarbonization	Warming
Atmosphere	1.000	0.880	0.840	0.787	0.759	0.494	0.418	0.257	−0.003	−0.055
Emissions	0.880	1.000	0.829	0.911	0.786	0.520	0.476	0.224	−0.068	0.091
Pollution	0.840	0.829	1.000	0.676	0.774	0.596	0.225	0.162	−0.183	−0.052
Greenhouse gas	0.787	0.911	0.676	1.000	0.682	0.493	0.579	0.176	0.053	0.177
Air	0.759	0.786	0.774	0.682	1.000	0.762	0.488	0.409	−0.015	−0.188
Pollution	0.494	0.520	0.596	0.493	0.762	1.000	0.500	0.410	0.038	−0.114
Climate	0.418	0.476	0.225	0.579	0.488	0.500	1.000	0.186	0.155	0.284
Temperature	0.257	0.224	0.162	0.176	0.409	0.410	0.186	1.000	0.278	−0.051
Decarbonization	−0.003	−0.068	−0.183	0.053	−0.015	0.038	0.155	0.278	1.000	0.134
Warming	−0.055	0.091	−0.052	0.177	−0.188	−0.114	0.284	−0.051	0.134	1.000

Source: authors' calculations.

Table 2 offers descriptive characteristics of the studied variables. On average, the words from the authors' glossary relating to climate change amounted to 2.5% of the total number of words in reports. Moreover, not a single word from the glossary (CD = 0) was used in earlier reports of companies with a relatively low market capitalization: En Plus (2015, 2016), Nizhnekamskneftekhim (2015, 2016), Evraz (2015), Transneft (2015), RussNeft (2015). The highest frequency of words (CD = 9.2%) was found in the 2018 report by NLMK.

Table 2. Descriptive statistics

	Minimum	First quartile	Median	Mean value	Third quartile	Maximum
CD	0.0000	0.01436	0.02072	0.02541	0.03211	0.9169
ln_assets	10.58	12.28	13.06	13.17	13.86	16.90
Roa	−42.702	3.670	7.365	9.143	12.924	53.603
margin	−25.882	6.045	12.388	14.631	19.073	72.381
DA	0.0000	16.21	26.54	30.70	47.97	87.91
Interest_cov	−25.955	2.653	5.467	24.185	12.769	917.400
Assets_age	0.2837	0.5205	0.6275	0.6068	0.6989	1.0000
Capex_rev	0.007878	0.063481	0.102331	0.125321	0.176133	0.404211
Tobin_Q	0.0053	0.7541	1.1229	1.2552	1.6234	3.3082
Gov	0.0000	0.0000	0.0000	0.3617	1.0000	1.0000
Ind	0.0000	0.0000	1.0000	0.7447	1.0000	1.0000
GHG	48.72	1301.90	5334.50	24518.33	31 215.00	239 970.00
GHG_assets	0.1371	3.1504	9.9166	39.6802	45.6760	402.4594
CDP	0.0000	0.0000	1.000	1.113	1.000	5.000

Source: authors' calculations.

In order to verify the hypotheses, five panel random effect regressions were evaluated with the gradual addition of new regressors. The first model assessed only the influence of emissions in absolute and relative terms (GHG_{ij} и GHG_assets_{ij}) on the disclosure level (CD_{ij}). It and all its variables turned out to be statistically significant at a 5% level. The determination coefficient amounted to 20%. The second model included an additional variable indicative of government ownership of a part of a company (Gov_{ij}), which was also significant at a 5% level. The determination coefficient rose by one percentage point, amounting to 21%. A variable indicative of the company's affiliation with a polluting industry (Ind_{ij}) was added to the third model. It was statistically significant at a 0% significance level. The determination coefficient rose by five percentage points to 26%. The fourth model also comprised a variable indicative of the company's CDP rating (CDP_{ij}), which turned out to be statistically significant at a 0% level. The determination coefficient rose by five percentage points to 28%. At the fifth stage, we added variables characterizing corporate financial indicators ($\ln\_assets_{ij}$, roa_{ij}, $margin_{ij}$, DA_{ij}, $Interest\_cov_{ij}$, $Assets\_age_{ij}$, $Capex\_rev_{ij}$, $Tobin\_Q_{ij}$). In general, this model was statistically significant, as confirmed by the F statistics. The determination coefficient R^2 was at a level of 48%, i.e., about half of the dependent variable dispersion that characterizes the information disclosure level explained by the proposed model. Eight out of 13 variables in the random effect model were significant at least at a 5% level (GHG_{ij}, Gov_{ij}, Ind_{ij}, CDP_{ij}, $\ln\_assets_{ij}$, roa_{ij}, $margin_{ij}$, DA_{ij}). These variables were included in the final panel regression model, which contained only statistically significant variables. Its determination coefficient amounted to 47%. The Breusch–Pagan test proved the absence of heteroscedasticity of random residuals in the final model.

The panel random effect regression model was chosen because it had the best final indicators. The Hausman test was conducted for evaluation. Its zero hypothesis states that the model factors are exogenous, i.e., we should prefer the random effect model, while the alternative hypothesis states that the factors are endogenous, and thus the fixed effect model is more preferable. The significance value of this test exceeded 0.1 (p-value). So, the zero hypothesis should be accepted, and the random effect model should be chosen.

Table 3 shows the characteristics of the considered models.

Table 3. Key characteristics of considered panel regression models with random effect[1]

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Emission indicators						
GHG	1.7976e-07 (2.3920e-08)***	2.0115e-07 (2.5803e-08)***	2.0509e-07 (2.5149e-08)***	1.7298e-07 (2.5971e-08)***	7.5713e-08 (2.6826e-08)**	7.9639e-08 (2.4105e-08)**
GHG_assets	-3.5380e-05 (1.5397e-05)*	-3.7308e-05 (1.5310e-05)*	-4.9348e-05 (1.5261e-05)**	-3.5897e-05 (1.5293e-05)*	5.3231e-06 (1.6740e-05)	
Control variables						
Gov		-4.8881e-03 (2.3096e-03)*	-5.2533e-03 (2.2512e-03)*	-4.8542e-03 (2.1940e-03)*	-9.0504e-03 (2.2640e-03)***	-9.9303e-03 (2.0298e-03)***
Ind			8.6156e-03 (2.3349e-03)***	7.9392e-03 (2.2802e-03)***	6.5101e-03 (2.2053e-03)**	6.4670e-03 (2.0396e-03)**
Company rating						
CDP				3.2437e-03 (8.7563e-04)***	1.9690e-03 (7.9973e-04)*	2.1052e-03 (7.8449e-04)**
Financial indicators						
ln_assets					6.6864e-03 (9.6969e-04)***	6.4936e-03 (8.1747e-04)***

[1] The boxes indicate the values of the coefficient in the model and the standard error in parentheses.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Roa					-3.8978e-04 (1.6763e-04)*	-3.4308e-04 (1.4153e-04)*
margin					3.3871e-04 (1.0598e-04)**	3.3221e-04 (9.5679e-05)***
DA					-1.4138e-04 (5.1477e-05)**	-1.0418e-04 (4.3235e-05)*
Interest_cov					-1.4857e-05 (1.0708e-05)	
Assets_age					-7.7057e-03 (7.7816e-03)	
Capex_rev					6.3467e-04 (1.2175e-02)	
Tobin_Q					2.1173e-03 (1.8544e-03)	
Const	2.2409e-02 (1.2755e-03)***	2.3729e-02 (1.4114e-03)***	1.7826e-02 (2.1091e-03)***	1.4830e-02 (2.2066e-03)***	-6.3236e-02 (1.3538e-02)***	-6.4155e-02 (1.0352e-02)***
Model indicators						
R-Squared:	0.1974	0.21267	0.25667	0.2987	0.48112	0.47263

Level of statistical significance: 0 "***"; 0.001 "**"; 0.01 "*"; 0.05 "."; 0.1 " "

Source: authors' calculations.

Thus, regression analysis shows that the climate information disclosure level may be explained by legitimacy theory, confirming the first hypothesis (*H1a*). Companies with larger emissions in absolute terms attract more attention from society and therefore should disclose more climate-related information in order to reduce public pressure and risks of legitimacy loss. Our results are in line with studies [11; 12]. It should be noted that, in this case, the amount of emissions normalized against company size proved to be insignificant in our sample. This suggests that the general impact of a company's activities on climate is taken into consideration irrespective of its size. Hypothesis H1b is rejected: signalling theory fails to explain climate information disclosure by Russian companies.

Moreover, it is shown (confirming the legitimacy theory) that Russian companies affiliated with polluting industries disclose more climate-related information in order to improve their social image and justify their activities to society. This agrees with our hypothesis (*H3*) and the results of [19].

Legitimacy theory also explains the higher level of climate information disclosure by large companies. Practice has shown that, due to their size, such companies attract more attention and so have to disclose more information to justify their activities. These results are in line with hypothesis (*H5*) and the studies [20; 27].

Russian companies with a higher CDP rating disclose more information on climate, because they have already collected, processed and analysed such information. This confirms our hypothesis (*H4*).

At the same time, debt burden and the state ownership of company capital have a negative influence on the level of climate-related disclosure. This disproves hypotheses *(H2) and (H5)*. This may mean that state-owned companies and companies with a high debt burden lack the necessary funds, labour and time resources for collecting, processing and analysing climate-related information, which is still furnished voluntarily. Our findings contradict the studies [17; 18].

As to profitability, we found a contradictory result that precludes us from making a definite conclusion: the indicators of the return on assets and the net profit were both statistically significant yet had opposite effects on the dependent variable. Unlike previous research results [19; 22; 23], no relation between the level climate information disclosure and the coverage of interest payments, the newness of assets, the capital expenditure level and company growth opportunities was found for Russian companies. This partially contradicts our hypothesis (*H5*).

Conclusion

Today, the issue of climate change evokes the ever greater concerns of society due to its possibly irreversible effects on the planet and serious economic losses. For this reason, many investors and regulators across the globe request that companies disclose more information about their climate impact. However, despite the growing requests, climate information disclosure is still non-uniform among companies. Thus, it is important to understand which factors influence disclosure, which is precisely what our paper does for Russian companies.

The factors that increase climate-related disclosure by Russian companies include the amount of greenhouse gas emissions, company size, its affiliation with a polluting industry, and its CDP rating. At the same time, state ownership and a high debt burden discourage a company from disclosing climate-related information.

Our study provides practical tools for identifying the factors influencing the level of climate-related disclosure by Russian companies, which is important for investors, regulators and other stakeholders interested in increasing company transparency about climate impact. In particular, our results may prove useful for investors who choose companies for their portfolios by using the criterion of information transparency about climate impact. They may also be useful for financial regulators defining requirements for non-financial information disclosure.

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Support of State and Private Institutions for Biomedical Start-ups in Russia

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Abstract

This paper describes the differences between biomedical start-ups with state support and start-ups with support provided by private market participants in Russia as a country with limited private investments. Based on the sample of Skolkovo biomedical start-ups, we analyse ownership and management characteristics of start-ups as well as the performance of companies supported by these two types of institutions.

To compare start-ups supported from different sources, the sample of biomedical companies is divided into four clusters based on the presence of state and/or private support. The results of cluster characterization indicate that start-ups with different types of support vary significantly in ownership concentration, share of managerial ownership, gender diversity and CEO experience.

Although tests for differences among the groups' mean values showed the insignificance of performance variation among clusters, start-ups with private funding in the sample were mostly smaller-sized companies with fewer patents and employees. At the same time, start-ups that were supported from both private and state sources performed better on average in the number of employees and patents and the presence of revenue. Although the causal relationship between the type of support and start-up performance is not investigated in this paper, our results suggest the importance of the synergy of state and private support for biomedical start-up performance in Russia.

Besides contributing to the literature on start-up support in emerging markets, this paper is, as far as we know, one of the first academic studies to provide insights into the market of Russian biotech start-ups.

Key words: biotech start-ups, state support, emerging markets

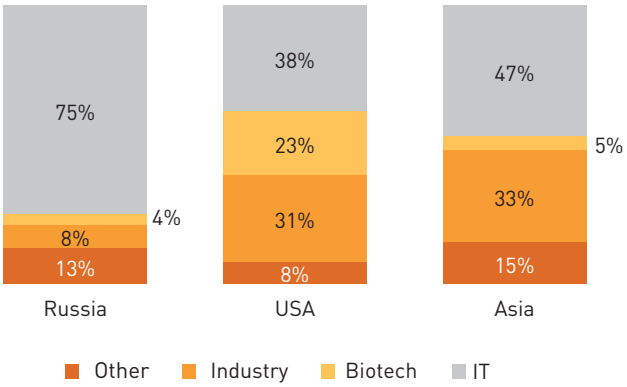
Introduction

After its outbreak in Q1 2020, the coronavirus pandemic resulted in a world crisis with an unprecedent decline in trade activity and petroleum demand, leading to an overall forecast of −4.9% for global GDP growth in 2020 [1]. Nevertheless, some industries managed to win out in the crisis and attract investors' attention: the S&P 500 pharmaceuticals, biotech and life sciences index significantly outperformed the market S&P 500 index [2]. In Russia, the pharmaceutical market grew by 23% in monetary terms during Q1 2020 year-over-year [3], while Russian companies in pharma and medical equipment manufacturing were the only market participants to increase their output in April and May year-over-year [4].

However, the biotechnology sector in general and biotech start-ups in particular had not been popular among institutional and private investors in Russia historically. In 2018, venture investments in biotech represented only around 4% of total venture investments in Russia (just as in Asia with its majority of developing countries), while such investments were much more common in the US (Figure 1).

Biotechnology companies face significant challenges in securing investments in comparison to other industries, as innovations in this field require not only collaborations between scientists and businessmen [7] but also a lot more time for product development, necessitating longer-term capital investments. The challenge for small businesses is even greater on account of their higher opacity. Small businesses are also more vulnerable to crises: for example, after the 2008 crisis, it took two years more for smaller companies to return to their pre-crisis contribution to the GDP in comparison to larger enterprises [8].

Figure 1. Share of venture investments by sector in 2018



Source: author's representation based on [5; 6].

The specificity and vulnerability of small biotech firms explain the importance of state support for such companies, especially on emerging markets with institutional voids. In both developed and developing countries, states recognize the need for supporting small and medium enterprises (SMEs), as entrepreneurship and the entrepreneurial ecosystem have been identified as drivers of national economic growth and job creation [9–11]. Moreover, special attention has been paid to new technology-based firms, whose products and innovations can create enormous economic value and have an impact on everyone's life [12].

The most typical forms of state support for SMEs usually include custom and tax exemptions and loans on preferential terms. Such measures are implemented by states both on emerged markets (e.g. Start Up Loans programme in the UK, Small Business Innovation Research (SBIR) programme in the USA) and in emerging countries (e.g. Small Business Innovation Research Initiative in India, SME bank programmes in Malaysia).

However, this paper shall rather focus on the specific type of state support for new technological ventures. This type of support, which includes establishing and funding different varieties of state technoparks, incubators and accelerators, is more often seen in countries with significant state participation in the economy (e.g. Sweden, China, or Israel). We shall specifically focus on start-ups in Russia, as the Russian venture market is characterized by the presence of significant state financing as well as limited access to private capital financing. Indeed, the total volume of venture capital investments on the Russian market amounted to less than 0.1% of the volume of global venture capital investments in 2018. At the same time, in 2018 Russian tech companies received almost $99 million from state institutions, or 13% of the total venture capital investments in Russia, according to Dsight [13].

The main aim of this paper is to describe the differences between biotech start-ups with state support provided by development institutes and start-ups with support provided by professional market participants such as private equity and venture funds, business angels and private companies in Russia as a country with limited private investments. In particular, we shall focus on two research questions: first of all, we shall analyse whether the ownership and management characteristics of start-ups with support from state or private institutes are heterogeneous. Second, we shall consider whether the performance of start-ups supported by these two types of institutions differs.

In this paper we shall also take a closer look at 510 Russian biotech start-ups using a sample of resident companies of the Skolkovo innovation system, the largest Russian innovation ecosystem. However, the type of support provided to these start-ups differs significantly: while some of the companies are supported only by private investors, other firms receive grants from the Skolkovo Foundation and/or become residents of technoparks. For the purpose of this study, we consider a sample of 213 start-ups for which the forms of support provided by investors can be traced from the information presented on the Skolkovo platform, with data about ownership structure and management characteristics collected from the Spark Interfax Database.

After cluster characterization, we shall show that start-ups supported by the state and start-ups that receive support from private investors differ significantly in ownership concentration, share of managerial ownership, gender diversity and CEO experience.

Although tests for differences between the groups' mean values confirmed the insignificance of performance variations among groups, the cluster of start-ups with private funding in our sample includes smaller-sized companies with fewer patents and employees in comparison to companies in clusters with state or mixed support. Start-ups that were supported by both private and state sources performed better on average in the number of employees and patents and the presence of revenue. Such results can be an indicator of the life-cycle differences of start-ups: while the support of private institutions is more often observed among companies without any revenue, state institutions tend to focus on more mature companies.

Literature review

Before analysing the different kinds of support, we should note that the sample is biased, as all of the start-ups in it participate in the Skolkovo innovation system, and 311 of them (61% of the final sample) are registered in Skolkovo. A spatial concentration of start-ups can generate strong cross-company spillovers that are observed in many areas of concentration of firms around the world (e.g. New York, Boston or Shanghai), while cluster support policies exist in many developed and developing countries (e.g. special economic zones in China or regional innovative clusters in Sweden). Therefore, to generalize our conclusions based on the Skolkovo sample to Russian start-ups outside Skolkovo, additional tests must be performed. This lies outside the scope of the present paper, however.

In this study, we shall focus only on start-ups in the biomedical cluster, the industry with the most significant emerging technologies today [14]. Most start-ups from the research-intensive biotech industry require not only financial support but also special infrastructure; as a result, membership in a technopark that provides the necessary equipment for research plays a very important role for biomedical start-ups. In addition, owning a patent is a major indicator of success of biotech start-ups, and we are able to trace this indicator using the available data.

Characteristics of start-ups supported by state and private institutions

The academic literature presents significant evidence that the individual characteristics of entrepreneurs have an influence on their choice of financing. Using a purely theoretical approach, Schwienbacher [15] showed that the type of entrepreneur (life-style, serial or pure profit-maximizing entrepreneur) affects the choice of financing, including its source. Drover, Wood and Fassin [16] confirmed that entrepreneurs with a high fear of failure are less likely to partner with unethical investors.

Therefore, different types of entrepreneurs and companies can show different preferences when choosing between state and private types of support. Still, as Islam, Fermeth and Marcus [17] showed, these sources are not mutually exclusive: on the contrary, US state research grants are used by start-ups as signals to advance relationships with VCs, as start-ups which win prestigious state grants are 12% more likely to get VC funding subsequently.

At the same time, not only entrepreneurs choose their sources of funding: state and private institutions also select investments in line with their goals and preferences.

There exists extensive academic research on the process of investment selection by private institutions. Knockaert, Clarysse and Wright [18] identified three clusters of venture fund investors based on an analysis of their investment decisions: technology (investors whose decision is primarily based on the technology involved), people (investors who attach importance to the personal qualities of the team) and financial (investors who make their decision based on ROI, growth and team competences). Malmstrom, Voit-

kane, Johansson and Wincent [19] showed that women who signal entrepreneurial attitude receive significantly less capital when applying for venture capital funding.

Although state institutions are more often perceived as entities whose decisions can be influenced by personal ties, Shane and Cable [20] confirmed that social relationships play a role in the investment selection process of venture funds, too.

While private institutions are interested in the wealth-maximization of particular shareholders, the purpose of state institutions is the maximization of state welfare. Afful-Dadzie and Afful-Dadzie [21] analysed criteria for the selection of businesses by state venture funds from a vast body of academic literature and showed that, along with standard venture fund criteria such as entrepreneur/team personality and experience, product potential, and the financial and market characteristics of the product, an important factor for state institutions is the product's societal contribution. Uzuegbunam, Liao, Pittaway and Jolle [22] further investigated the selection criteria of state venture funds, showing that the education of the founder is more relevant than his or her experience, while the number of patents owned by the company positively influences investment in such firms.

Performance of start-ups supported by state and private institutions

The positive impact of private investments on start-up performance is well documented in academic literature. However, most of the research in this field is devoted to the importance of venture fund support. Using a sample of US medical start-ups, Pahnke, Katila and Eisenhardt [23] showed that venture capital was the most successful source of funding in terms of the number of patents and FDA approvals received by supported firms. Samila and Sorenson [24] confirmed that the growth of the venture capital supply leads to an increase in company creation, employment and aggregate income. Puri and Zarutskie [25] found that VC-backed firms outperform their matched non-VC counterparts in terms of lower failure rates as well as IPO and acquisition rates.

While previous research demonstrated the positive impact of state programmes for supporting SMEs [26; 27], the influence of state institutions such as state venture funds on company performance was found to be ambiguous. For example, Luukkonen, Deschryvere and Bertoni [28] found no differences in contribution to portfolio companies between state venture capital (GVC) funds and independent venture capital (IVC) funds, while Grilli and Murtinu [29] showed that IVC funds positively impact the sales growth of high-tech firms, while GVC funds affect neither sales nor employee growth.

In addition, previous literature showed that the influence of state funding on entrepreneurship and innovation is dependent on the channel of such support. Fleming [30] provided evidence that the proportion of US patents relying on state funding reached 30% in 2011, with start-ups being heavily dependent on state research.

This paper contributes to existing literature by examining the characteristics of start-ups supported from different sources using a sample of Russian biotech start-ups. As a country with limited private investments gives particular importance to state investments, this paper can contribute to the study of the capacity of state to fill institutional voids. Moreover, this is, as far as we know, the first study to describe the market of Russian biotech start-ups.

Methodology

In order to compare start-ups supported from different sources, our sample of Skolkovo participants in the biomed cluster in 2018 is divided into four clusters based on the presence of state and/or private support. We separate firms which do not get any support (besides being Skolkovo participants), firms which get significant state support, firms supported only by private companies and/or funds, and firms which are supported by both state and private institutions. Consequently, the clusters are based on the following variables: private company share (Russian and foreign), PE/VC share, State institution share, residence in Skolkovo or other technoparks, presence of external financing and Skolkovo grant received by the start-up. During the first stage, the characteristics of the start-ups are examined to determine whether start-ups supported by the state are different from those supported by private institutions. In particular, we shall analyse age, ownership concentration, and experience and gender of start-up owners and CEOs.

During the second stage, the performance of start-ups from different clusters shall be compared. In particular, three main indicators are used to measure the performance of a start-up: the number of employees, the number of patents owned by the start-up, and the presence of a minimum viable product (MVP), which we proxy by the presence of company revenue.

As there are more than two clusters and the sample is classified by the type of support, the analysis of cluster characteristics shall be based on a comparison of mean values using a one-way analysis of variance (ANOVA). The null ANOVA hypothesis assumes the equality of in-cluster mean values against the alternative hypothesis of the existence of clusters with unequal means. If any significant differences are identified using ANOVA, we shall further examine which particular pair of group mean values show differences, taking the multiple comparison problem with the Bonferonni correction into account. As 6 pairwise comparisons are run, alpha must be equal to 5%/6 = 0.83% for a 5% level of significance of the Bonferonni correction. Although the ANOVA test assumes normally distributed data, studies have shown moderate effects of non-normality on the Type 1 error [31; 32]; therefore, no transformation of the variables is made in this paper to fit the normality assumption. For binary variables, Pearson's chi-squared tests with the null hypothesis for the independence of the type of support and chosen characteristics will be performed.

It should be noted that this study is mainly descriptive in nature and that the proposed methodology does not aim

to study the causal relationship between a start-up's characteristics, its type of support and its subsequent performance. However, the next step in this research would be to enlarge the sample to include Russian start-ups which are not participants of the Skolkovo ecosystem. Thereafter, start-ups which are residents of Skolkovo and start-ups supported by private investors should be compared using a methodology that would take the potential endogeneity of such support into account. Moreover, further research should also consider differences in channels of support from private and state investors.

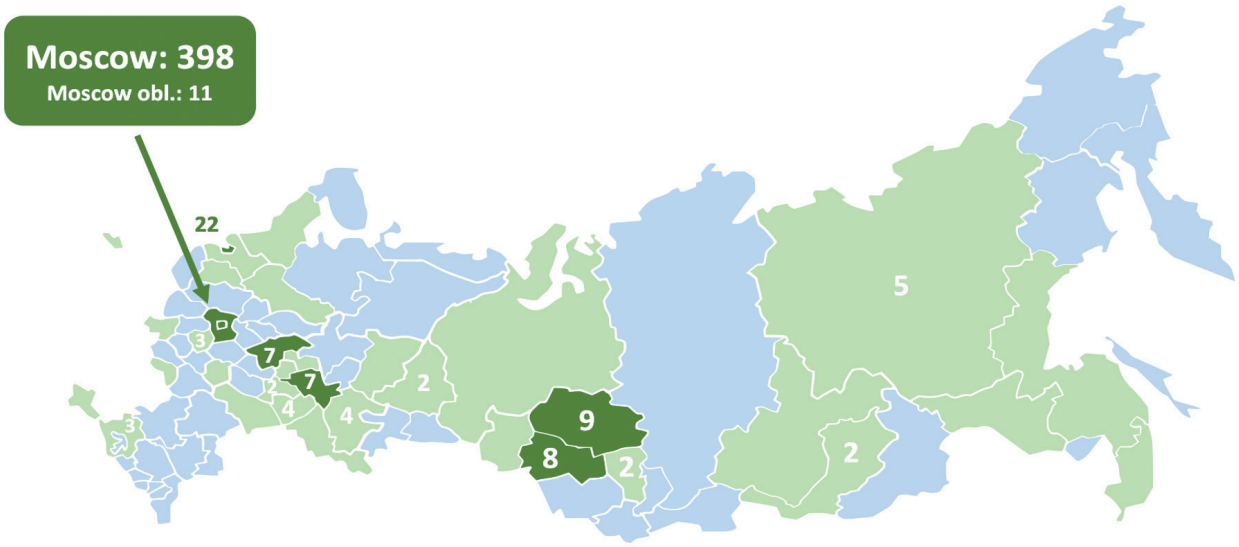
Data

The list of biomed start-ups was collected from the Skolkovo website, and the description of each start-up was analysed to classify its activities. As of May 13, 2020, there were 510 start-ups in the Skolkovo biomedical cluster, with 119 companies in agriculture and industrial biotechnologies and 391 medtech companies. Out of 119 companies working in agriculture and industrial biotechnologies, 38 were engaged in plant breeding, 29 in animal breeding, 46 focused on various industrial biotechnologies and 6 were foodtech companies.

Of the 391 medtech companies, the majority (139) specialized in drug manufacturing with 37 focusing on oncological diseases, 24 on infectious/viral/parasitic diseases and 13 on degenerative diseases. Other fields of specialization of medtech start-ups included the production of medical instruments/equipment/materials (77 firms), IT solutions (55), diagnostic methods (53), genomics (21) and other equipment for daily life (6).

Most Skolkovo biomed start-ups are located in Moscow, Saint Petersburg and the Moscow Oblast (Figure 2). The other regions with the greatest number of start-ups (Novosibirsk Oblast, Nizhny Novgorod Oblast, Tomsk Oblast, and Tatarstan) are known for their research institutes and universities.

Figure 2. Location of Skolkovo biomedical start-ups



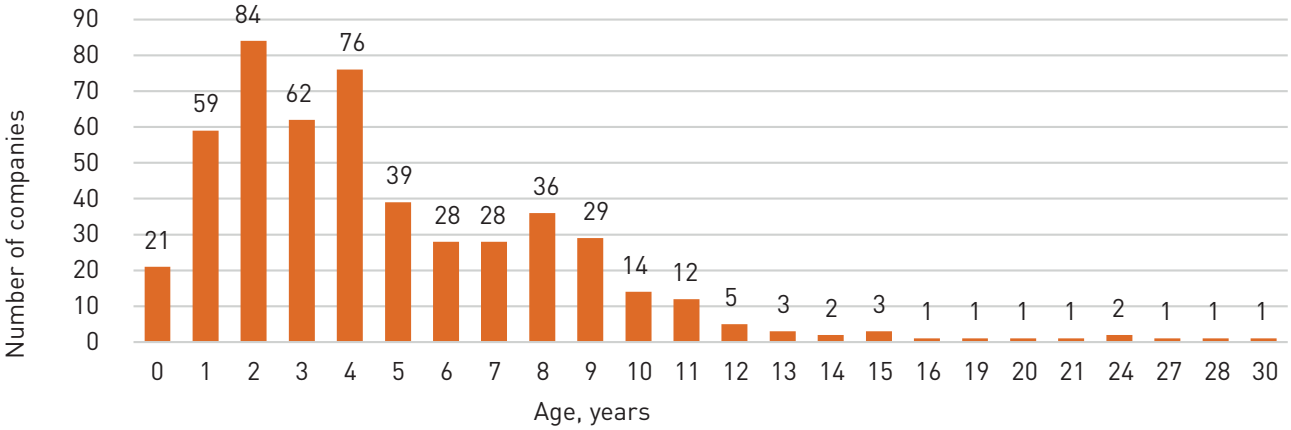
*Regions without Skolkovo biomedical start-ups are shaded in light blue, while regions with 1 Skolkovo biomed start-up are shaded in light green without a number.

Source: Skolkovo website, author's representation.

Skolkovo regulations do not have a strict age limit for start-ups, and the oldest company in the sample is 30 years old. However, the median company age in the data sample was 4 years, which indicates that 50% of the companies were founded in 2016 and later (Figure 3).

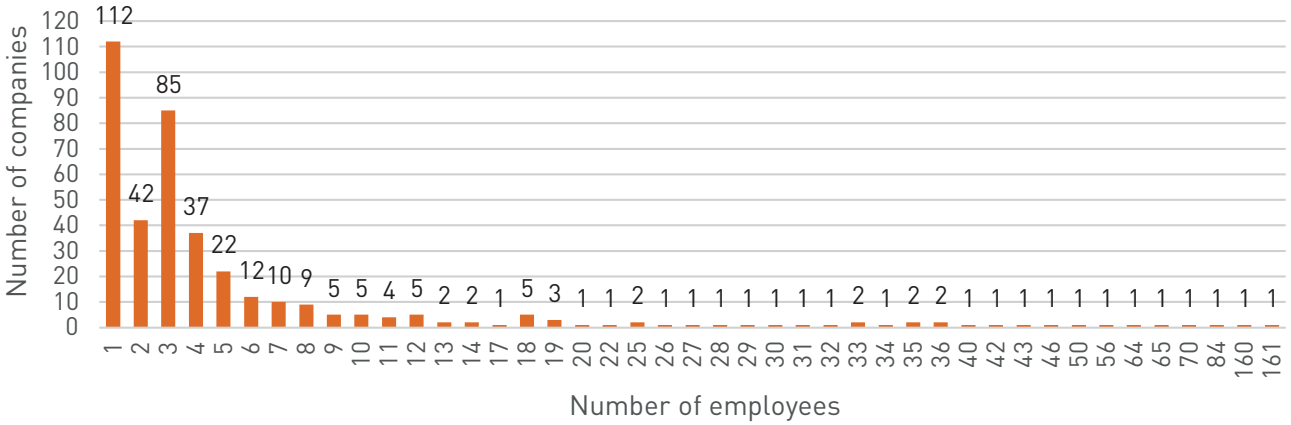
Data for the number of company employees is presented by Spark Interfax for only 391 companies. Most start-ups satisfy the generally accepted criteria for small and micro enterprises set by the European Commission and the Russian Small and Medium Business Corporation; however, there are 7 firms with more than 50 employees (Figure 4). The median staff headcount of the biomedical start-ups in the sample is 3.

Figure 3. Age distribution of biomedical start-ups, May 2020



Source: Spark Interfax, author's representation.

Figure 4. Distribution of the number of employees in biomed start-ups, May 2020



Source: Spark Interfax, author's representation.

When we were working on this study, no information was available about the 2019 financial results of companies, and so we used 2018 financial data. Thus, all start-up characteristics are presented as of late 2018. Our final data sample consists of 213 Skolkovo start-ups from the biomedical cluster, which most recently became Skolkovo participants (as of the end of 2018). While 50% (median group) of the 213 start-ups in our sample were established after 2017, two companies were established in 1993 and 1995, four companies in 2000, 2004, 2006 and 2007, and the rest after 2008. The number of owners in the median biomedical start-up was 2, while the average biggest share of ownership in a start-up was 67.2% (Table 1).

At least 70% of the start-ups in the sample had managerial ownership in their ownership structure, with an average CEO share of 53.2%. 72% of owners of the start-ups in the sample had ownership in other companies earlier, while 59% of the CEOs of biomedical companies in the sample had previous CEO experience. A significant positive correlation was also found between an experienced owner and an experienced CEO in a start-up (Table 4).

Furthermore, start-ups from the 2018 biomedical cluster were compared with a sample of start-ups from the 2017 space and nuclear industry clusters, which had been studied by Guseva and Stepanova [33]. The descriptive statistics indicate that start-ups from the biomedical cluster are younger than start-ups from the nuclear and space clusters in Skolkovo (median age of 2 vs. 4 years), their ownership structure is less concentrated (median biggest share of 60% vs. 76%), and the CEO has a higher share in the company (average CEO share of 53% vs. 43%). Moreover, biomedical start-ups are more gender diverse than start-ups from the nuclear and space clusters: the share of start-ups with female owners is two times higher (35% vs. 15%), while female CEOs are four times more common.

Table 1. Descriptive statistics of start-ups in the biomedical cluster in 2018

	Count	Median	Min	Max	Mean	Std. dev.
Age	213	2	1	26	3.53	3.48
Number of owners	213	2	1	12	2.46	1.52
Biggest share, %	213	60	16.67	100	67.21	25.22

	# of start-ups	% in total sample of 213 start-ups
CEO share (avg. share = 53.2%)	149	70
Experienced owner	154	72
Experienced CEO	126	59
Presence of female owner	74	35
Female CEO	47	22

Table 2. Description of dependent variables

	Count	Median	Min	Max	Mean	Std. dev.
Number of team members	207	4	2	5	3.65	0.60
Number of employees	190	3	1	108	5.45	11.66
Assets, thousand RUB	177	3087	2	1 427 587	50 611	183 151
Debt, thousand RUB	178	1997	0	945 113	24 374	96 682
Revenue, thousand RUB	167	0	0	590 857	14 210	62 481
Net profit, thousand RUB	164	−61	−80 634	275 009	3466	28 992

	# of start-ups	% of total sample
MVP>0	71	33
Patents>0	69	32

As performance measures we took the typical indicators used for start-ups in the academic literature: the number of employees, financial indicators [25] and the number of patents [23]. In our data sample, the median start-up had 4 team members (according to the Skolkovo webpages of the start-ups; team members usually exercise managerial functions such as CFO or COO) and 3 employees (Table 2). The average number of patents for a company was 1.01, with only 32% of start-ups having one or more patents. We took the main financial indicator of start-up performance to be the presence of revenue (which we associate with the presence of a minimum viable product (MVP)). Only 33% of start-ups in the sample had positive revenues (with the average revenue of such companies equal to RUB 33.4 million).

To differentiate between start-ups supported by state and private institutions, we looked at information about ownership structure and sources of financing on the Skolkovo website. In addition, we checked whether the start-up was a resident of a technopark, which is considered to be a state-supported structure.

19% of the start-ups in the sample were residents of the Skolkovo Technopark, and 13% of other technoparks. 51% of the start-ups in the sample received Skolkovo grants with an average grant amount of RUB 12 million. Data for binary variables indicating the presence of attracted external financing (which is considered private funding) was taken from the start-ups' Skolkovo webpages.

We traced the share of state venture funds (e.g. RVC), educational entities (e.g. MIFI) and state research institutes (e.g. NII KPSZ of the Kuzbass Cardiology Centre) in the ownership makeup of start-ups to determine the presence of state support. Only 6 start-ups (3%) in the sample had this kind of support, while over 18% of start-ups in the nuclear and space

clusters had state institutions in their ownership structure [33]. In addition, 5% of start-ups in the nuclear and space clusters were at least partially owned by state companies such as Rostec and Roscosmos, while no state-controlled companies were observed in the ownership structure of our sample of 213 Skolkovo biomedical start-ups [33].

Among the private institutions supporting start-ups, we distinguished between Russian private companies, foreign companies, PE and VC funds, and business angels (Table 3). However, none of the 82 most active business angels (information about which is published by RVC) were found in the ownership structure of the start-ups.

Table 3. Description of grouping factors

Type of owner/ characteristic	# of start-ups with this type of owner/ characteristic	% of sample of 213 start-ups	Average share in start-ups of this type of owner
Russian private company	51	24	60.7
Foreign company	8	4	61.4
PE/VC fund	15	7	20.8
State institution	6	3	17.9
Skolkovo Technopark	40	19	
Other technopark	28	13	
Attracted external financing	99	46	
Skolkovo funding	109	51	

The correlation matrix (Table 4) also gives some insight into the relationship between different start-up characteristics.

The presence of state support in the form of technopark residence is positively and significantly correlated with the number of start-up patents, while a state share in the ownership of a start-up has a positive relation to the number of its employees. In addition, the presence of Skolkovo funding is positively correlated with the start-up's number of patents and presence of revenue (MVP).

We have not found any significant correlation between the presence of a private Russian or foreign company in the ownership structure or of external financing and the chosen indicators of start-up performance. However, the PE/VC share was found to correlate positively and significantly with the presence of start-up revenue.

We also confirmed that private support in the form of private Russian or foreign company ownership was positively correlated with ownership concentration and negatively correlated with the CEO share. In addition, the chosen indicators of start-up performance had a positive and significant correlation *inter se*.

Table 4. Correlation matrix

	Age	Skolkovo Technopark	Other technopark	No. of owners	Biggest share	Experienced owners	CEO experience	Foreign company share	Russian private company share	PE/VC share	CEO share	State institution share	No. of employees	External funding	Patents owned	MVP	Skolkovo funding
Skolkovo Technopark	−0.07	1.00***	−0.08	0.05	−0.01	0.11	0.11	−0.02	0.08	0.00	0.05	−0.09	0.00	0.05	0.05**	−0.01	−0.01
Other technopark	−0.03	−0.08	1.00***	0.06	−0.07**	0.12*	0.07	−0.08	−0.06	−0.06	0.00	0.07	0.19**	0.03	0.08	0.11*	0.02
No. of owners	0.04	0.05	0.06	1.00***	−0.69***	0.32***	0.09	−0.02	−0.04	0.21**	−0.34	0.06	0.09	0.10	0.04	0.12	0.15
Biggest share	0.04	−0.01	−0.07**	−0.69***	1.00***	−0.39***	−0.03	0.16***	0.14***	−0.15*	0.35	−0.02	−0.04	−0.14	−0.00	0.06	−0.13
Foreign company share	0.05	−0.02	−0.08	−0.02	0.16***	−0.08	0.10	1.00***	−0.06	−0.03	−0.19*	−0.04	0.01	0.03	0.02	0.00	0.01
Russian private company share	0.01	0.08	−0.06	−0.04	0.14***	−0.29***	0.06	−0.06	1.00***	−0.06	−0.44***	0.16	−0.02	−0.25**	−0.04	0.14	0.04
PE/VC share	0.02	0.00	−0.06	0.21**	−0.15*	−0.08	−0.08	−0.03	−0.06	1.00***	−0.07	0.17	−0.00	0.03	0.02	0.13***	0.08
CEO share	0.04**	0.05	0.00	−0.34	0.35	−0.02	0.03	−0.19*	−0.44***	−0.07	1.00***	−0.11	0.03	0.10	0.07**	0.01	−0.07
State institution share	0.17	−0.09	0.07	0.06	−0.02	−0.13	−0.06	−0.04	0.16	0.17	−0.11	1.00***	0.10**	0.02	0.02	0.13*	0.02
No. of employees	0.44***	0.00	0.19**	0.09	−0.04	0.05	0.08	0.01	−0.02	−0.00	0.03	0.10**	1.00***	0.05	0.51**	0.36***	−0.01
Assets	0.53***	-0.04	0.07	0.09	0.01	−0.05	0.12	0.05	0.14	−0.04	−0.06	0.03	0.59***	−0.00	0.47***	0.31***	0.09**
Debt	0.50***	0.02	0.07	0.13	0.01	0.07	0.13	0.09	0.06	−0.03	−0.02	0.05	0.46***	0.03	0.56***	0.27**	0.11*
Revenue	0.34***	−0.05	0.12	0.02	0.01	−0.05**	0.01	0.03	−0.10	−0.04	0.02	−0.01	0.78***	0.02	0.36	0.27**	−0.06
Net profit	0.12	−0.04	−0.02	−0.07	0.04	−0.01	0.05	−0.01	0.01	−0.08	−0.03	−0.09	0.37***	0.01	0.20	0.21	0.01
External funding	0.00	0.05	0.03	0.10	−0.14	0.17	−0.08	0.03	−0.25**	0.03	0.10	0.02	0.05	1.00***	0.03	−0.14	−0.09
Patents owned	0.65***	0.05**	0.08	0.04	−0.00	0.05	0.08	0.02	−0.04	0.02	0.07**	0.02	0.51**	0.03	1.00***	0.26*	0.08*
Experienced owners	−0.13	0.11	0.12*	0.32***	−0.39***	1.00***	0.36***	−0.08	−0.29***	−0.08	−0.02	−0.13	0.05	0.17	0.05	−0.16	−0.04
CEO experience	0.02	0.11	0.07	0.09	−0.03	0.36***	1.00***	0.10	0.06	−0.08	0.03	−0.06	0.08	−0.08	0.08	0.00	0.11*
MVP	0.37***	−0.01	0.11*	0.12	0.06	−0.16	0.00	0.00	0.14	0.13***	0.01	0.13*	0.36***	−0.14	0.26*	1.00***	0.13**
Age	1.00***	−0.07	−0.03	0.04	0.04	−0.13	0.02	0.05	0.01	0.02	0.04**	0.17	0.44***	0.00	0.65***	0.37***	0.19***
Skolkovo funding	0.19***	−0.01	0.02	0.15	−0.13	−0.04	0.11*	0.01	0.04	0.08	−0.07	0.02	−0.01	−0.09	0.08*	0.13**	1.00***

Results and conclusion

The clusterization of the data sample by private and state support yielded four clusters of start-ups. The first cluster ("no support") includes 32 companies for which the presence of state or private support was not confirmed. However, it should be said that, although no sources of support were identified by our methodology for such companies, they may still receive the support of friends, family, or employees. The second cluster ("state support") has 58 start-ups that are residents of a technopark and/or have Skolkovo grants and/or have a state institution share in their ownership structure yet do not receive any private support. The third cluster ("private support") includes 39 start-ups that do not have any state support besides being Skolkovo participants and have a private Russian or foreign or PE/VC fund in their ownership structure or have received external financing in the past. The fourth cluster ("mixed support") consists of 84 start-ups that receive both types of support.

The descriptive statistics of the four clusters are presented in Table 5. Companies which have both types of support tend to be older, which is a consistent conclusion: survival of a start-up is considered to be a positive sign by investors, while more support can increase the likelihood of the company's survival.

One-way ANOVA analysis indicated that there exist significant variations in the ownership concentration, managerial ownership and CEO experience among the four clusters. A multiple pairwise comparison of the number of owners and the biggest share in a start-up (Appendix 1) did not show any statistically significant differences between purely state and privately supported companies, while the ownership of companies with mixed support was significantly less concentrated. At the same time, a significant difference was observed in the CEO share: the highest share of CEO ownership was found in start-ups with no support at all or with state support. It was also shown that state-supported start-ups had more experienced CEO than companies financed by private institutions (Table 6).

In addition, the data indicate that start-ups which are founded, owned or managed by women are less likely to receive any type of support, which partially confirms the findings of Kwapisz and Hechavarría [34] that being a woman significantly lowers the probability of asking for funding. Pairwise comparisons (Appendix 2) show that the most significant difference in gender diversity was observed between start-ups with no support and start-ups with private support, while companies with state support are almost as much gender-diversified as firms with no support.

Table 5. Descriptive statistics of clusters

Type of support	Established (median)	Number of owners (average)	Biggest share (average), %	CEO share (average), %
No support	2017	1.81	72.39	58.12
State	2016.5	2.33	66.98	55.25
Private	2017	2.13	73.89	34.74
Mixed	2016	2.94	62.28	27.84
F-stat		5.8653	2.4838	11.3044
p-value		0.0007	0.0618	0.0000

Table 6. Descriptive statistics of clusters (proportion of such companies in the cluster), %

Type of support	Ownership experience	CEO experience	Female founder	Female owner	Female CEO
No support	78	41	47	47	34
State	74	66	38	40	28
Private	64	49	26	21	10
Mixed	73	67	23	32	19
Chi-2	1.9529	9.2391	8.3569	6.4491	7.4550
p-value	0.5822	0.0263	0.0392	0.0917	0.0587

Our findings about start-up performance indicate that start-ups which are supported from both private and state sources tend to be bigger and more successful: on average, such start-ups have a higher number of employees and more patents and are more likely to have revenue (MVP). At the same time, support from private institutions is more often observed among start-ups which are smaller in terms of asset size, number of employees, number of patents and revenue. However, the significance of performance differences between clusters was not confirmed.

Companies with state support have a smaller average debt than start-ups from other clusters, which may indicate that equity and grant financing are more popular kinds of support for such institutions. At the same time, start-ups from the sample with no support have more debt, which indicates that the clusterization of companies can be improved by accounting for debt sources. While the source of debt is confidential information and cannot be traced using publicly available data, the information about attracted external financing from the Skolkovo website, which is included in the analysis, partially reflects the debt of start-ups.

Table 7. Performance of start-ups in different clusters

Type of support	MVP (% in cluster)	Assets (average)	Debt (average)	Revenue (average)
No support	69	29 159.67	69 87.86	4026.37
State	59	40 347.85	17 817.29	14 613.51
Private	41	7793.47	43 96.31	6484.22
Mixed	52	80 520.33	41 505.53	12 848.34
F-stat	6.0241*	1.4228	1.5765	0.3567
p-value	0.1104	0.2378	0.1968	0.7842

*Chi-2 is given.

Type of support	Number of employees (average)	Number of patents (average)	Number of patents acquired in 2018 (average)
No support	4.93	0.56	0.13
State	5.94	1.10	0.33
Private	2.36	0.64	0.10
Mixed	6.82	1.39	0.32
F-stat	1.1322	0.8441	1.0778
p-value	0.3374	0.4712	0.3595

Observations about the characteristics and performance of start-ups supported from different sources also indicate that the source of support for biomed start-ups can depend on the life-cycle stage of the company. In this paper, "start-up" is generally defined in line with Skolkovo regulations yet also includes companies at their seed stage as well as companies which have started their international expansion and are generating sustainable revenue.

In our sample of start-ups, support from private investors was more often observed for younger companies whose performance (measured by the presence of revenue, assets, and the number of employees and patents) was leaner than firms from other clusters. This partially confirms the findings of Puri and Zaratuskie [25], who corroborated the claim that venture capitalists are willing to invest in companies with no immediate revenue. At the same time, state support is observed for more mature companies, which may also indicate that the support provided by private and state institutions is different in nature: while private organisations more often provide companies in this sample with guidance at early stages (initial customer expansion), state institutions can patronage regulatory approvals and hurdling of administrative barriers, as well as giving access to state contracts and networks. However, the most successful start-ups in this sample were supported by both state and private organisations, which partially confirms the findings of Cumming, Grilli and Matrinu [35] that mixed syndicated investments of independent and state venture funds have a positive effect on the exit performance of tech start-ups.

While this paper is one of the first studies of biotech start-ups in Russia and has a descriptive purpose, further research should examine the causal relationships between start-up characteristics, the type of support, and start-up performance to identify which type of support should be provided to a particular start-up to maximize its performance. Moreover, the specificity of biotech companies requires further and deeper investigation of the various channels of support that can be used by such companies and that may differ from other tech-industries.

Our results indicate that, although the state is an important source of support for start-ups on emerging markets, it cannot be considered to be an absolute substitute for private investments and expertise. In addition, we should point out that state and private investors may be interested in different kinds of start-ups due to different goals: while private investors are looking for investments with the highest returns, state institutions are more focused on the long-term social effects of their investments, which is especially important for start-ups in the biomed industry. Therefore, the synergy of these sources can be an important driver for biomedical start-up performance.

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Appendix 1. Pairwise comparisons (Bonferroni-adjusted alpha equal to 5%/6 = 0.83%)

1a. Number of owners

Cluster 1	Cluster 2	Mean cluster 1	Mean cluster 2	t-stat	t critical two-tail	p-value
No support	State	1.81	2.33	−2.3340	1.9873	0.0219
No support	Private	1.81	2.13	−1.3981	1.9971	0.1668
No support	Mixed	1.81	2.94	−4.7133	1.9810	0.0000
State	Private	2.33	2.13	0.7780	1.9867	0.4386
State	Mixed	2.33	2.94	−2.2848	1.9772	0.0238
Private	Mixed	2.13	2.94	−2.9811	1.9818	0.0035

1b. Biggest share

Cluster 1	Cluster 2	Mean cluster 1	Mean cluster 2	t-stat	t critical two-tail	p-value
No support	State	72.39	66.98	0.9675	1.9949	0.3367
No support	Private	72.39	73.89	−0.2575	1.9966	0.7976
No support	Mixed	72.39	62.28	1.9987	2.0040	0.0506
State	Private	66.98	73.89	−1.3076	1.9879	0.1945
State	Mixed	66.98	62.28	1.0716	1.9812	0.2862
Private	Mixed	73.89	62.28	2.4589	1.9935	0.0163

1c. CEO share

Cluster 1	Cluster 2	Mean cluster 1	Mean cluster 2	t-stat	t critical two-tail	p-value
No support	State	58.12	55.25	0.3796	1.9983	0.7056
No support	Private	58.12	34.74	2.7386	1.9955	0.0079
No support	Mixed	58.12	27.84	4.3635	2.0086	0.0001
State	Private	55.25	34.74	2.7626	1.9917	0.0072
State	Mixed	55.25	27.84	4.9720	1.9812	0.0000
Private	Mixed	34.74	27.84	1.0149	1.9990	0.3141

Appendix 2. Pairwise comparisons (Bonferroni-adjusted alpha equal to 5%/6 = 0,83%)

2a. CEO experience

Cluster 1	Cluster 2	Proportion in cluster 1, %	Proportion in cluster 2, %	Chi-2 stat	p-value
No support	State	41	66	4.2394	0.0263
No support	Private	41	49	0.1956	0.6583
No support	Mixed	41	67	5.4847	0.0192
State	Private	66	49	2.0669	0.1505
State	Mixed	66	67	0.0015	0.9696
Private	Mixed	49	67	2.8910	0.0891

2b. Female founder

Cluster 1	Cluster 2	Proportion in cluster 1, %	Proportion in cluster 2, %	Chi-2 stat	p-value
No support	State	47	38	0.3620	0.5474
No support	Private	47	26	2.6056	0.1065
No support	Mixed	47	23	5.4615	0.0194
State	Private	38	26	1.0859	0.2974
State	Mixed	38	23	3.2069	0.0733
Private	Mixed	26	23	0.0194	0.8893

2c. Female CEO

Cluster 1	Cluster 2	Proportion in cluster 1, %	Proportion in cluster 2, %	Chi-2 stat	p-value
No support	State	34	28	0.1870	0.6654
No support	Private	34	10	4.7741	0.0289
No support	Mixed	34	19	2.2505	0.1336
State	Private	28	10	3.2856	0.0699
State	Mixed	28	19	0.9856	0.3208
Private	Mixed	10	19	0.9350	0.3336

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Testing Russian Stock Market Efficiency Using Event Studies: Impact of Credit Ratings Changes

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Abstract

Event study is a widespread technique for testing the semi-strong form of the market efficiency hypothesis. Among traditionally studied events, changes in corporate credit ratings by rating agencies have a special importance, since rating agencies use both publicly available and insider information. Studies of developed and emerging markets point to different reactions of stock prices to rating upgrades and downgrades and identify several factors affecting the scale of this effect, including the size and liquidity of the stock market, the level of regulation of the industry, the market capitalization of the company, the status of the rating agency, and others.

On the Russian market, the impact of credit rating upgrades and downgrades on stock prices has not been investigated so far. Ongoing studies of other events affecting stock prices show that the market's reactions are pretty much in line with those of developed markets, despite its immaturity, limited transparency, high volatility, narrowness and low liquidity, as well as the small number of significant events.

In this article, we evaluate the level of efficiency of the Russian stock market and analyse the reaction of stock prices to changes in issuer credit ratings by international rating agencies using the traditional event study methodology in a narrow event window of 31 days over the period 2016–2020 on a sample of 49 public companies. We show that credit rating upgrades do not lead to statistically significant positive abnormal returns. Visual analysis demonstrates that rating downgrades result in substantial negative abnormal returns. This effect varies for financial and non-financial companies and companies with low and high capitalization yet differs from the effects observed for developed markets; nevertheless, these abnormal returns are not statistically significant. Still, there are grounds to conclude that the Russian stock market is not efficient in the semi-strong form and is closer in its characteristics to emerging markets, which is important information for investors, as it permits them to develop profitable trading strategies.

Key words: market efficiency, semi-strong form, stock prices, event study, transparency, credit rating, abnormal return, cumulative abnormal return

Introduction

Studies of the efficiency of the Russian stock market began as early as the 1990s. While tests of the weak form of market efficiency, according to which stock prices are indicative of all previous information about a company, are somewhat contradictory [1–4], researchers mostly believe that the Russian stock market is efficient in the weak form.

However, the issue of Russian market efficiency in the semi-strong form, which implies that all publicly available information about the issuer is immediately and comprehensively included in the market value of its securities, remains open. In a semi-strongly efficient market, security quotations should not respond to new information (the announcement of a so-called *event*), because all relevant information is taken into consideration in the current price. So, by considering the response of a given market to new information, one may estimate its efficiency, which, in turn, serves as a key factor for investors when they take decisions about the purchase and sale of securities.

The range of events whose influence on stock prices is traditionally investigated is broad: from macroeconomic to corporate events, including political and legislative changes, announcements of earnings and dividends, issue and split of shares, mergers and acquisitions, change of accounting policies, etc. One such event is a change in the issuer's credit rating.

Credit ratings are assigned by rating agencies (RAs), expressing the independent opinion of analysts about the relative level of credit risk, i.e., the issuer's (sovereign, institutional or corporate borrower's) ability to fulfil its obligations completely and in due time. Ratings also allow the evaluation of the credit quality of certain debt securities and their default probability.

Credit ratings are determined on the basis of historical and current information as well as anticipated future events and are therefore predictive in nature. It is natural that RAs specializing in credit risk assessment play a crucial part in the evaluation of the creditworthiness of issuers and the investment quality of their debt instruments. While there are dozens of RAs across the globe (including such Russian agencies as National Rating Agency, Expert RA, AK&M, and RusRating), there are only three international leaders: Standard & Poor's, Fitch Ratings and Moody's Corporation, which control over 90% of the global debt market.

RAs constantly rate issuers and debt securities using both publicly available and insider information obtained directly from the issuer in order to detect the factors which may influence its creditworthiness. When such factors are identified, RAs may adjust the rating or revise its upward or downward forecast, changing their opinion about the relative level of credit risk. As long as the credit rating provides significant information for investors, a change in it should entail a change in the market value of the issuer's securities. This concerns both debt and equity securities.

Thus, a series of questions arises:

- Is a discontinuous change of credit rating a factor that can in itself influence the market value of the issuer's fundamental financial instruments? Or do RAs that adjust ratings just register continual changes in the market value from information entering the market about the issuer's status, with some elements of forecasting?
- Does the response to a change of the credit rating of the quotation of debt and equity securities differ?
- Are there differences in the response of security quotations to information about the upgrade and downgrade of credit ratings?
- Does the response of security quotations depend on industry, company size and other factors?
- Does the response of security quotations depend on the maturity of the stock market?
- Does the RA's status (national / international) influence market response to rating change?

Literature Review

Early studies of the influence of credit rating changes on stock prices started with the *US market* (a useful list of literature is found in [5], for example). Employing monthly returns and different time horizons, they gave contradictory results. Current studies (from earlier [6] to more recent [7] papers), which make use of daily returns and consider the influence of credit rating change in a narrow event window, yield more consistent results (this may be due to the fact that the amount of information that is publicly available and relevant for share price formation is increasing in volume and spreading at an ever-growing rate). These studies share the conclusion that, unlike upgrades, downgrades significantly influence the market value of shares. This may be due to the fact that companies more willingly disclose positive information that upgrades credit ratings. This information influences financial quotes in advance, while negative information is withheld, and rating downgrades come unexpected.

The regularities identified for the US market also exist *for other large markets* such as Germany [8; 9], other European countries [10], and Australia [11; 12]. Thus, even developed markets are not efficient in the semi-strong form.

The regularities found for large markets may be distorted if *national RAs* change ratings. For example, [13] considers the influence of credit rating changes by the Japanese national RA R&I on the stock prices of companies listed on the Tokyo Stock Exchange, which surpasses the London Stock Exchange in capitalization. It shows that the market responds positively to negative information and vice-versa.

As to *local markets,* even less efficiency may be expected from them due to limited liquidity, information, and analysts' attention. Nevertheless, the effect on markets in Norway [14] and Nordic countries in general [15] corresponds to the regularities of large markets. At the same time, it was found that the New Zealand market responds to positive

as well as negative information about the revision of ratings and forecasts [16]; a rating and forecast upgrade was accompanied by a significant abnormal positive return in Italy [17]; and a rating downgrade and a negative forecast were accompanied by an abnormal positive return in Portugal [9]. However, it is difficult to make informative conclusions from a small sample, especially for such a volatile market as Portugal.

A limitation for many studies is the fact that a sample consists, as a rule, of blue chips of large transparent public companies – for example, companies included in the S&P 500 index. At the same time, researchers point out that the influence of events is more significant for small-capitalization companies [12; 14].

In addition, a stronger market response is observed when a rating changes from the investment to the speculative level [7; 12].

Researchers mainly associate *sector influence* with the existence of regulation. We may assume that the market response is much weaker if a company belongs to a regulated industry (banks, insurance companies), because such companies have to disclose more information, and the regulation procedure in itself is a source of information for the market.

The first studies of the influence of credit rating changes on the stock prices of banking groups [18] failed to reveal any differences in the response of banks in comparison to manufacturing companies. Later studies [10; 17] pointed to a less significant effect of downgrades on financial companies, which may be explained by more serious requirements for information disclosure.

Recent studies of the influence of bank credit rating changes on bank stock prices on US [19] and European [20; 21] markets identified abnormal returns from rating downgrades and upgrades, which may be due to the research period (a wide-scale rating downgrade after the crisis of 2008) and the sample structure (a large share – over 50% – of events in countries with presumably less efficient markets such as Italy, Spain, and Greece).

A study of the influence of rating agency status (Big Three / others) and the economic development of the country on bank credit ratings [22] showed that bank shares are sensitive to information about rating downgrades, that the influence of rating upgrades manifests itself in countries with average rating actions by economic development, and that the market responds more to international than national RAs.

An analysis of events on *emerging markets*, in particular in BRICS countries, is of special interest. [23] studies the response of the stock market to issuer rating changes in 26 countries included in the MSCI Emerging Market Index and shows abnormal returns in response to rating upgrades as well as downgrades. It argues that stock prices respond more to changes in ratings by international agencies than by national ones. Studies of the *Indian* stock market confirm this [24–26]. Statistically significant abnormal returns in the case of rating changes (upgrades and downgrades) by international RAs [27] were found for the *Brazilian* market. Indeed, the greatest informative effect was produced by rating downgrades. In fact, Pinto [28] found a statistically significant abnormal return only in the case of a rating downgrade. A study of the influence of credit ratings on the stock prices of companies on the Johannesburg Stock Exchange (*RSA*) in 2005–2015 [29] showed that, just as in developed economies, this market shows a significantly negative response only to rating downgrades. The markets of Brazil and RSA, whose ratings are assigned by international RAs, approximate advanced markets in their efficiency.

One may assume that the *effect of company size* will be more significant for emerging markets due to the limited available information. In particular, one found both an immediate and a long-term significant influence of rating change on the stock prices of small and mid-sized companies on the Bombay Stock Exchange in 2010–2014; moreover, the influence of rating downgrades was shown to be more apparent than the influence of upgrades [30].

A study of *sector influence* in India showed a statistically insignificant negative abnormal return in the case of a bank rating upgrade and a statistically insignificant positive abnormal return in the case of a downgrade [31]. However, the small sample made it difficult to generalize. At the same time, similar results were obtained in Pakistan [32]: a significant positive response of the market to bank rating downgrades by the Pakistan Credit Rating Agency and an insignificant negative response to rating upgrades.

On the *Chinese market,* the study of events such as the influence of credit rating change on stock prices has started only recently and has been conducted on a one-time basis. As late as 2018, there were only national RAs on the market, whose ratings are criticized for their methodology and reliability. The most relevant publication for the present study is [33], which compares the influence of credit rating changes on stock prices on the stock exchanges of Mainland China and Hong Kong and shows that both markets are inefficient, although the Hong Kong market is more efficient and has more characteristic features resembling developed markets. It also studies the influence of the reasons for bond rating downgrades on stock prices [34].

[35] made an attempt to sum up different empiric research by using meta-analysis to confirm the results of 62 studies performed over 30 years that rating downgrades are accompanied by significant abnormal returns, especially in the USA, while rating upgrades exert no significant impact, irrespective of the market. The following factors may be considered significant for research: market maturity (lower sensibility of emerging markets to rating downgrades); affiliation with the non-financial sector; a more apparent market response to rating changes after 2000; and preliminary announcements of inclusion on the CreditWatch list (ratings under review): a relatively higher response in the case of positive forecasts and a relatively lower response in the case of negative ones. In addition, the sample size and the employed statistical tools and procedures of preliminary data cleaning exert an influence.

On the *Russian market,* the first statistical investigations of the influence of events on the price of market shares were conducted as far back as 1990s and took into consideration the specifics of Russian events at that time. In particular [1], studied the influence of announcements of auctions in which state-owned stakes were sold as a part of cash privatization in 1995–1996. Today, authors consider methodological issues [36] as well as the effects of certain political [37] and corporate events, including the influence of dividend pay-outs on the market value of Russian companies [38; 39]; the announcements of mergers and acquisitions [40–42]; and the cross-listing of Russian companies [43]. Thus, the range of considered events is quite broad.

The article by A. Pogozheva [44] comes closest to the present study. It evaluates the informational significance of analytical reports by investment banks about Russian companies and shows that improvements in the recommendations of investment bank analysts led to a significant growth of stock prices of Russian issuers two or three days after the event, while deteriorating recommendations led to falling stock prices. Moreover, these results are stable for different data samples and are observed both at the MICEX and the London Stock Exchange. The study by Khlyupina and Berzon [45] shows that the growth of stock prices stemming from positive recommendations by analysts exceeds their fall from negative recommendations. In addition, the influence of a negative event is more time-spaced than the influence of a positive event. The authors conclude that a revision of recommendations does not have an immediate impact on prices, and, hence, the Russian stock market is inefficient.

The objective of the present paper is to study the influence of information about changes in the credit ratings of Russian issuers on their stock prices in order to evaluate the efficiency of the Russian stock market. As far as the authors know, no similar studies have been conducted on the Russian market so far.

Research Methodology

The modern methodology of event study (Russian literature also uses the term "event research") is based on papers by Ball and Brown [46] and Fama and Fisher [47]. It has been described in detail numerous times (see, for example, [48] and the Russian-language works [49–51]). It is based on a comparison of the actual return on assets during the period immediately before and after the event ("event window") with historic or expected returns in the case of the absence of an event in order to identify abnormal returns. Modifications of the methodology proposed by different authors relate mainly to the assessment of expected returns and the statistical processing of data for making conclusions. When the research methodology is applied to diverse events within different time intervals, there is no prevailing method that may be applied to all possible events.

Bowman proposed a five-stage structure of event study [52]:

1. Choice of an event or type of event for analysis

This may be a single event (for example, political or legislative changes which have an impact on all assets in the economy) or a certain type of events taking place in various companies at different times (announcement of earnings or dividends, issue or split of shares, etc.). In the latter case, event synchronization is necessary. It is achieved by adjusting the event to zero time and choosing an event window of a single duration.

2. Forecast of the expected response of security prices to the event

Research hypotheses tend to be generated at this stage: what will be the expected response of the prices of different assets to the event?

3. Choice of the method of abnormal (excess) returns evaluation as the difference between the actual and expected (normal) returns

In order to evaluate normal returns, statistical models (Comparison Period Mean Adjusted Model), market models on the basis of CAPM with various ways of calculating β, and economic multifactor models (Fama and French) may be used.

4. Adjustment and grouping of calculated abnormal returns

While abnormal returns may be studied separately, assets are usually grouped into uniform portfolios to verify the hypotheses proposed at stage 2. Cumulative average abnormal returns (CAAR) [47] or the abnormal returns index (MI) [48] are calculated for the portfolios.

5. Analysis of the results with the help of descriptive or formal statistics methods

The results of calculations may be presented in tables or diagrams or processed by applying parametric statistical methods.

Furthermore, it has been shown [53] that this structure may be basically reduced to three stages:

1) Defining the studied event and its time frame.
2) Choice of the "standard" model to assess normal returns.
3) Calculation and analysis of abnormal returns in the event window.

This is the structure used in the present paper.

We analyse the impact of a change of credit rating by the Big Three international RAs – S&P Global Ratings, Moody's Investors Service and Fitch Ratings – on the stock prices of 49 public joint-stock companies from various industries that have different market capitalizations and shares traded on the Moscow Stock Exchange. 109 cases of rating upgrade and 26 cases of rating downgrade were considered.

The chronological framework of the research was limited by the period 2016–2020, because the sovereign credit rating of the Russian Federation was lowered in early 2015, entailing a downgrade in the ratings of many Russian raw material, telecommunication, and infrastructure companies. For many companies, the rating forecast became neg-

ative. Therefore, in order to avoid the influence of previous events on the general statistics, we only analysed data after 2015. Information on changes in long-term ratings in national currency was obtained from the sites of the rating agencies S&P Global Ratings, Moody's Investors Service and Fitch Ratings. The stock prices (closing prices) within an evaluation window of 100 trading days immediately before the event window and an event window of 31 days ([–15; +15], with only trading days being taken into consideration) were taken from the website of the Moscow Stock Exchange. The limited length of the evaluation window of 100 trading days (approximately five calendar months) was due to the fact that, for many companies, a change of credit rating is quite a frequent event that took place several times (up to 5–7) during the research period.

The sample was analysed for errors. We excluded changes of ratings which overlapped with other events within the evaluation or event window that could result in a change of stock prices (for example, the suspension of trade, additional issues, split of shares, etc.) as well as sequential rating changes (within the event window) by two or more RAs. In the latter case, we took into consideration only the earliest event.

The (actual) daily returns were calculated using the following formula:

$$R_{i,t} = \frac{P_{i,t}}{P_{i,(t-1)}} - 1,$$

where $R_{i,t}$ is the actual return on share *i* at time t,

P_t is the price of share i at time t,

and P_{t-1} is the price of share i at time t–1.

The normal return was defined by the constant average return method:

$$NR_i = \frac{1}{T}\sum_{t=t_1+1}^{t_2} R_{i,t},$$

where t_1, t_2 are the lower and upper evaluation window edges, respectively,

and T is the number of calculated returns ($T = t_2 - t_1 = 99$).

The abnormal returns (excess returns) were calculated using the following formula:

$$AR_{i,t} = R_{i,t} - NR_i.$$

The average abnormal returns in a sample of N companies were defined using the formula

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}.$$

The cumulative average abnormal returns within the event window (t_1; t_2) were calculated as follows:

$$CAAR(t_1;t_2) = \sum_{t=t_1}^{t_2} AAR_t.$$

In accordance with the methodology accepted for other markets, samples were compiled to verify the following hypotheses:

Hypothesis 1: stock prices respond more to rating downgrades than to rating upgrades (109 cases of rating upgrades and 26 of downgrades).

Hypothesis 2: the response to rating downgrades is more significant for non-financial companies (4 rating downgrades of financial companies and 22 of non-financial companies).

Hypothesis 3: the response to rating downgrades is more significant for low-capitalization companies (6 events for high-capitalization companies and 20 events for low-capitalization companies).

The obtained results were visually assessed using diagrams of cumulative abnormal returns, and their statistical significance was verified with the Student's Test (significance level of 0.05).

The confirmation of these hypotheses would mean that the Russian market is inefficient in the semi-strong form and that stock prices respond to credit rating changes in the same way as on developed markets.

Special Features of the Sample

The Big Three of international RAs (S&P Global Ratings, Moody's Investors Service and Fitch Ratings) operate on the Russian market. Currently, international RAs assign credit ratings to over 200 issuers. The sample comprises changes by international RAs of the credit ratings of Russian issuers whose ordinary shares are traded on the Moscow Stock Exchange. The sample structure is fairly unusual. In particular, there is only a limited number of companies whose shares are traded on the market (at present, a little over 200 companies, 49 of which are included in the sample).

The sample mainly consists of raw material, metallurgic, power, transportation and telecommunication companies. They are the largest public companies and, due to their export orientation and/or high status on the Russian market, they are interested in the evaluation of their creditworthiness by international rating agencies. Many of these companies cooperate with several RAs, including the Russian agencies ACRA, Expert RA, National Rating Agency (NRA) and National Credit Ratings (NCR). There are no smaller companies in the sample because of their local orientation. As a result, international RA ratings are not characteristic for them, and they mainly cooperate with Russian RAs.

Some large organisations such as X5 Retail Group, Yandex, and OZON, despite their Russian origins, are officially foreign issuers and are therefore not included in the sample.

The period of 2016–2020 was characterized by the recovery of the Russian economy, including the Russian stock market, after the devaluation of the rouble in October 2014, the imposition of economic sanctions by Western governments, and the downgraded sovereign credit rating of Russia and the downgraded ratings of the largest Russian issuers. This may explain why credit rating upgrades prevail over downgrades as events.

Nevertheless, it should be noted that the majority of ratings of Russian issuers are at the speculative level: only 6 out of 49 issuers in the sample had credit ratings of investment level at the beginning of the considered period (of which 4 were assigned by one RA, with ratings by other RAs being speculative) and 24 at the end of 2020. Often the shift from the speculative to the investment category took place step by step. Although issuers had acquired speculative status as a result of all the rating downgrades, only PJSC Megafon and PJSC Polus had investment ratings initially. Given such a small sample size, there is no point in trying to define the influence of the initial rating (investment / speculative).

The intensity of rating actions within the considered period differed from company to company: there were numerous rating actions related to a certain issuer, including rating changes by several RAs simultaneously or only by some RAs while other RAs left the ratings unchanged. For many of the largest issuers such as PJSC Rostelecom or PJSC Uralkali, the rating actions within the considered period were limited to the adjustment or confirmation of forecasts, while the overall ratings remained unchanged; such companies were not included in the sample. RAs often took rating actions with respect to several (several dozen) issuers simultaneously (S&P on 28 January 2021, Moody's on 28 January 2018 and 12 February 2019, Fitch on 20 August 2019). At the same time, the rating actions of several RAs with respect to a specific issuer coincided very rarely in time.

Although RAs (including international agencies) cooperate a lot with Russian banks, insurance companies and investment corporations by assigning credit ratings both to issuers and to their debt instruments, the sample includes a very small number of financial organisations, because the majority of Russian banks and other financial companies are not public entities, and their shares are not traded on the stock market.

On the Russian market, the criterion for big business is the amount of revenue (over RUB 2 billion) and the number of employees (more than 250 employees)[1]. According to these criteria, all the companies in the sample may be considered to be big businesses. However, the main criterion in Western countries is the market capitalization of a company: market capitalization exceeding $10 billion is generally considered to be high. According to the latest data[2], there are 14 such companies on the Russian market. Within the studied period, only one company from the sample – PJSC Magnit – met this criterion on the date of rating change. Therefore, for the purposes of our study, issuers with capitalization exceeding RUB 200 billion are classified as high-capitalization companies. The market capitalization of companies was calculated on the date of rating change.

Research Results

The visual assessment of the results shows that an announcement of credit rating upgrade (Figure 1) leads to a *fall* in stock prices. This contradicts expectations and observed effects in developed markets; however, it is consistent with data from other emerging markets. Besides, in the event window, prices fall first, and then increase, with a period of stabilization immediately before the announcement of the rating upgrade. They subsequently fall on the 4th and 5th days before returning to their initial levels by the end of the event window.

However, the high volatility of average abnormal returns in comparison to their absolute value (AAR root-mean-square deviation of approximately 1.4–1.8%) prevents us from making significant conclusions. This is confirmed by t-statistics for AAR (Table 1) that show a statistically significant *fall* in stock prices immediately after the event as well as on the -11th and 4th days and a *rise* in prices on the -5th day. The rise and fall of stock prices on the indicated dates are shown in the figure; however, they are so insignificant that it would be hard to develop income-generating trade strategies on their basis. T-statistics of cumulative average abnormal returns (CAAR) reveal no statistically significant values.

The visual analysis of the response of stock prices to a rating downgrade shows that a fall in prices takes place before the event, a significant reduction in prices occurs on the next day after the rating downgrade, and prices further decrease for five days before starting to grow gradually, almost attaining their initial values. However, t-statistics (Table 1) indicate only one statistically significant decrease in average abnormal returns that occurs 11 trading days before the event. Other values of average and cumulative abnormal returns are not statistically significant. One may assume that this is due to a prolonged and gradual reduction of prices as well as their high volatility and the smaller size of the sample. Thus, hypothesis 1 is confirmed at the empirical level yet not statistically.

A comparison of the response to a rating downgrade of financial and non-financial companies (Figure 2) indicates that the prices of shares of non-financial companies show a significant decrease when a rating downgrade occurs and continue to fall up to the 8th day before returning almost to their initial level. However, only the negative average abnormal return on the -11th day is statistically significant, while CAAR values are statistically insignificant.

[1] Regulation of the Government of the Russian Federation of 04.04.2016 No. 265 "On the Limit of Revenue Earned by Business Operations for Each Category of Small and Medium Business Entities".

[2] The most expensive Russian public companies – 2021. RIA Rating, 04.02.2021. URL: https://riarating.ru/corporate_sector/20210204/630194247.html (accessed on 15.02.2021).

Figure 1. Cumulative average abnormal returns (CAAR) in the case of credit rating upgrade and downgrade

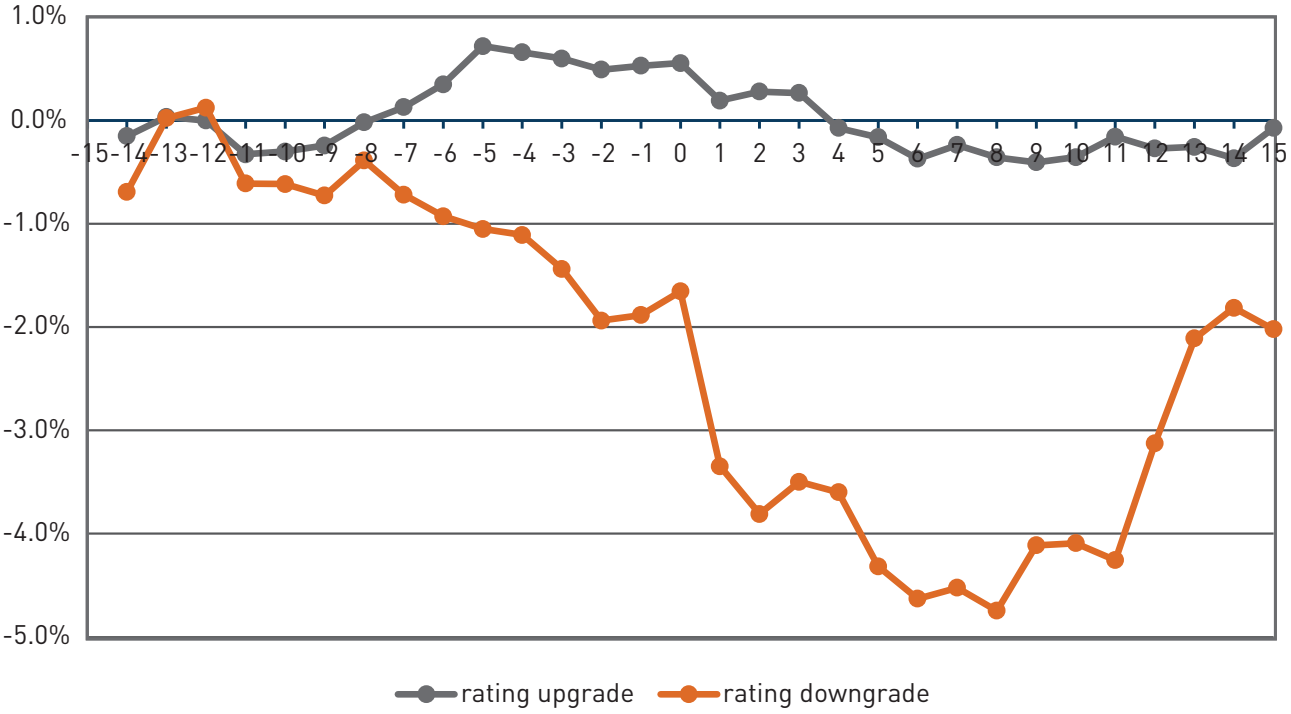


Figure 2. Cumulative average abnormal returns of financial and non-financial companies due to credit rating downgrades

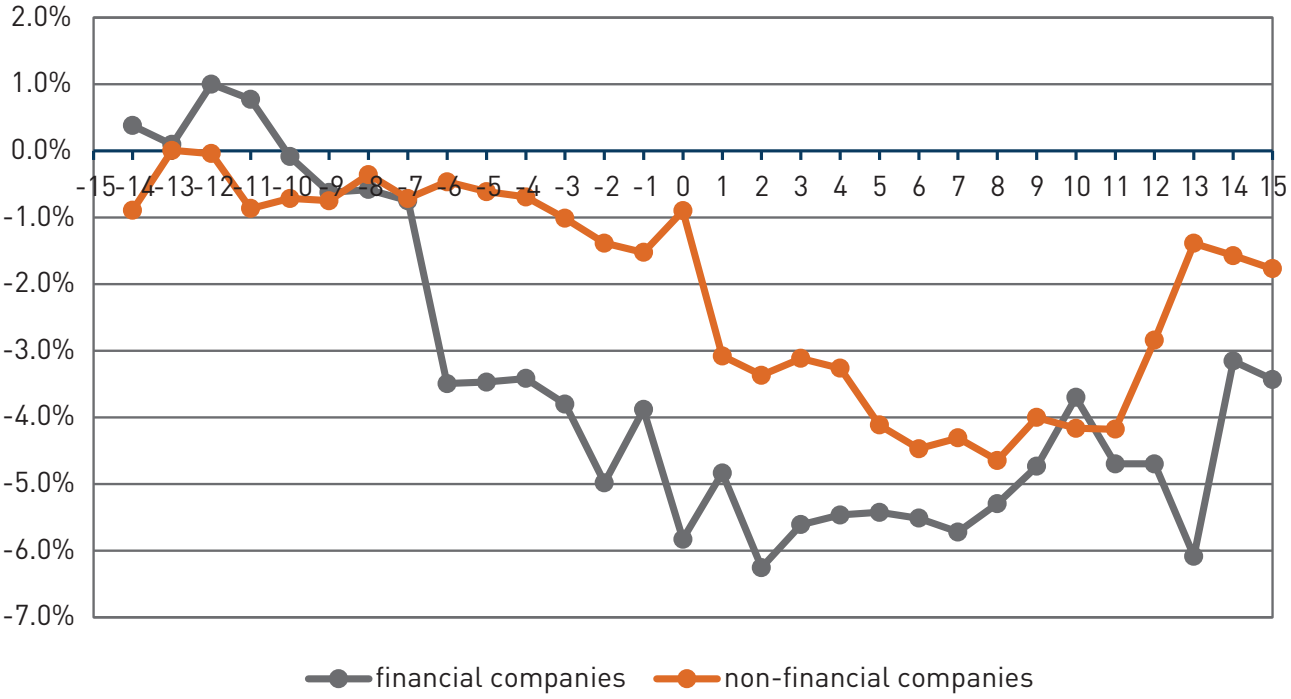
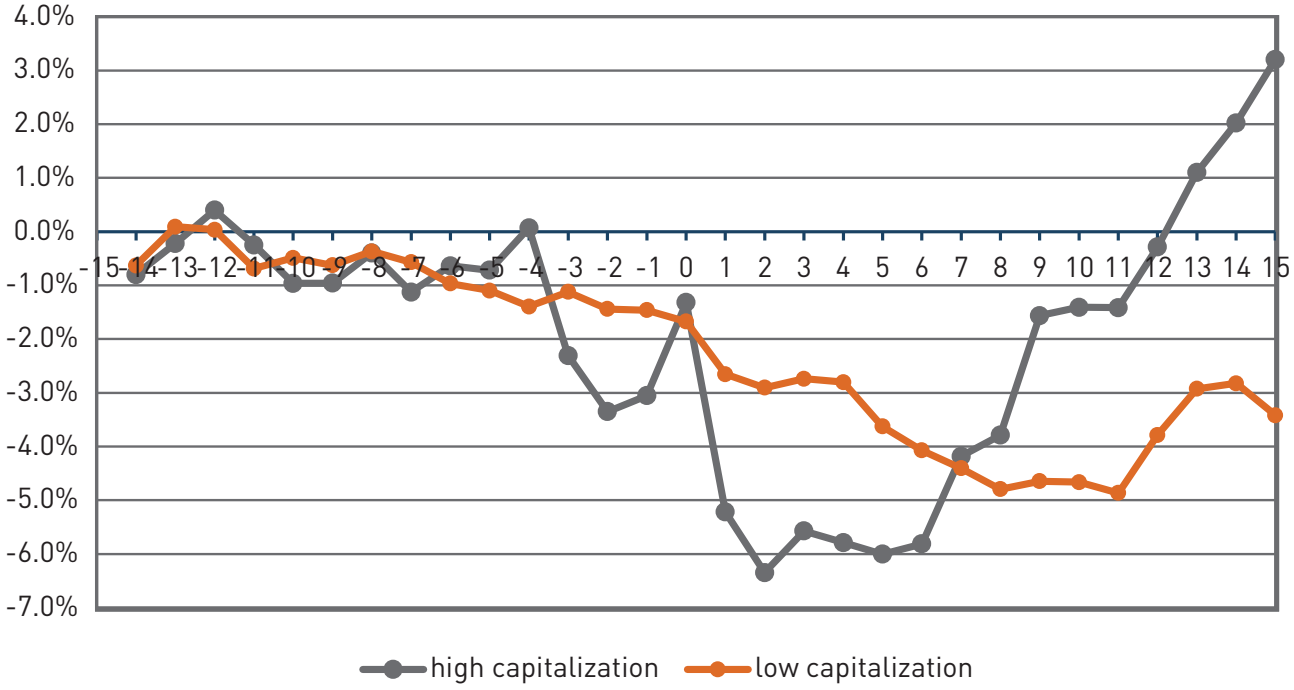


Table 1. Testing the significance of average abnormal returns (AAR) and cumulative average abnormal returns (CAAR)

Day	Rating upgrade		Rating downgrade		Rating downgrade							
					Financial companies		Non-financial companies		High capitalization		Low capitalization	
	109 events t = 1.98		26 events t = 2.06		4 events t = 2.77		22 events t = 2.07		6 events t = 2.45		20 events t = 2.09	
	AAR	CAAR	AAR	CAAR	AAR	CAAR	AAR	CAAR	AAR	CAAR	AAR	CAAR
…	…	…	…	…	…	…	…	…	…	…	…	…
–11	**–2.34**	–1.10	**–2.64**	–1.06	–0.78	1.14	**–2.56**	–1.28	–1.94	–0.37	**–2.05**	–0.94
…	…	…	…	…	…	…	…	…	…	…	…	…
–3	–0.38	1.02	–0.53	–0.82	–0.57	–1.11	–0.44	–0.50	**–2.39**	–0.65	0.38	–0.52
–2	–0.82	0.81	–1.24	–1.05	–1.20	–1.45	–0.84	–0.65	**–3.83**	–0.96	–0.62	–0.63
–1	0.23	0.82	0.14	–1.03	1.79	–1.01	–0.31	–0.72	0.23	–0.98	–0.05	–0.64
0	0.17	0.86	0.39	–0.85	–1.42	–1.37	0.99	–0.41	0.71	–0.35	–0.52	–0.69
1	**–2.72**	0.29	–1.65	–1.63	0.91	–1.21	–1.86	–1.29	–1.05	–1.54	–1.10	–1.04
2	0.58	0.40	–1.15	–1.66	**–3.22**	–1.43	–0.63	–1.26	–0.96	–1.65	–0.59	–1.02
3	–0.11	0.37	0.68	–1.51	**3.24**	–1.29	0.46	–1.15	0.98	–1.40	0.29	–0.96
4	**–2.12**	–0.10	–0.38	–1.51	0.45	–1.23	–0.47	–1.17	–0.32	–1.62	–0.21	–0.94
…	…	…	…	…	…	…	…	…	…	…	…	…
9	–0.30	–0.49	1.30	–1.45	0–86	–1.03	1.14	–1.20	**3.18**	–0.70	0.26	–1.28
…	…	…	…	…	…	…	…	…	…	…	…	…
15	0.75	–0.08	–0.61	–0.64	–1.11	–0.96	–0.49	–0.47	**2.54**	0.84	–1.63	–0.89

Figure 3. Cumulative abnormal returns for high- and low-capitalization companies when credit rating downgrades



For financial companies, the price reduction begins long before the announcement of the rating downgrade, which may be due to more serious requirements for information disclosure, including negative information that enters the market in the period preceding a rating action. Prices do not return to the old level within the event window. T-statistics (Table 1) show that there is a statistically significant negative AAR value on the 2nd day and a positive value on the 3rd day. However, the assertion of the high significance of the obtained results for financial companies is hardly reasonable due to the small sample (four events). Thus, empirical analysis suggests that shares of financial and non-financial companies behave in a different way within the event window. However, the response of financial companies is more profound and starts earlier, and so hypothesis 2 is also rejected.

The difference in the behaviour of stock prices of companies with high and low capitalization is noteworthy (Figure 3). The stock prices of companies with low capitalization decrease gradually long before the event, a significant fall is observed immediately on the date of the credit rating downgrade, and the prices decrease further on the 5th day. Stock prices do not return to their initial level within the event window. Statistically significant values of AAR and CAAR have not been identified despite the relatively large sample size (20 events).

The stock prices of companies with high capitalization seem to be stable during the period preceding the rating downgrade. A statistically significant negative average abnormal return occurs only on the -11th day. Despite its strongly pronounced nature, the decrease in AAR on the date of the event is not statistically significant, nor is the subsequent rise of stock prices to a level exceeding the initial one. This may be due to a high volatility of share prices and the small sample. In general, the response of shares of high-capitalization companies to rating downgrades is more significant. This may be due to their higher liquidity, on the one hand, and the greater optimism of investors about large companies, on the other. Thus, hypothesis 3 is confirmed neither at the empirical nor at the statistical level.

The statistically significant negative values of abnormal returns 11 trading days (14–15 calendar days) before the announcement of the rating change, whether an upgrade or a downgrade, are noteworthy. We may conjecture that information about the start of the procedure of rating change by RAs becomes available to the market at this time despite its confidentiality and has an impact on stock prices.

Conclusions

The analysis of the response of stock prices to announcements of credit rating *upgrades* (statistically significant *decreases* of returns) suggests that the Russian stock market is inefficient in the semi-strong form. At the same time, the absence of a statistically significant response to the announcement of credit rating *downgrades* does not provide sufficient grounds to consider the market to be efficient; it is most likely the result of the limited size and specific characteristics of the sample (a small number of rating downgrade events and a small number of financial companies and high-capitalization companies). Taking into consideration the market's immaturity, high volatility, narrowness and low liquidity and the small number of significant events, one can make the general conclusion that the Russian stock market is not efficient in the semi-strong form.

When rating agencies monitor issuers and adjust their credit ratings and forecasts, they provide significant informa-

tion to the market. This is less true of positive events when RAs play a certifying role of sorts, using the credit rating upgrade to register positive information that has become available to the market and on the basis of which the rating action is performed. At the same time, the response of stock prices to credit rating downgrades is indicative of the fact that the market obtains new and unique information.

Our analysis of the influence of industry and company size uncovered regularities different from the ones observed in developed markets: the response of the stock prices of financial companies to credit rating downgrades was more pronounced, as was the response of the stock prices of high-capitalization companies. However, it is difficult to assert the stability and statistical significance of these regularities due to the high volatility of stock prices and the small size of the sample, as well as other factors apart from the rating downgrade which influenced stock prices within the event window.

In general, the comparison of our results to the data obtained from other markets shows that, in its response to credit ratings change, the Russian market has more in common with emerging markets than with developed ones.

The understanding of the impact of credit ratings on stock prices is important for various market players and, in particular, for asset and asset portfolio managers who take investment decisions. The rather insignificant response of stock prices to credit rating upgrades suggests that income-generating trade strategies are unlikely to be developed on their basis. However, it is possible to develop efficient trade strategies with returns exceeding transaction costs on the basis of RA announcements of credit rating downgrades.

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The Accounting Reform in Russia. How to Teach Economists?

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Abstract

Today, a major reform of national accounting standards is being conducted in Russia in order to harmonize the national system with IFRS. Employers require graduates to have the knowledge and ability to apply not only existing standards but also standards that will be introduced in the coming years as well as international standards. This creates a unique challenge for universities that have to teach students three accounting systems at the same time. This has required changing existing teaching methods. The present study is based on the experience of South Ural State University. Since 2016, it has introduced an intensive methodology for teaching bachelor's students in economics majoring in "Accounting, Analysis and Audit". The methodology promotes student research and analytical work. Students take research courses for 5–7 semesters. In addition to assimilating academic disciplines, they analyse a large volume of materials published by the developers of the new standards. The task of this analysis is to draft sample federal accounting standards. In 2016–2020, over 120 students (78% of all students enrolled in the programme) took part in this work. This has resulted in the preparation of specialists who are able to tackle accounting tasks in real companies. The methodology is applicable in all university departments offering bachelor's programmes in accounting.

Key words: accounting, accounting education, accounting reform, Russia, bachelor's programme, teaching methods

Introduction

Accounting reform in Russia

Russia belongs to a group of countries making a gradual transition to IFRS while maintaining national accounting standards harmonized with international norms. A similar situation exists in most parts of the world. Thus, according to the IFRS Foundation[1], 144 out of 166 countries represented in a 2018 study require the use of IFRS standards by all or most publicly traded companies. However, only 36 of these countries require IFRS for all companies. In particular, IFRS standards are directly used in Kazakhstan. In such conditions, fewer difficulties seem to arise. However, most countries have adopted combinations of IFRS and national standards. For example, listed companies in the Baltic states and the Czech Republic must apply IFRS standards. Several countries allow the use of IFRS instead of national standards. Among post-socialist countries, Hungary applies such a procedure. There are also countries whose national accounting standards are close to IFRS (e.g., Russia)[2]. Thus, in most post-socialist countries, accounting standards are based simultaneously on two accounting systems.

In such conditions, students should acquire knowledge and skills in two accounting systems simultaneously: national standards and international standards.

New national accounting standards programme

A programme for the development of Federal Accounting Standards (FAS) over the subsequent three calendar years is adopted annually. The latest version was approved for the period 2019–2023 (Table 1).

Table 1. Federal Accounting Standards to be adopted in Russia in 2019–2023

FAS	Estimated year of compulsory application	Developer
Inventories	2021	AMC Foundation[3]
Intangible Assets	2022	AMC Foundation
Lease Accounting	2022	Russian Ministry of Finance[4]
Fixed Assets	2022	AMC Foundation
Capital Investments	2022	AMC Foundation
Documents and Document Flow in Accounting	2022	Russian Ministry of Finance
Accounting Reports	2022	Russian Ministry of Finance
Non-Profit Activities	2022	AMC Foundation
Income	2022	IPAR NPO[5]
Financial Instruments	2022	AMC Foundation
Membership in Related Entities and Joint Ventures	2022	Russian Ministry of Finance
Expenses	2023	IPAR NPO

In 2018, the Russian Ministry of Finance recommended the approval of three new-generation standards developed by the AMC Foundation: "Inventories", "Fixed Assets" and "Capital Investments". These standards differ significantly from current accounting regulations. The draft standard "Inventories" has the following novel features:

- Inclusion of work-in-progress inventories in inventories;
- Accounting for inventories purchased in instalments at a discounted value;
- Incorporation of the estimated liability for dismantling and disposal of inventories and environmental recovery of the land plot occupied by them into the cost of inventories;
- Ban on the inclusion of management expenses in the cost of inventories;
- Partial write-off of a semi-fixed part of general production costs for period expenses in case of a significant decline of production.

[1] Yurieva, Y. IFRS Standards. URL: https://www.fd.ru/articles/159206-standarty-msfo (in Russian; accessed 18 January 2021).

[2] Countries using or planning to adopt IFRS. URL: https://gaap.ru/articles/strany_uzhe_ispolzuyushchiesya_msfo_ili_predpolagayushchie_perekhod_na_msfo/https:/www.businessinfo.cz/ru/upravlenie-kompaniej/vedenie-bychgalterskogo-uceta.html (in Russian; accessed 13 June 2020).

[3] Foundation for the Development of Accounting "National Non-Government Standard-Setter 'Accounting Methodological Centre'". URL: http://bmcenter.ru/News/obsugdeniye_FS-OS (in Russian; accessed 14 January 2021).

[4] Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/ru/perfomance/accounting/ development/project/ (in Russian; accessed 14 January 2021).

[5] Institute of Professional Accountants of Russia. URL: https://www.ipbr.org/en/ (accessed 14 January 2021).

The Ministry of Finance of the Russian Federation is also an active developer of new standards. The approval of FAS 25/2018 "Lease Accounting" in autumn 2018 was a major achievement. This standard is fully based on the provisions of IFRS 16 "Leases". There had been no such standard in the RAS system before. It contains concepts that have not been previously applied in Russian accounting, such as the right to use an asset, the fair value of a leased object, the present value of future lease payments, the estimated liability connected with a leased object, the liquidation value of a leased object and a number of others.

New employer requirements for graduates

The new procedure for the development and approval of federal accounting standards began to be applied in practice in 2016–2018. At this time, employer requirements for accounting specialists also began to change. For example, the Mechel Group (one of the largest concerns in Russia, whose biggest portfolio asset is the Chelyabinsk Metallurgical Plant, http://www.mechel.ru/) formulated a number of requirements for accounting graduates, including the following competencies:

1) Knowledge, abilities and skills of applying current (not yet abrogated) accounting standards.
2) Understanding the principles and fundamentals of accounting according to IFRS.
3) Knowledge (at the level of understanding) of new federal accounting standards (or their draft versions).

These requirements are listed in a cooperation agreement between the company and South Ural State University (signed on December 17, 2017). In 2018–20, about 40% of graduates of the university's Department of Accounting, Analysis and Audit who had such competencies were invited to work not only at Mechel but also in large audit companies (both Russian and international). Our analysis has shown that about 60–70% of them actively participate in the department's research work involving the development of new accounting standards in Russia and the application of IFRS principles. However, the current curriculum approved by the Ministry of Science and Education of Russia[6] focuses only on existing Russian standards and does not provide for the formation of competences in IFRS and future accounting standards. Therefore, no methods have been developed for simultaneously teaching different accounting standards.

Thus, a peculiar feature of teaching during the active phase of the accounting reform in Russia (2019–2022) is that graduates are being simultaneously taught three different accounting systems: (1) the current Russian system, (2) the system patterned after international financial reporting standards that are used as a basis for the development of new Russian standards, and (3) the system based on the draft federal accounting standards, which will gradually come into force within the prescribed period. This problem is also relevant for many other countries of the post-Soviet space, in which national accounting is harmonized with international practices.

Review of literature

In recent years, many Russian scholars have studied different issues relating to the reform of national accounting: A.S. Bakaev [1; 2], V.G. Getman [3; 4], T.Y. Druzhilovskaya & E.S. Druzhilovskaya [5–7], I.R. Sukharev [8; 9], L.I. Khoruzhiy [10], S.A. Kuzubov [11], K.O. Shayaxmetova & A.S. Krikunov [12], L.Z. Shneidman [13], E.Y. Svyatkovskaya [14], etc. Unfortunately, as there are very few papers covering these issues in the English language, English-speaking readers are unable to keep track of accounting reform in Russia. The landmark work of R.W. McGee [15] is the best known, yet this book was published 10 years ago. Among recent works, the most comprehensive review of this reform is presented in a paper by N. Generalova, G. Soboleva, and N. Sokolova [16].

A review of approaches to teaching accountants at universities in developed countries leads to the conclusion that the main learning technology remains the case study, to which over 50% of articles in profile journals have been devoted over the past 10 years [17]. There is a great need for technological innovation (online assessment, online instructional resources, managerial accounting software, digital education tools, social media such as Facebook and Twitter, multiple software systems, tax software, Tableau, etc.), yet this process is not dynamic enough for the time being [17–19]. Research as a pedagogical technology is also used in preparing bachelor's students majoring in accounting. In particular, James H. Irving has noted that the use of primary source materials allows students to find and identify answers to a number of complex accounting questions, as well as developing oral and written communication skills, enhancing knowledge through teamwork, promoting the interaction of students in groups, and making them familiar with business-related applications of technologies [20].

At the same time, the system of accounting education in Russia has begun to change rapidly. One of the reasons is the influence of IFRS (Vysotskaya & Prokofieva [21]). A recent study by T.T.Y. Chen that compared trends in accounting education in Russia, China and English-speaking countries concluded that innovative curricula and teaching methods should become a priority for former communist countries implementing accounting reform [22]. Consequently, when the Russian accounting reform enters its active phase, the problem of the development and introduction of such curricula and methods will become increasingly relevant. These curricula and teaching methods must take the transition to the new standards into account.

[6] Federal State Educational Standard of Higher Education. Bachelor's level. Economics. URL: http://fgosvo.ru/uploadfiles/fgosvob/380301.pdf (in Russian; accessed 12 December 2020).

From our point of view, the development of James H. Irving's approach based on individual student research work would be promising in the present-day Russian context characterized by an abundance of primary sources and new accounting tasks.

Methodology

South Ural State University has developed a methodology for teaching bachelor's students the necessary competencies for managing accounting records in the new conditions. These conditions are characterized by the fact that, while enterprises are still performing accounting according to the previous standards, new accounting standards fully harmonized with the IFRS will have come into force by the time students complete their studies (or soon after their graduation). In addition, as the practice of Russian enterprises has shown, new standards will begin to be applied before the appointed date to allow greater flexibility in the introduction of new accounting regulations. In particular, many big companies have already started to apply FAS 25/2018 "Lease Accounting", although the starting date for its compulsory use is January 1, 2022.

The development of new approaches to teaching students in such conditions began with training seminars for lecturers from the Department of Accounting, Analysis and Audit. In 2016, South Ural State University began to cooperate with the Foundation "NSS 'AMC'", with whom it signed an agreement in 2017. Lecturers take part in the Foundation's methodological activities by drafting FAS and accounting recommendations. An accounting analysis laboratory was jointly established by the University and the Foundation. The laboratory provides a platform for video conferences and webinars, as well as video broadcasts of meetings of the Foundation's methodological specialists, at which new draft accounting standards are discussed. The University participated in drafting the FAS "Inventories", "Intangible Assets", "Capital Investments", and "Receivables and Payables". This has allowed it to identify the most important novelties in the future standards and to include them in the educational process. However, the main task at this stage is for lecturers to understand the scope of the new standards in an interactive and high-quality manner and to develop the corresponding teaching and learning aids.

The preliminary work on training lecturers of the SUSU Department of Accounting, Analysis and Audit to teach students in the conditions of in-depth accounting reform has cast the foundations for the development and implementation of new teaching methods. These methods make it possible to teach students to work in the conditions of the transition to IFRS-compatible standards. The development of these methods has led to significant changes in the curricula of accounting courses. The methods are based on a new structure of professional competencies that are formed during the learning process. The new competency structure makes use of learning outcomes [24].

The methodology includes five interconnected components that correspond to the successive levels of mastery of a field of professional activity drawn from Bloom's taxonomy [23; 24]: knowledge, comprehension, application, analysis and synthesis. A higher level (grade) of mastery is formed by master's programmes.

The first level of the methodology is the formation of **knowledge**. A unique feature of the proposed methodology is that it clearly identifies the topics that require coverage in major courses with regard to all three accounting systems:

1) The accounting system currently in force in Russia and set out in the Russian Accounting Standards (RAS).
2) The international accounting system set out in the International Financial Reporting Standards (IFRS), which serves as a methodological framework for the reform of accounting in Russia.
3) The accounting system contained in draft Federal Accounting Standards (FAS).

Lecture materials cover accounting principles, concepts and regulations from all three systems of standards. Students study the material independently for the most part. In each practical class, the lecturer explains the most difficult aspects of the topic, gives examples and then assigns students exercises to consolidate the studied material. Thus, the methodology forms knowledge through the use of traditional teaching methods.

Assimilating this vast material at the level of **comprehension** requires the use of active teaching methods. The department recommends that such teaching methods be supplemented with in-class discussions of the novelties of future standards with regard to the studied questions and topics. When preparing to discuss a specific topic, students study materials from the website of the Foundation "NSS 'AMC'" containing texts of draft and adopted standards. In these texts, they have to identify principles, definitions of concepts, and basic accounting regulations. At mini-conferences, students explain the new material, discuss the mistakes made in the presentations, and express their opinions.

Mastering accounting at the level of **application** takes place in two stages. The first stage involves studying a case from each topic. Specialists from the department's partner companies (industrial enterprises and audit companies) participate in this process. The topic being studied is connected to real situations, prepared in advance by company specialists and harmonized with the department. As a rule, this is a rather difficult assignment for students that requires not only comprehension but also calculations. A course consisting of 4 credits usually includes 4–6 topics exemplified by practical situations. The second stage involves the solution of these problems and the assimilation of calculational skills.

Mastering accounting by bachelor's students at the level of **analysis** also takes place in two stages. During the first stage, the valuable methodological material accumulated by colleagues from the Foundation "NSS 'AMC'" is used extensively. The Foundation's website provides access

to an archive of different versions of standards as well as comments submitted during the discussions of new draft standards. Each student is invited to choose one of the comments and give his/her own answer to the question of why the comment was not accepted.

The second stage of the formation of the ability to analyse subject matter is based on a totally new role and organisation of student research work during each semester under the guidance of a lecturer. Student research projects (SRPs) are considered as an interdisciplinary form of student individual work. All the topics of the SRPs are aimed at a profound study of draft FAS. Students work on project teams, which increases the effectiveness of learning. The main skill formed during the R&D process is the ability to highlight key elements of an accounting standard and, on the basis of this analysis, make tables comparing the key provisions of the standards of the three accounting systems. We recommend using PricewaterhouseCoopers' document "Similarities and Differences: A Comparison of International Financial Reporting Standards with Russian Accounting Regulations"[7] to learn how to highlight key elements and build a comparative table. In this case, the comparison covers not two but three accounting systems (therefore, the table contains 4 rather than 3 columns: topic (reflecting the key elements to be compared), RAS, IFRS, and draft FAS).

The R&D gives rise to an obligatory progress report, which ends with a final comparative table and its interpretation. As a rule, students also willingly participate in the year-end academic conference (the number of participating students has more than doubled since 2016). Students also publish their research findings in articles (the share of such students is over 50–60% today in comparison to less than 15% in 2016).

Accounting is mastered at the level of **synthesis** through the student final project that is an analogue of Capstone and other practice-oriented projects used in different countries. The department has elaborated new requirements for final research projects. The uniqueness of this level of the methodology is that it highlights two aspects of this skill – methodical and organisational. The need for such an approach is explained by the fact that future specialists should be able not only to make calculations using the methods outlined in the new draft accounting standards but also to organise the transition from the old to the new standards. The latter may be called the skill of developing a business process for the transition from existing to new accounting standards. A peculiar feature of this business process is that it is implemented in the conditions of the ongoing management of accounting records at the enterprise, which cannot be stopped even temporarily.

In the next section, we will consider in more detail some underlying aspects of the methodology.

The attraction of specialists from the department's partner companies

The attraction of specialists from the department's partner companies is one of the intensive teaching methods used at SUSU. Since the 2017–2018 academic year, specialists from partner companies have taken an active part in teaching at the department. At the beginning of the semester, a schedule of classes by specialists is drawn up. The main criterion for the selection of topics is the need to explain the provisions of the new accounting standards that are difficult to understand and apply. These provisions are generally lacking in the current standards. For example, specialists of the Avuar Group have held practical classes with 3rd and 4th-year bachelor's students on the following topics: professional judgments by accountants during the transition to new accounting standards, accounting for estimated liabilities, and lease accounting. Specialists of the Mechel Group have held master and practical classes on the following topics: accounting for reserves and their reflection in accounting policy, accounting under IFRS in a public company (issues of organising accounting and disclosure), and automating accounting in the conditions of continuously changing accounting standards.

Student research work

By the decision of the university academic council, individual semester-long research work under the guidance of a lecturer has been introduced into the curriculum of bachelor's students in economics (semesters 4–6, 324 hours of student independent work). The department provides a list of topics for student research work relating to specific aspects of the application of draft FAS. The student assignment includes the independent evaluation and commentary of draft FAS.

When performing the assignment, the student must compare the current accounting procedure with the procedure proposed in a draft FAS. In addition, a comparison is also made with the relevant IFRS procedure. Based on these comparisons, the student evaluates the degree of harmonization of accounting standards for individual objects and learns to work with the new standards. Another compulsory element of the assignment is to design a case that would reflect the realities of the business life of an organisation as required by each standard. The assignment ends with the development of recommendations on improving the text of the draft FAS in the aspects considered by the student.

Examples of topics for individual research assignments:

1) Accounting for estimated obligations for the dismantling and disposal of property and the environmental recovery of the land plot occupied by it that arise in a company in connection with its receipt of fixed assets.

[7] Similarities and differences: Comparison of International Financial Reporting Standards with Russian Accounting Regulations. URL: https://www.pwc.ru/ en/ifrs/publications/assets/rar-versus-ifrs-2015.pdf (in Russian; accessed 18 October 2020).

2) Accounting for the revaluation and impairment of fixed assets.
3) Accounting for inventories during a significant reduction in the rate of operation in the reporting period as compared to the regular level.
4) Accounting for inventories in the case of purchases on deferred payment conditions for a period exceeding 12 months.
5) Accounting for the disposal of intangible assets at non-zero disposal value.

Thus, research work serves as the basis for the formation of a whole range of professional competencies related to the new standards. One of the basic skills to be mastered by the student is drawing up a comparative table of the provisions of RAS, IFRS and FAS (or their drafts, if the standard has not been approved by the Russian Ministry of Finance so far) as well as drawing conclusions about the similarities and differences of these accounting systems.

Student final research project

In 2017–2018, the Department of Accounting, Analysis and Audit changed the recommended structure of the bachelor's final research paper. The final research project must now include a section forecasting changes in the accounting procedures at the studied enterprise after the adoption of the FAS related to the topic of the paper. The student must assess the consequences of the change in the accounting procedures for the enterprise's financial statements and recommend changes to its accounting policy. In addition, the student can choose a topic related to the analysis of a specific draft FAS.

Here are some examples of topics of final research papers defended in 2018–2020: "Accounting and Audit of Investment Property According to IFRS Using the Russian Plan of Accounts", "Accounting and Analysis of the Property, Plant and Equipment of Ariant Agricultural Company LLC in the Conditions of Reforming Russian Accounting Standards", "Accounting for Deferred Taxes According to IFRS and RAS (Comparative Analysis)", "Harmonization of Property, Plant and Equipment Accounting Regulations in the Russian Federation with International Financial Reporting Standards", and "Accounting for Subsidies and Disclosure of Government Assistance in Financial Statements".

As an example, let us examine in greater detail a final research paper on the topic "Harmonization of Property, Plant and Equipment Accounting Regulations in the Russian Federation with International Financial Reporting Standards". The recommended scope of the paper is presented in Table 2.

Table 2. Recommended scope of the final research paper on the topic "Harmonization of Fixed Assets Accounting Regulations in the Russian Federation with International Financial Reporting Standards"

Section number	Section name	Subsection number	Subsection name
1	Genesis of accounting reform in the Russian Federation	1.1	Premises for accounting reform in Russia
		1.2	Stages of the accounting reform
		1.3	State-of-the-art procedure for the development and approval of documents pertaining to accounting regulation
2	Russian and international property, plant and equipment accounting regulations	2.1	Evolution of the Russian property, plant and equipment accounting standards: the harmonization with international financial reporting standards
		2.2	The need to reform existing property, plant and equipment accounting procedures
		2.3	Similarities and differences of the draft federal accounting standard "Property, Plant and Equipment" and IFRS (IAS) 16 "Property, Plant and Equipment"
3	Procedures for the practical application of the provisions of the draft federal accounting standard "Property, Plant and Equipment"	3.1	Accounting for the initial recognition of property, plant and equipment
		3.2	Accounting for the depreciation of property, plant and equipment
		3.3	Accounting for revaluations of property, plant and equipment
		3.4	Accounting for the impairment of property, plant and equipment
		3.5	Accounting for the disposal of property, plant and equipment

The preparation of the bachelor's final research project completes the formation of professional competencies relating to the new standards. The student profoundly assimilates an accounting topic by describing the current accounting procedure, the main provisions of the new standards, and the organisation of the process of the transition to new standards at a particular enterprise. The effectiveness of this stage of bachelor's education has been highly evaluated by specialists of partner enterprises that took part in the work of the project defence committee. Almost one third of graduates in 2018–2020 received job offers from companies. Given that another quarter of the students were invited even earlier to work in major regional companies, this is a very high index of graduate employment in highly prestigious companies.

Results

The described methods have already been applied for 10 semesters, starting from autumn 2016. The obtained results can be systematized in three areas relating to the main stakeholders of the new educational process:

1) The activity and interest in the educational process among students as the main targets of the new methods:
2) The activity and interest in work based on the new methods among lecturers as the main actors of the educational process.

The activity and interest in programme graduates of employers as the main beneficiaries of the new teaching methods.

The main quantifiable results are presented in Tables 3 and 4. Since the introduction of the new intensive methods for teaching bachelor's students, the following aspects have changed significantly: students' research activity, participation in the implementation of real projects, readiness to undertake internships and part-time work at the department's partner enterprises, attitude to choosing places of internship, and attitude to choosing the topic of the final research project.

Table 3. Relative* changes in indicators characterizing the results of the introduction of intensive teaching methods for bachelor's students in accounting at SUSU: the achievements of students

Indicator	2016–2017 academic year	2017–2018 academic year	2018–2019 academic year	2019–2020 academic year
Percent share of students participating in research project teams	20	35	60	65
Percent share of students participating in academic conferences	15	15	40	50
Percent share of students publishing their research results	10	22	30	50

* Absolute values are not representative due to the different numbers of 3rd and 4th-year students in the bachelor's accounting study programme.

Table 4. Changes in indicators characterizing the results of the introduction of intensive teaching methods for bachelor's students in accounting at SUSU: the achievements of lecturers

Indicator	2016–2017 academic year	2017–2018 academic year	2018–2019 academic year	2019–2020 academic year
Number of research articles published by the department's lecturers on subjects relating to the accounting reform in Russia*	1	6	18	24
Number of lecturers participating in the activities of the methodological specialists of the Foundation "NSS 'AMC'"	1	2	3	5

* Only publications in journals indexed by the Russian RSCI citation base are taken into account.

From the 3rd year on, students become involved in research work in areas relating to the development and implementation of new national accounting standards. The share of 3rd and 4th-year students working on project research teams amounted to 20% during the 2017–2018 academic year, 35% in 2018–2019, and about 60% in 2019–2020. This figure seems to be close to the limit, since other students choose other areas of research (analysis, management accounting, internal control). These students were guided by lecturers who participated in the development of the new standards. The share of participants in academic conferences at SUSU and other universities who make reports on topics relating to the accounting reform also shows an upward trend. During the 2020–2021 academic year, this figure amounted to about 40% of all 3rd and 4th-year students. Finally, the number of student publications on these topics is also growing: during the current academic year, 10–12 articles should appear. One also notes a growing number of participants and winners of all-Russian and international academic competitions, including competitions held by Big Four companies.

The lecturers' activities and academic interests include designing research and practical seminars covering the relevant accounting reform issues for other lecturers and chief accountants, making comments and proposals on drafting federal accounting standards, publishing research articles describing accounting procedures relating to the new federal standards, and participating in the activities of the methodological specialists of the AMC Foundation and other initiatives relating to the development of this focus area of the department. All the indicators show an upward trend (Table 4). Since the methodology was introduced, proposals have been developed and submitted for the following draft FAS: "Inventories", "Intangible Assets", and "Receivables and Payables". It is planned to increase the number of members in the Association of the AMC Foundation to 6 people, who will become active participants in the accounting reform process.

The most important achievement of department lecturers was winning a grant of the Vladimir Potanin Foundation[8] for the development of the new master's course "Accounting and Auditing According to IFRS Using the Russian Plan of Accounts" in 2018–2019. The foundation's educational activities cover many different areas; they have the common goal of changing the educational environment, supporting the values of knowledge, professionalism, creativity and volunteering, and developing and diffusing new educational practices. Department staff is currently working on the development of the course. To this end, a textbook and software for innovative teaching methods have been created (December 2019).

Employers' activities and interests are conditioned by the need for highly qualified personnel. A shortage of specialists in the field of accounting and auditing has emerged over the last 2–3 years under the influence of several objective and subjective factors. Some trends and figures in this area have been highlighted at conferences (in particular, at the conference of the Russian Union of Auditors –Russia's largest self-regulating organisation of auditors – entitled "On the role of auditing and economic development in Russia and the Russian Union of Auditors in the consolidation of the auditing community to increase the prestige of the auditor's profession at the Russian and international levels") and in the business press.[9] However, the employers' interests are conditioned less by the shortage of specialists than by the need for personnel proficient in the new accounting methods. For example, in 2017 Mechel PJSC signed a cooperation agreement with SUSU for preparing economists. The company introduces new accounting methods before their official entry into force. The recommendations given by the specialists of the company's accounting and reporting department are taken into account when developing the curricula of bachelor's programmes. During the 2019–2020 academic year, 9 seminars and workshops were held for bachelors. 10 graduates were recruited to work for the company on the basis of their final papers in 2020; 7 of them are active participants in research work on accounting reform in Russia. Currently, 16 bachelors are working in the company on a part-time basis as well as participating in on-the-job and pre-graduation internships in the company's economic and accounting departments. The results of the joint project have been highly assessed by the management of Mechel PJSC; it is planned to expand the project to include accounting automation based on the new methodology.

Discussion, limitations, and further research

When we started working on this project, we realized that the need for intensive training methods will exist only so long as the accounting reform is underway. However, the government is constantly expanding the list of standards to be harmonized with IFRS. Therefore, our experience should be in demand for at least the next decade.

The methodology was developed with the help of two key resources of the SUSU Department of Accounting, Analysis and Audit. First of all, it is the only university department in the country that is a co-developer of new national accounting standards. Several lecturers serve as methodological specialists for the AMC Foundation. Secondly, there are many large industrial enterprises and audit companies in the Urals with which the university has partnership agreements.

A lack of such resources may seem to be a serious limitation to the use of our methodology. However, 4 or 5 years

[8] Vladimir Potanin Foundation. URL: https://www.fondpotanin.ru/ competitions/projects/ (in Russian; accessed 14 January 2021).

[9] Prosvirina, I.I. On the verge of extinction: Will the professions "accountant" and "economist" disappear? URL: https://chel.dk.ru/news/prezhnie-metody-uderzhaniya-i-motivatsii-spetsialistov-ne-rabotayut-a-novye-ne-sozdany-237116304 (in Russian; accessed 14 January 2021).

ago, our department did not have such opportunities, either. We decided to try to participate in the public discussion of draft FAS via the website of the AMC Foundation. Any interested person can do so, too. This helped us to sign a cooperation agreement and arrange joint work. In recent years, the search for partner enterprises has ceased to be a problem due to the shortage of specialists in the field of accounting. Enterprises facing the challenge of switching to new accounting methods have begun to cooperate actively with universities. Thus, most Russian universities can copy our experience.

We shall continue our department's work on the further development and diffusion of our methodology through the creation of new teaching and learning aids. We have already gathered a lot of materials for this in the form of assignments, practical tasks and cases prepared by department lecturers, the data of our published studies dealing with accounting reform in Russia, and the developments of the department's partners – specialists from enterprises and audit companies. These materials are currently being systematized and prepared for publication.

Our plans for developing intensive teaching methods include an opinion survey of department students and graduates who have been or are being taught with the new methods, as well as employers. To date, the total number of potential participants in the survey of students and graduates attains 350 people. Such a survey will allow us to obtain valuable comments and identify positive aspects of the methodology along with representative data on the necessary changes and directions for their refinement.

Conclusion

The current in-depth accounting reform in Russia, as well as the results of a study conducted by T.T.Y. Chen (Chen, 2015), showed the necessity of developing new approaches and introducing innovative methods for teaching bachelor's students in the field of accounting. When we started this project, we did not expect it to lead to the revision of virtually all elements of the educational process. The keystone of the new methodology is the employers' need for specialists who are able to work in the conditions of the constant introduction of new accounting standards. The main task of the university was to form knowledge with an eye to the future: students must be familiar with standards that have not yet come into effect (at least, with their basic concepts and approaches to accounting and their differences from existing standards).

The search for a teaching methodology led us to the learning outcomes approach, which fully meets employers' needs. In view of the requirements laid down by the department's partner companies, students assimilate professional activities at the levels of knowledge, comprehension, application, analysis and synthesis. The methodology developed in 2016–2018 contains teaching methods for each of these levels. In particular, the methodology includes the following innovations:

1) Classes taught by specialists from partner companies.
2) Use of the database of the AMC Foundation, which contains comprehensive information about the process of developing new standards.
3) Introduction of individual student research work under the guidance of department lecturers who are co-developers of the new accounting standards and with the use of project-based teaching.
4) New requirements for the final project that allow students to synthesize the skills acquired at previous levels into a unified system by developing a project for a specific enterprise (as a rule, the project involves methodological and organisational preparation for the transition to one of the new accounting standards).
5) Greater satisfaction of graduates with the results of their studies, as shown by (a) the increasing quality of student performance in the 3rd and 4th years: the share of students with good and excellent grades increased from 55% in 2018 to 71% in 2020, (b) the increasing number of 3rd and 4th-year students wishing to participate in internships with partner companies: the percentage of students combining studies and internships increased from 10% in 2018 to 35% in 2020, (c) the high proportion of students seeking to find employment in partner companies after graduation (at least 75%), and (d) the quick career growth of graduates after employment with no dismissals during the period of observation from 2018 to 2020.

There is no doubt that these indicators result from the introduction of the new methodology, as other factors remained unchanged during this period. In particular, the same educational standards (Federal State Educational Standard of Higher Education 3+), curricula and academic course programmes have remained in force since 2015. The teaching staff of the department has not changed, either.

The improvement in results became particularly visible in summer 2018. As we highlighted in departmental reports, student research activity (participation in conferences and publication of articles) increased by 2–3 times over 6 academic semesters, and many students became participants and winners of high-level academic competitions. Nevertheless, the main result is that 38% of our graduates have received job offers from big prestigious companies. Previously, employers of this type had usually required work experience, and our graduates often did not meet these requirements. Therefore, we link the improvement of our educational process to the new methodology of teaching bachelor's students in the field of accounting described in this article.

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Investigation of the Influence of Internal Control System Factors on the Financial Stability of Companies (Review)

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Abstract

The quality of internal control systems can have a significant impact on decision-making by users of financial information as well as on the financial position of organisations and on negative economic consequences of economic activity (bankruptcy, fictitious audit reports, etc.). The tools for ensuring the financial stability and solvency of a company are largely determined by the processes developed, implemented and maintained within its internal control system. In turn, the quality of the internal control system and its ability to respond quickly to emerging threats to reduce financial stability depend on external and internal factors affecting the system itself. We believe that negative consequences are typical for Russian organisations due to the insufficient study of these factors.

The goal of this paper is to investigate the influence of the external and internal factors of internal control systems on the financial stability and solvency of Russian organisations based on a review of foreign publications.

This paper has the following targets: (a) identifying the external and internal factors of internal control systems based on a review of foreign studies of the determinants of internal control systems, (b) identifying the characteristic factors of Russian organisations and (c) developing a methodology for assessing the dependence (relationship) between the characteristic factors of internal control systems and the financial indicators of Russian organisations.

Our research hypothesis is that the high level of economic crimes, bankruptcies and other negative economic consequences of low financial stability and solvency of organisations in Russia is due to the weak elaboration of factors affecting the internal control systems of organisations.

To achieve our research goal, we conducted a systematic review of foreign (Chinese, US and European) publications. The selection criteria for publications were indexability in Scopus and the Web of Science and ranking by citation level. Our research question was the influence of external and internal factors on the quality of the internal control systems of organisations. We began our literature review with the year 2014 which witnessed the appearance of studies of the results of a ten-year application of the COSO Concept: Internal Control and the Sarbanes-Oxley Act. The literature review allowed us to identify the external and internal factors affecting the internal control systems of foreign organisations. This separation is due to the fact that internal factors depend, as a rule, on the activities of the organisation, which can manage them in order to improve the quality of its internal control system and influence financial stability and solvency. External factors do not depend on the activities of the organisation, and the task of the management is to monitor risks and to respond to changes in the external environment promptly in order to minimize the negative impact on the quality of the internal control system.

Russian companies do not publish similar reports on the quality of their internal control system, which represents a significant limitation of our research. We identify the following characteristic factors for Russian organisations: external audit, state, and market factors (external factors) and the characteristics of the management board, the CEO and the board of directors, the ownership structure, and the organisation of the internal control / audit system (internal factors). In addition, the prospects for studying the impact of these factors on the internal control systems and the financial stability and solvency of organisations are outlined. A methodology for assessing the dependence (relationship) between the factors of the internal control systems and the financial indicators of Russian organisations is developed.

Key words: internal control system, ICS, ICS determinants, external factors, internal factors, finance

Introduction

In recent years, the study of the external and internal determinants of internal control systems has been gathering pace due to the expanding experience of applying the COSO Concept: Internal Control and the Sarbanes-Oxley Act (section 302 of Corporate Responsibility for Financial Reports, section 404 of Management Assessment of Internal Controls). In most cases, researchers divide countries into three categories: countries regulating internal control system reports on the basis of the Sarbanes-Oxley Act, countries regulating internal control system reports along the American model, and countries which do not regulate this sphere at all. The regulation system influences the quality of internal control systems (ICSs); for this reason, analysis gives different results in different countries. Researchers have also identified various factors that have an impact on internal control systems and their reports, depending on national specifics. They include external factors such as external audit, national culture, market environment, and the model of internal control system regulation and internal factors such as characteristics of the CEO and the management board committee, internal audit, and ownership structure [1].

Practical issues related to determinants and economic after-effects of the quality of internal control systems have become relevant in Russia. This is related to a great number of modified auditor's opinions, detected fraudulent auditor's opinions, increasing company and especially bank bankruptcies, and the spread of fraud. Over the past decade, companies have increasingly had to grapple with economic crimes. According to the Global Economic Crime and Fraud Survey 2018 [2] prepared by the accounting firm PricewaterhouseCoopers, the following types of fraud prevail in Russia: misappropriation of assets, bribery and corruption, and procurement fraud. According to a poll conducted in Russia, 41% of respondents whose companies had suffered from economic crimes over the previous two years said that their losses had amounted to $100,000 [2]. Audit results confirm that the misrepresentation of financial statements takes place on a regular basis. According to reports of the Ministry of Finance of the Russian Federation, approximately 20% of audit reports over the past five years have been issued with a modified opinion, which was represented in most cases as a qualified opinion [3].

Global Economic Crime and Fraud Surveys indicate that internal control mechanisms are most effective in detecting unscrupulous practices. Thus, the identification of external and internal factors, the study of their influence on internal control systems and their correction on the basis of the detected factors make it possible to decrease the likelihood of modified auditor's opinions, bankruptcy and other negative consequences resulting from low-quality internal control systems.

In view of this we propose the following research hypothesis: in Russia, there is a high level of economic crimes, bankruptcies and other negative economic consequences of the low financial stability and solvency of organisations due to an insufficient understanding of factors affecting the internal control systems of organisations. The purpose of this paper is to investigate the influence of external and internal factors of internal control systems on the financial stability and solvency of Russian organisations based on a review of foreign publications

Our study has the following targets: identifying the external and internal factors of internal control systems based on a review of foreign studies of the determinants of such systems, identifying the characteristic factors of Russian organisations, and developing a methodology for assessing the dependence (relationship) between characteristic factors of internal control systems and the financial indicators of Russian organisations.

The paper consists of three sections that study the influence of internal factors on the internal control system, the influence of external factors on the internal control system, and the characteristics of the internal control systems of Russian companies.

To attain this goal, we make a systematic review of foreign publications (China, Europe and the USA). The following selection criteria were used for publications: published in 2014–2020 (the beginning of this period witnessed the publication of studies about the results of a ten-year application of the COSO Concept: Internal Control and the Sarbanes-Oxley Act), indexability in Scopus and the Web of Science, ranking by citation level, and international scope (the sample comprises studies from the USA, Europe, China and other countries, making it possible to identify similarities and differences in conclusions about the influence of similar factors on internal control systems due to the specifics of national regulations and old ways).

Study of the Influence of Internal Factors on the Internal Control System

In order to test our hypothesis and identify the ICS characteristics of Russian companies, we shall make a detailed review of foreign studies of the influence of internal corporate factors on internal control systems.

An analysis of literature indicates that the main internal factors are the characteristics of the CEO, the board of directors, the audit committee, and the ownership structure (Table 1).

Characteristics of the CEO, Board of Directors and Management Board

The board of directors and audit committee play an essential role in establishing the internal control system. Audit committees control the audit of a company, analyse major shortcomings and monitor remedial measures. The board of directors assumes the final responsibility for the supervision of the internal control system.

CEO characteristics (for example, individual approach or cooperation with the board of directors, management style

(power), ownership of company shares) may also have an impact on ICS quality. For example, a powerful CEO may jeopardize the ability of the board of directors to control management decisions and weaken the internal control and corporate monitoring systems in order to serve his/her own interests.

Do the characteristics of the board of directors and internal auditors influence the reliability of internal control systems? Studies conducted in the USA by Balsam, Jiang and Lu (2014) demonstrate that the characteristics of the board of directors (size and independence) and the audit committee (financial examination and size) have no significant impact on the disclosure of information about the weaknesses of the internal control system (as per SOX 404) [1]. However, Chen et al. (2017) believe that the independence of the board of directors has a negative impact on the disclosure of information about the shortcomings of the internal control system and that this negative relation defines to a greater extent the double nature of CEOs [1]. Probably, the contradicting results are related to the different regulation systems in the USA and China as well as to the different time periods of the studies.

How does the CEO's gender influence the quality of the internal control system? In recent years, there have appeared a number of studies that may be used to trace the impact of gender diversity of the board of directors and audit committee on the quality of the internal control system. Parker et al. (2017) examine the question of whether the gender of auditors and board members influences ICS quality. Their results show that the share of women on the audit committee is positively related to the probability of the disclosure of information on ICS weak points in reports. For the board of directors, this relation is negative [5]. Chen et al. (2016) also suggest that the percentage of women on the board of directors has a negative relation to the probability of the disclosure of information about ICS shortcomings [6].

In comparison with earlier research, the aforementioned papers largely confirm that ICS quality has a direct relation to the characteristics and composition of the board of directors. It complies with good management practice. Studies on audit committees and the ICS also support the opinion that positive aspects of audit committees (such as expert knowledge and independence) are related to higher ICS quality. Studies of the influence of CEO characteristics and new studies of the influence of women CEOs on ICS quality are more equivocal. The conclusions depend on the country of study, the national culture and the customary ways of doing business.

Ownership Structure

The characteristics of the ownership structure (family ownership, ownership concentration) have a significant impact on corporate management practices and, hence, on risk management and internal control systems due to the ability/inability of some persons to influence decision making.

How does family ownership influence the quality of the internal control system in various countries? Bardhan (2015) and Weiss (2014) studied the impact of family ownership on ICS quality in the USA and Israel, respectively. Weiss (2014) points out that family ownership is, to a large extent, associated with a smaller number of material shortcomings of the ICS disclosed in the reports of Israeli companies [7]. Bardhan (2015) provides evidence that American family firms have lower ICS quality (SOX, section 404) than non-family ones [8]. Obviously, the difference in these researchers' conclusions is explained by specifics of the national cultures of the studied countries.

Internal Auditors

The audit committee plays an important role in assuring the proper quality and efficiency of corporate governance, creating and maintaining the company's business value and improving its investment attractiveness. The main function of the audit committee is to provide assistance to the board of directors in exercising efficient control, including the following factors:

- Completeness, accuracy and reliability of reports.
- Efficiency of corporate governance, risk management and the internal control system.
- Efficiency of internal audit.
- Quality of internal audit.
- Counteracting the unscrupulous practices of employees.

Thus, the internal audit department plays an essential role in monitoring and uncovering the shortcomings of the internal control system and informing the senior executive management about them so that remedial measures are taken in due time. The aforementioned studies indicate that the improvement of internal audit is related to the improvement of the quality of the internal control system.

Table 1. Internal determinants of the internal control system (ICS)

Authors	Factors of the internal control system (ICS)	Country	Statutory regulation / used reports	Main results
Characteristics of the CEO, board of directors and management board				
Lin et al. (2014) [1]	CEO characteristics and ICS shortcomings	USA	SOX 404, disclosure of ICS shortcomings	CEO security (length of appointment) and age are related negatively to ICS quality (the older the director, the lower the ICS quality)
Campbell et al. (2016) [1]	Professional community of the senior executive management (positions of the CEO / chief financial officer) and ICS quality	USA	SOX 404, disclosure of ICS shortcomings	Executive relationships (joint ownership by the CEO / chief financial officer) are related negatively to the probability of ICS shortcomings
Chen, Knechel et al. (2017) [1]	Independence of the board of directors and the probability of including information on ICS shortcomings in the report	USA	SOX 404, disclosure of ICS shortcomings	The independence of the board of directors is related negatively to the disclosure of shortcomings of the internal control, and this negative relation tends to be even greater in the case of the CEO's double nature
Chen, Eshleman et al. (2016) [6]	Presence of women on the management board and ICS shortcomings	USA	SOX 404, disclosure of ICS shortcomings	Companies with a high percentage of women on their boards of directors are less likely to have ICS shortcomings
Pakey et al. (2017) [3]	Presence of women on the audit committee and management board and disclosure of ICS shortcomings	USA	SOX 404, disclosure of ICS shortcomings	The share of women on the audit committee (management board) is significant and positively (negatively) related to the probability of disclosing ICS shortcomings. The influence has not been defined.
Hay et al. (2014) [1]	Independent directors on the board and ICS quality	China	Voluntary disclosure of audit reports concerning the ICS	Independent directors on the board of directors improve ICS quality.
Shen et al. (2020) [9]	Rural origin of the director (as well as his/her gender, age, and education) and the internal control system	China	Statements of Chinese listed companies	The rural origin of the CEO may improve significantly the quality of corporate internal control. At the same time, when the CEO is a woman, the positive influence of the CEO's rural origin on the quality of the internal control is not apparent; however, when the CEO is older and has a higher education, the positive influence of the CEO's rural origin on the quality of corporate internal control becomes more apparent.
Shu et al. (2018) [10]	Corporate integrity and shortcomings of internal control	China	Data of polls about corporate integrity	Corporate integrity is related very significantly and negatively to internal control shortcomings. The negative relation between corporate integrity and internal control shortcomings is more significant in cases of underdeveloped legislation and market competition. More efficient corporate governance may strengthen the relation between corporate integrity and the quality of internal control. Corporate integrity may improve the quality of internal control
Lu, Cao (2018) [11]	Individual characteristics of the members of the board of directors (education, experience, certification) and internal control quality	China	Statements of Chinese listed companies	Internal control quality is better, shortcomings of internal control are reduced, and elimination of shortcomings is more likely in companies whose chairman and members of the board of directors have higher qualifications. Moreover, the right of ownership has a restraining influence on the interrelation between the characteristics of the board of directors and internal control.
Agyei-Mensah (2016) [12]	Independence of the board of directors, size of the board of directors, institutional ownership and ICS disclosure	China	Informative analysis of ICS reports	Only the independence of the board of directors has a significant positive influence.
Michelon et al. (2015) [1]	Characteristics of the board of directors, audit committee and ICS disclosure	Germany, France, Italy, Great Britain	Index of ICS information disclosure	The double nature of the CEO has a negative impact on the disclosure of ICS shortcomings. An expert chairman of the audit committee has a positive influence.
Ownership structure				
Bardhan (2015) [4]	Family ownership and ICS shortcomings	USA	SOX 404, disclosure of ICS shortcomings	Family firms show greater ownership shortcomings of the internal control system that non-family companies
Weiss (2014) [7]	Family ownership and ICS shortcomings	Israel	SOX 302, disclosure of ICS shortcomings	Family ownership is to a great extent related to a smaller number of ownership shortcomings of the internal control system
Ji et al. (2015) [1]	Ownership structure and voluntary disclosure of ICS shortcomings	China	Informative analysis of ICS reports	The size of the board of directors and ownership concentration have a negative impact on the voluntary disclosure of ICS shortcomings, while the expertise of the audit committee has a positive impact.
Internal audit quality				
Mazza and Azzali (2015) [1]	Influence of internal audit quality on the gravity and resistance of ICS shortcomings	Italy	Examination of internal auditors	The improvement of internal audit quality is related to a decrease in the gravity and resistance of control shortcomings
Chang et al. (2019) [13]	Influence of the characteristics of internal audit on the efficiency of internal control	China	Data on Taiwanese companies	Internal audit assists management in improving internal control. A larger internal audit group may increase the efficiency of internal audit, while the competence of an internal auditor is positively related to the efficiency of the internal control of compliance, not operations

Study of the Influence of External Factors on the Internal Control System

In order to test our hypothesis and identify the ICS factors characteristic of Russian organisations, we shall consider in greater detail foreign studies of the influence of external factors on the internal control system.

A literature analysis shows that the main external factors are external audit, national culture and market factors (Table 2).

Variables Related to Audit

Not only internal but also external audit has been shown to have a significant impact on company operations in general and on the internal control system in particular. For example, it has been argued that an improvement in auditor quality is positively associated with ICS performance. Auditors' IT expertise and in-depth knowledge of their client companies allow them to conduct advanced auditing procedures and make the corresponding tests to detect risk areas. This is likely to enhance audit quality and reduce the probability of ICS shortcomings. The auditor type (Big 4 or non-Big 4) may also have an impact on ICS quality, insofar as Big 4 auditors tend to be more independent due to their diversified client portfolio and exert more pressure on management to improve the ICS. Thus, organisations that are subject to mandatory external audit or commission voluntary audit improve the quality of their internal control systems.

How does payment for auditing services influence the quality of the internal control system? There are a lot of studies that consider the impact of a flawed internal control system on the quality of financial statements, decision making and audit. Buslepp et al. (2019) attempted to develop an alternative measure of internal control quality. They assumed that an erroneous classification of fees related to audit is indicative of a low quality of internal control in disclosures of annual reports. Due to lower-quality internal control, companies that erroneously classify fees related to audit are more likely to inform of a significant shortcoming, submit applications at an inappropriate time (a longer time lag) and pay higher fees for audit. An erroneous classification of the fees related to audit correlates with a low quality of internal control [14].

Irrespective of the country (USA, China, or Egypt), researchers register the positive influence of high-quality external and internal audit on the quality of the internal control system.

Financial Analysts

The question of the influence of financial analysts and the reports they publish on the quality of the internal control system is hardly considered in the literature, despite the fact that financial analysts play an important role as intermediaries between companies and investors. By studying a company and estimating its profit, financial analysts provide an additional mechanism of external monitoring that can lead to the imposition of severe restrictions on company management in order to improve ICS quality.

Mao and Yu (2015) studied the interrelation between the beginning of analyst forecasting of cashflows and the rise in ICS quality in the USA. They concluded that, after analysts started to make forecasts on cashflow movements, companies began to reveal a smaller number of ICS shortcomings as per SOX 404, implying that analysts motivate managers to focus on the quality of the internal control system [1].

Nevertheless, the influence of financial analyst activity and reports on the quality of the internal control system requires additional study.

National Culture

According to Hofstede's definition (2001) that places special emphasis on individualism, the avoidance of instability and power distance characteristics, the national culture may also influence ICS quality [15]. Managers operating in countries with a higher level of individualism care more for their own interests than for the welfare of shareholders and the demands of affected parties. They are more inclined to use discretionary instruments to serve their own purposes. A higher level of individualism and power distance has a positive relation with ICS shortcomings, while a higher level of instability avoidance decreases the probability of shortcomings in the internal control system.

Hooghiemstra's study of the internal control reports of companies from 29 countries and Kanagaretnam's study of SOX 404 reports on the disclosure of ICS shortcomings of US-incorporated companies from 39 countries show that individualism has a positive impact on the disclosure of information about ICS quality [16].

Regulatory and Market Factors

How does government regulation influence companies' operations in general and their internal control systems in particular? A high level of government regulation forces companies to comply with rules and guiding principles in order to survive. Market competition makes it more likely that a company characterized by a high cost of goods, work and services will be liquidated. The implementation of a high-quality internal control system requires financial resources, and so companies with lower profitability have less opportunities to improve their internal control systems.

How do the characteristics of the market on which the company operates influence its internal control system? In the USA, Kim et al. (2015) considered the influence of three factors on competition on the product market (Herfindahl-Hirschman index, the greatest concentration coefficient (for four companies) and the industry leader indicator) in order to evaluate the quality of internal control systems. They showed that companies operating on highly competitive markets are characterized by lower ICS quality (SOX, section 404) [1].

Table 2. External Determinants of the Internal Control System (ICS)

Authors	Factors of the internal control system (ICS)	Country	Statutory regulation / used reports	Main results
External audit				
López et al. (2014) [19]	Auditor type and ICS quality	USA	Internal control shortcomings disclosed in A-133 information letters of auditor's opinions of health care companies	Companies verified by Big 4 auditors have higher ICS quality
De Simone et al. (2015) [1]	Rendering of tax services by an auditor and ICS quality	USA	SOX 302 and 404, ICS shortcomings disclosure	Companies which purchase tax and non-audit services disclose major shortcomings of the ICS less frequently
Albring et al. (2018) [20]	Unexpected fees and financial shortcomings of internal control	USA	SOX 404, ICS shortcomings disclosure	Unexpected fees are related to shortcomings of the ICS at the corporate level
Chen, Gul et al. (2016) [21]	Term of auditor's powers and geographic proximity to the customer and ICS shortcomings	USA	SOX 404, ICS shortcomings disclosure	Companies whose auditors are involved in their activities in the long term and which are geographically closer to auditors have less serious problems with ICS shortcomings
Haislip et al. (2016) [1]	Auditor's IT experience and ICS shortcomings	USA	SOX 404, ICS shortcomings disclosure	Auditor's IT experience has an inverse relation to ICS shortcomings
López and Rich (2017) [19]	Geographical distance between municipalities of the USA and their external auditors and ICS quality	USA	A-133 information letters, ICS shortcomings disclosure	Geographical distance between municipalities of the USA has a positive impact upon disclosure of ICS exceptions
Buslepp et al. (2019) [14]	Erroneous classification of fees related to audit and shortcomings of internal control	USA	SOX 404, ICS shortcomings disclosure	In accordance with a lower quality of internal control, companies which classify audit-related fees erroneously are more likely to report major shortcomings, submit applications at an inappropriate time and pay higher fees for audit. Erroneous classification of fees related to audit is defined by a low quality of internal control
Xudong Ji et al. (2018) [22]	Payment for audit and shortcomings of the internal control system	China	Voluntary disclosure of auditor's opinions about the ICS	Payment for audit is related positively to detected shortcomings of internal control. In particular, it is significantly related to non-financial reporting but has no relation to financial statements
Khlif and Samaha (2016) [23]	Activity of the audit committee and ICS quality and influence of the scope of external audit	Egypt	Examination of external auditors	The activity of the audit committee is related positively to ICS quality, and such interrelation is more characteristic of audits performed by Big 4 auditors
Financial Analysts				
Mao and Yu (2015) [1]	Predictive analysis of cash flows and ICS quality	USA	SOX 404, ICS shortcomings disclosure	Forecasts of cash flow movements reduce the possibility of financial ICS shortcomings
National Culture				
Hooghiemstra et al. (2015) [1]	Individualism and uncertainty avoidance and voluntary disclosure of the ICS	29 countries	Analysis of ICS reports	Individualism (uncertainty prevention) has a positive (negative) influence on the disclosure of ICS information
Kanagaretnam et al. (2016) [16]	National culture (individualism, uncertainty avoidance and power distance) and ICS shortcomings	Companies from 39 countries incorporated in the USA	SOX 404, ICS shortcomings disclosure	Individualism and power distance are related positively while uncertainty avoidance is related negatively to the disclosure of ICS shortcomings
Governmental and Market Factors				
Kim and Kim (2015) [1]	Competition on the product market and ICS quality	USA	SOX 404, ICS shortcomings disclosure	Companies active on competitive markets have lower ICS quality
Bryan (2017) [17]	Power of trade unions and quality of audits and internal control	USA	SOX 404, ICS shortcomings disclosure	Trade unions have reasons to request high-quality inspections and reliable internal control systems, because they rely on financial information when conducting negotiations for signing collective bargaining agreements. Nevertheless, organised labour motivates managers to commission lower-quality audits and provide weaker internal control in order to have more influence over the content of financial information submitted to trade unions. The power of trade unions is related to high audit quality and better internal control.
Zhang and Chen (2016) [18]	Competition on the product market and ICS quality. Does government ownership mitigate this ratio?	China	Analysis of annual reports (index of ICS quality)	Intensive competition on the product market is related to higher ICS quality. This relation is stable only for companies with non-governmental ownership.

At the same time, Zhang and Chen (2016) demonstrated that the intense competition on the product market in China leads to a higher level of disclosure of information about the internal control system [18]. National differences may be a possible reason for these contradictory conclusions.

Do trade unions and their activities influence the quality of the internal control system? Bryan (2017) makes a classification on the basis of this category. Trade unions have reasons to request high quality inspections and reliable internal control systems, because they rely on financial information when conducting negotiations for signing collective bargaining agreements. Nevertheless, organised labour motivates managers to employ lower-quality audits and set up weaker internal controls in order to have more influence on the financial information submitted to trade unions. The power of trade unions is related to high audit quality (and high payments for audit) and better internal control (smaller number of major shortcomings) [17].

Thus, quality of the internal control system is related directly to the level of government regulation of corporate operations in general and the internal control system in particular, the level of non-government regulation (trade union activities), and the level of competition on the market.

Our review of foreign literature identified the following factors as having a significant impact on the internal control system: characteristics of the director, board of directors and management board, ownership structure, and internal audit quality (internal factors) and external audit, financial analysts, national culture, governmental and market factors (external factors). For some characteristics (for example, women occupying senior management positions), contradictory results were obtained about their influence on the corporate internal control system. The differences are due to the time periods of the studies, national traditions of doing business, and the specific nature of the regulation of internal control in the USA and some other countries. The majority of conclusions about the strength and type of relation between the internal control system and external / internal factors were obtained on the basis of corporate reports about the state of the internal control system made in conformity with the Sarbanes-Oxley Act and other reports: independent evaluation of the control tools System and Organisation Controls (SOC, previously: Service Organisation Controls) in accordance with SSAE 18, ISAE 3402 and other standards [24].

The Internal Control System of Russian Organisations: Developing a Methodology for Assessing the Influence of the Internal Control System Factors on the Financial Stability and Solvency of Russian Organisations

While internal control is obligatory in Russia today [25], requirements for internal control systems and the obligation to prepare reports have not been codified by law. The greatest problem of our study in this domain is the absence of statistics in Russia that could be used to determine the influence of factors on the internal control system in the national environment and hence their influence on corporate finance.

Table 3 presents internal and external factors which, in the author's opinion, influence or may influence the internal control systems of Russian companies.

Table 3. Determinants of the internal control systems of Russian organisations

ICS factors		Main results
Internal	Characteristics of the management board	The existence of a board of directors has a positive influence on the quality of the internal control system
	Characteristics of the CEO and board members	Organisations managed by directors (boards of directors) of middle age (younger than 40) are more likely to have internal control shortcomings. The greater the participation of the director (members of the board of directors), the lower the quality of the internal control system. In contrast, the higher their education attainment and experience, the less likely the existence of ICS shortcomings
	Ownership structure	The influence of private / government / mixed structure has not been determined
	Arrangement of the internal control / audit system	The existence of internal control / audit departments has a positive impact on ICS quality

ICS factors		Main results
External	External audit	Obligatory audit has a positive impact on the quality of the internal control system. With regard to audit company type (Big 4, non-Big 4), companies examined by Big 4 auditors have higher-quality ICS
	Governmental and market factors	Statutory regulation of the industry (specific laws and regulations): the tighter the governmental control, the higher the ICS quality. Organisations which maintain accounting and write up account statements according to IFRS are less likely to have major ICS shortcomings. The higher the competition on a market, the higher the quality of the internal control system

The conclusions concerning the characteristics of the management board and CEO are confirmed by the data of Russian surveys about economic crimes and fraud. Approximately 50% of economic crimes in Russia are committed by employees in their own organisations – in particular, by senior executive managers (39%) and middle-ranking managers (47%) and, more specifically, by finance department employees [1]. The typical perpetrator of fraud is a male of age 31–40 with a tertiary degree and professional experience of three-five years. On the basis of this data, we can make the conclusion that, when an organisation is managed by such employees, it has a worse internal control system. This enables them to commit fraud.

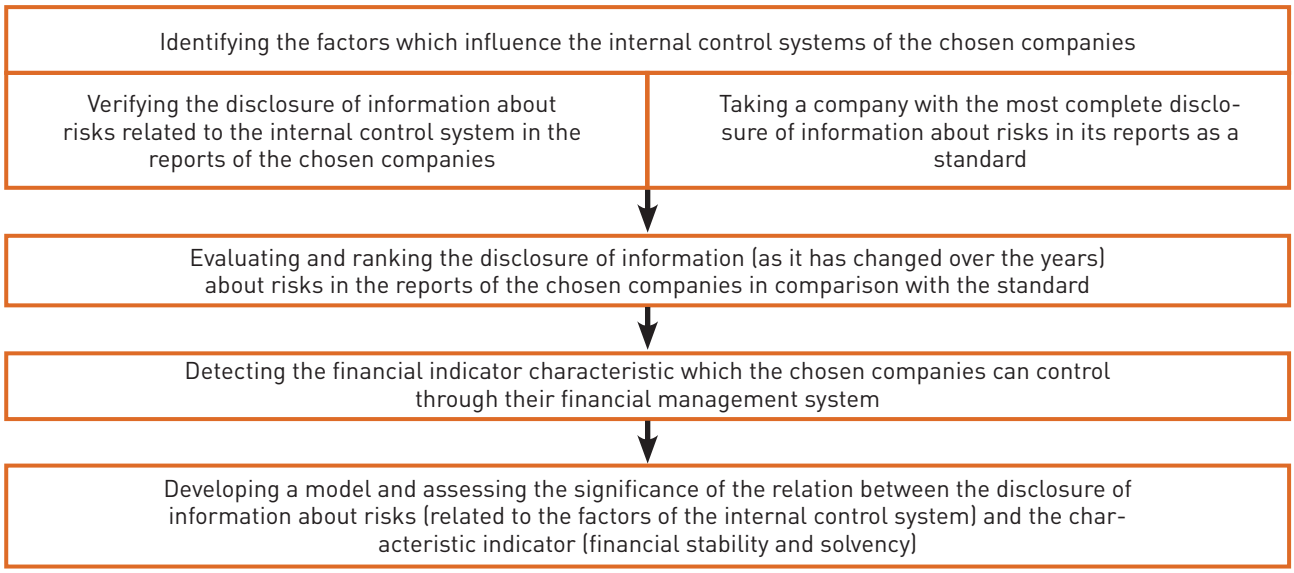
It should be noted that, in Russia, 41% of respondents whose companies had suffered from economic crimes over the preceding four years said that their losses had amounted to $100,000 [1]. This confirms the assumption made at the beginning of our study about the insufficient understanding of factors that influence the internal control systems as well as the financial stability and solvency of Russian companies.

To test our conclusions on a real-life case, we chose the pharmaceutical industry on account of its high social significance. Most pharmaceutical distributors make up statements of accounts as per IFRS. Such annual reports are subject to obligatory audit. We analysed reports of key pharmaceutical distributors incorporated and operating on the market of the Siberian Federal District (selection criteria: type of activity – wholesale in pharmaceutical products; principal economic activity code (OKVED (Russian National Classifier of Types of Economic Activity)) – 46.46; revenue for 2017 and/or 2016 and/or 2018 – over RUB 1 million). However, to avoid preparing (or publishing) reports about their internal control systems, some companies include only information on internal audit in their annual reports, while issues related to the internal control system in auditor's opinions are not considered to be important.

In this section of our study, we evaluate the dependence (interrelation) between factors of the internal control systems and the financial indicators of the chosen companies. We apply the methodology presented in Figure 1.

In order to apply this methodology, we take liquidity as the characteristic "problematic" indicator. A financial analysis of pharmaceutical distributor operations demonstrates that the majority of companies from the Siberian Federal District show a significant negative deviation from average market liquidity indicators across the country (average industry indicators: current liquidity ratio – 3.02, quick liquidity ratio – 2.02, absolute liquidity ratio – 0.54).

Figure 1. Methodology for assessing the dependence (interrelation) between the factors of the internal control systems and the financial indicators



If a significant and direct dependence (interrelation) of the chosen indicators is observed (i.e. the higher the assessment of disclosure of information on risks related to the factors of the internal control system, the higher the liquidity indicators of the chosen companies), our hypothesis that the high level of economic crime and fraud, bankruptcies and other negative economic after-effects of low financial stability and solvency of Russian organisations is due to an insufficient understanding of the factors that influence the internal control systems of organisations will be proven.

Conclusion

Despite some controversy about the results of a systematic review of foreign publications, we identified the external and internal factors of internal control systems and defined their influence on the latter (taking national specifics into account in some cases). Companies can control the following internal factors to improve the quality of their internal control systems: characteristics of the CEO, board of directors and management board; ownership structure; and quality of internal audit. The following external factors are characteristic of the internal control systems of foreign companies, according to our analysis: external audit, financial analysts, national culture, and governmental and market factors. It should be noted that government regulation of the internal control system is one of the most important governmental factors determining differences in the results of studies in various countries.

At the beginning of this paper, we divided countries into three categories: countries regulating the reports of the internal control system by the Sarbanes-Oxley Act, countries regulating reports of the internal control system along the American model, and countries which do not regulate this sphere at all. However, Russia does not belong to any of these categories. Federal Law No. 402-FZ "On Accounting" [25] sets down the requirement of conducting internal control, and some instructional guidelines about the disclosure of specific aspects of internal control have also been introduced. However, the requirements for the internal control system and the obligation to prepare reports have not been strictly codified by law, in contrast to countries that adopted the Sarbanes-Oxley Act or similar laws. In this regard, the absence of the required information impedes the study of the influence of external and internal factors on the internal control systems of Russian organisations. We identified the following characteristic factors of Russian companies: external audit and governmental and market factors (external factors) and the characteristics of the management board, the CEO, and members of the board of directors, ownership structure, and the arrangement of the internal control / audit system (internal factors), although the type of influence has not been identified for all factors. We then proposed a methodology for assessing the dependence (relationship) between the factors of the internal control system and the financial indicators.

If the results of the proposed methodology show a significant and direct dependence (relationship) between the chosen indicators (i.e. the higher the assessment of the disclosure of information on risks related to the factors of the internal control system, the higher the liquidity indicators of the chosen companies), the hypothesis that a high level of economic crime and fraud, bankruptcies and other negative economic after-effects of low financial stability and solvency of Russian organisations is due to an insufficient understanding of the factors which influence the corporate internal control system will be proven.

Finally, it should be noted that the goal of the paper of investigating the influence of external and internal factors of the internal control system on the financial stability and solvency of Russian organisations based on a review of foreign publications has been achieved. The limitations of our study include the small sample of companies (the leading pharmaceutical distributors of the Siberian Federal District) and the lack of a database of corporate reports on internal control systems.

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