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New Research

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The Determinants of Corporate Cash Holdings: Novel Evidence from Emerging Countries

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Abstract

The aim of this study is to investigate the determinants of corporate cash holdings in emerging countries. The sample comprises non-financial firms from six emerging countries, five of them commonly referred to as BRICS, plus Turkey. The dataset includes the data of 4,769 firms and covers a ten-year period from 2012 to 2021, resulting in a total of 47,690 firm-year observations. We run panel regressions, specifically fixed and random effects models, and conduct the J.A. Hausman [1] test to choose between the latter. We use several firm-specific variables as independent variables and the GDP growth rate and the inflation rate as country-specific control variables. The results reveal that firm size, leverage, capital expenditures, net working capital, operating cash flow, dividend payments, firm age, and research and development (R&D) expenditures are significant determinants of corporate cash holdings, with some differences among countries and/or industries in terms of the sign and the significance levels. The macroeconomic variables showed significant results in some countries and industries, yet they were not consistent enough to make general conclusions. This study provides new empirical evidence on the determinants of corporate cash holdings by using a large dataset from major emerging countries. Our findings have important implications for corporate managers and policymakers in designing cash holding and liquidity policies. A comprehensive understanding of the main determinants of corporate cash holdings enables managers to adopt appropriate financing and investing strategies in the long term, as well as better short-term financial policies.

Keywords: corporate cash holdings, BRICS, emerging countries, liquidity, financial determinants, panel data

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Introduction

Cash holdings play a crucial role for both firm managers and parties analyzing firms for several reasons. Managers must maintain a safe and efficient level of liquidity by holding cash and cash equivalents, ensuring smooth financial management and adhering to risk management policies. Shareholders and potential investors base their investment decisions on valuations, with cash, particularly free cash flow, serving as a fundamental component of many valuation models. Cash is central to both short- and long-term financial decisions. In the short term, a firm's cash conversion cycle is a commonly used measure of working capital management, while in the long term, the present value of expected future cash flows informs the firm's capital budgeting decisions. Although these cases pertain more to cash flows rather than the stock of cash as a balance sheet value, the importance of cash holdings remains unchanged due to the strong association between smooth cash flows and cash holdings. In general, firms tend to hold more cash than their working capital requirement, a tendency supported by empirical evidence worldwide [2–4].

Firms hold cash and cash equivalents for various purposes, including transaction, speculation, and precautionary motives. However, there exists a trade-off for firms in deciding the amount of cash to hold, as cash is not an earning asset and thus incurs an opportunity cost. Despite this, holding cash can offer benefits such as the ability to receive trade discounts from suppliers.

The study makes several contributions to the existing literature. Firstly, it offers novel empirical evidence on the determinants of cash holdings using a comprehensive dataset comprised of emerging countries. Secondly, it provides results for the entire sample, as well as at the country and industry levels.

The remainder of the article is structured as follows: the next section offers a review of pertinent literature. Third section outlines the sample details, data sources, methodology, and model specifications. Fourth section presents the findings and offers a discussion. The final section draws the conclusions.

Literature Review

Cash holdings and their determinants constitute one of the most extensively researched areas in corporate finance literature. Numerous studies across various contexts have explored the factors influencing corporate cash holdings, revealing significant variations across countries and regions. Theoretical frameworks have sought to explain these differences through various approaches.

Three theories commonly used in the literature offer explanations for why corporations maintain cash and cash equivalents: the trade-off theory, free cash flow theory, and pecking order theory. According to the trade-off theory, there exists an optimal level of cash where the marginal benefits and costs are balanced [5; 6]. The benefits typically stem from transaction and precautionary motives, while costs may include opportunity costs [7] and agency costs resulting from the desire to enhance managerial discretion [8; 9]. Pecking order theory [10], on the other hand, suggests that firms prioritize financing sources in a hierarchy, beginning with retained earnings, followed by debt, and finally equity. Cash holdings are viewed as a reflection of the firm's choices regarding potential investments and alternative financing options, suggesting that there is no single optimal level of cash. Free cash flow theory [11] contends that managers often hold cash to increase their discretion over the firm's investments and reduce monitoring by capital providers. However, this increased managerial power may lead to agency conflicts, as managers may prioritize retaining cash over investing in profitable projects, which may not align with shareholders' best interests [12].

Having reviewed the theoretical underpinnings, this section presents the findings from previous literature regarding the determinants of cash holdings. The discussion is structured according to the variables utilized in our empirical model, and hypotheses are formulated based on both theoretical discourse and empirical observations.

Firm Size

There are conflicting views regarding the relationship between firm size and cash holdings, both theoretically and empirically. On the one hand, some argue that small firms tend to hold more cash while large firms hold less, while others propose the opposite. Small firms may face higher costs related to external financing and bankruptcy due to lower credibility and diversification [13], suggesting a negative relationship. Conversely, large firms often possess better corporate governance mechanisms, leading to lower information asymmetry and external financing costs. Additionally, firm size can serve as a proxy for financial distress, with small firms holding more cash to mitigate such risks [14]. On the other hand, the pecking order theory suggests that large firms tend to have a more profitable history and higher accumulated reserves, suggesting a positive relationship between firm size and cash holdings [6].

Therefore, we formulate two hypotheses to investigate these opposing perspectives:

H1a: There is a positive relationship between cash holdings and firm size.

H1b: There is a negative relationship between cash holdings and firm size.

Leverage

Firms with higher levels of leverage might face increased financing costs due to a reduced borrowing capacity, leading them to hold less cash. This tendency is particularly notable in emerging countries where bankruptcy costs are significant [7; 15]. According to the pecking order theory, we anticipate a negative relationship, as firms would prioritize using liquid resources over issuing new debt when retained earnings are insufficient. Likewise, firms with a surplus may opt to repay existing debt, further reducing leverage. Empirical studies have consistently demonstrated

a negative correlation between cash holdings and leverage [9; 13; 16; 17]. This leads us to formulate the second hypothesis as follows:

H2: There is a negative relationship between cash holdings and leverage.

Profitability

Previous studies have consistently found a positive correlation between cash holdings and profitability, primarily supported by the pecking order theory [6; 7; 18; 19]. Profitable firms are better positioned to meet their financial obligations, including dividends and debt repayment, and are thus able to accumulate greater cash reserves. Conversely, less profitable firms tend to hold lower levels of cash and may rely on debt issuance to fund investments, exhibiting reluctance to issue new equity [20]. Based on these premises, we formulate the third hypothesis as follows:

H3: There is a positive relationship between cash holdings and profitability.

Growth Opportunities

Both the trade-off theory and the pecking order theory suggest a positive relationship between cash holdings and growth opportunities. Firms with greater growth prospects are inclined to maintain higher levels of cash reserves to mitigate the risk of illiquidity. This strategy aligns with the transaction cost motive and the precautionary motive, as firms with viable investment opportunities seek to safeguard against cash shortages and potential financial distress [6; 21; 22]. Accordingly, we formulate our next hypothesis as follows:

H4: There is a positive relationship between cash holdings and growth opportunities.

Capital Expenditures

Capital expenditures refer to investments made by a firm to enhance its productive capacity, typically involving the acquisition or construction of non-current assets. These assets can serve as collateral for borrowings, leading to an expansion in debt capacity and a reduced need for cash reserves [21]. Furthermore, in line with the pecking order theory, firms adhere to a financing hierarchy starting with internally generated funds. Accordingly, a firm with viable investment opportunities would prioritize spending on capital expenditures, thereby allocating a smaller portion of its resources to liquid assets. Consequently, we anticipate a negative correlation between cash holdings and capital expenditures:

H5: There is a negative relationship between cash holdings and capital expenditures.

Net Working Capital

Net working capital represents the difference between current assets and current liabilities. While current assets may comprise some less liquid items such as inventory, the majority are comprised of liquid assets that can be readily converted into cash if needed. Consequently, firms with higher net working capital tend to maintain lower levels of cash reserves [7]. Previous research has similarly identified a negative correlation between cash holdings and net working capital, aligning with the principles of the trade-off theory [13; 14; 23].

H6: There is a negative relationship between cash holdings and net working capital.

Operating Cash Flow

The net cash flow from operations serves as the primary liquidity source for a healthy firm. Conversely, in cases where this is insufficient, firms may resort to external financing, incurring additional costs and imposing financial constraints. As such, operating cash flow acts as a safeguard against financial constraints [24]. The trade-off theory posits a negative correlation between operating cash flow and cash holdings, contending that firms with stable operating cash flow trends require smaller cash reserves. Conversely, the pecking order theory suggests a positive relationship, as firms prioritize reserves as their primary financing option, thereby accumulating greater cash holdings [9]. Hence, we formulate two hypotheses:

H7a: There is a negative relationship between cash holdings and operating cash flow.

H7b: There is a positive relationship between cash holdings and operating cash flow.

Firm Age

Firm age denotes the number of years since the establishment of the firm. It is presumed that there exists a positive correlation between firm age and cash holdings, as older firms typically operate in more mature phases of their life cycle, thereby generating higher cash flows [25].

H8: There is a positive relationship between cash holdings and firm age.

Dividends

The trade-off theory posits a negative relationship between dividend payments and cash holdings. This perspective suggests that firms distributing dividends may opt to reduce or eliminate dividends to access funds when necessary, leading them to maintain lower levels of cash reserves [26].

H9: There is a negative relationship between cash holdings and dividend payments.

Research and Development Expenditures

Research and development (R&D) initiatives typically span long periods and may require significant financial resources over time. Consequently, firms engaged in R&D endeavors often maintain substantial cash reserves to sustain these activities. Empirical studies have indicated a positive correlation between higher levels of R&D expenditure and increased cash holdings [21; 27].

H10: There is a positive relationship between cash holdings and R&D expenditures.

Methodology

Sample and Data

The sample comprises 4,769 non-financial firms from six major emerging countries. Table 1 provides a breakdown of the firms by country and industry. Initially, the sample consisted of 6,505 firms; however, after eliminating those with missing data or outlier values, the final sample comprised 4,769 firms. The dataset spans a 10-year period from 2012 to 2021, totaling 47,690 firm-year observations. The countries included are the BRICS nations (Brazil, Russia, India, China, and South Africa), along with Turkey, another significant emerging economy with similar characteristics. The industries covered are non-financial, excluding sectors such as banking, insurance, and leasing. Additionally, governmental agencies and non-profit organizations were omitted due to their distinct characteristics. The data were sourced from Refinitiv Eikon, formerly known as Thomson Reuters.

Table 1. Sample Details by Country and Industry

	Brazil	China	India	Russia	South Africa	Turkey	Total
Basic Materials	24	435	388	42	26	45	**960**
Consumer Cyclicals	43	398	404	13	22	63	**943**
Consumer Non-Cyclicals	21	176	128	12	9	33	**379**
Energy	7	99	36	29	3	5	**179**
Healthcare	6	208	104	6	2	4	**330**
Industrials	32	600	254	56	16	31	**989**
Real Estate	25	143	72	2	12	22	**276**
Technology	8	340	122	11	15	14	**510**
Utilities	34	96	24	44	–	5	**203**
Total	**200**	**2495**	**1532**	**215**	**105**	**222**	**4769**

Variables

Table 2 displays the variables used in the analysis, along with their measurements and the expected sign of their relationship with cash holdings. Net cash, which excludes cash and cash equivalents from total assets, is preferred as the proxy for cash holdings.

Table 2. The variables used in the analysis

	Variable	Calculation Formula	Selected References	Expected Sign
Dependent	Cash Holdings	Cash & Cash Equivalent (CCE)/ (Total Assets–CCE)	[21]	n/a
Independent	Size	Natural logarithm of Total Assets	[2]	+/–
	Leverage	Total Debt/Total Assets	[16]	–
	Profitability	Net Profit/Total Assets	[19; 20]	+
	Growth Opportunities	Market Price per Share/Book Value per Share	[22]	+
	Capital Expenditures	Net Cash Flow of Capital Expenditures/Total Assets	[21]	–
	Net Working Capital	Net Working Capital/Total Assets	[7; 13]	–
	Operating Cash Flow	Cash Flow from Operations/ Total Assets	[9]	+/–

	Variable	Calculation Formula	Selected References	Expected Sign
Independent	Firm Age	Number of years since establishment	[25]	+
	Dividends	Dummy variable: 1 if paid, 0 if not paid	[26]	–
	RD	R&D Expenditures/Total Assets	[27]	+
Control	GDP Growth	YoY change in GDP	[28]	+
	Inflation	Annual rate of inflation	[28]	–
Dummy		Dummies for country and industry		n/a

Model Specification

The model is represented by the following equation:

$$CH_{i,t} = \beta_0 + \hat{a}_1 SIZE_{i,t} + \beta_2 LEV_{i,t} + \beta_3 PROF_{i,t} + \\ + \beta_4 GROW_{i,t} + \beta_5 CAPEX_{i,t} + \beta_6 NWC_{i,t} + \\ + \beta_7 OCF_{i,t} + \beta_8 AGE_{i,t} + \beta_9 DIV_{i,t} + \beta_{10} RD_{i,t} + \\ + \beta_{11} GDPGR_{i,t} + \beta_{12} INFL_{i,t} + \beta_{13} COUN_i + \\ + \beta_{14} IND_i + \varepsilon_{i,t},$$

where *CH* – cash holdings; *SIZE* – the firm size measured as the natural logarithm of total assets; *LEV* – leverage measured as the ratio of total debt to total assets; *PROF* – the net profit margin; *GROW* – growth opportunities measured as the ratio of market price per share to book value per share; *CAPEX* – capital expenditures measured as the ratio of net cash flow of capital expenditures to total assets; *NWC* – the ratio of net working capital to total assets; *AGE* – the firm's age; *DIV* – the dummy variable for dividends; *RD* – research and development expenditures divided by total assets; *GDPGR* – the country's GDP growth rate; *INFL* – the country's inflation rate; *COUN* – the country dummy variable; *IND* – the industry dummy variable.

Estimation Technique

Following the approach of previous studies on the determinants of corporate cash holdings [6; 9; 28], we employ a static model and conduct estimation in two steps. Initially, we utilize pooled ordinary least squares (POLS) regressions, followed by panel regressions, encompassing both fixed and random effects. To determine whether panel regressions are warranted, and thus ascertain the presence of panel effects, we administer the Breusch – Pagan Lagrange Multiplier (LM) test. Subsequently, we employ the Hausman test to choose between fixed and random effects [1].

Results and Findings

Descriptive Statistics

The descriptive statistics for all variables are presented in Table 3.

Table 3. Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max
CH	overall	0.149	0.246	–0.117	4.991
	between		0.179	–0.002	2.707
	within		0.169	–1.478	4.185
SIZE	overall	19.648	2.048	10.331	26.736
	between		2.005	11.997	26.644
	within		0.416	15.502	23.177
LEV	overall	0.539	0.362	0.001	14.335
	between		0.314	0.020	10.682
	within		0.180	–4.030	10.742
PROF	overall	0.042	0.122	–3.531	3.411
	between		0.071	–0.515	1.201
	within		0.099	–3.366	3.408

Variable		Mean	Std. Dev.	Min	Max
GROW	overall	1.530	1.463	0.002	14.991
	between		1.145	0.003	9.057
	within		0.911	–4.213	13.845
CAPEX	overall	0.038	0.060	–1.638	0.786
	between		0.035	–0.543	0.217
	within		0.048	–1.412	0.749
NWC	overall	0.151	0.294	–3.780	0.985
	between		0.245	–1.889	0.888
	within		0.163	–2.710	1.891
OCF	overall	0.054	0.098	–2.255	2.222
	between		0.054	–0.303	0.410
	within		0.082	–1.899	2.059
AGE	overall	26.792	17.915	1.000	158.000
	between		17.685	5.500	153.500
	within		2.872	22.292	31.292
DIV	overall	0.587	0.492	0.000	1.000
	between		0.385	0.000	1.000
	within		0.307	–0.313	1.487
RD	overall	0.008	0.016	0.000	0.308
	between		0.014	0.000	0.233
	within		0.007	–0.157	0.260
INF	overall	0.041	0.031	0.010	0.196
	between		0.025	0.021	0.115
	within		0.018	0.001	0.133
GDPGR	overall	0.057	0.033	–0.063	0.114
	between		0.017	0.005	0.067
	within		0.028	–0.058	0.118

The table gives descriptive statistics for the overall sample, including the mean, standard deviation, minimum, and maximum values. For cash holdings, the mean value is 15%, which is considered reasonable for most firms. The minimum value is negative, potentially due to bank overdrafts, while the maximum value reaches almost 5, indicating very high cash holdings. Leverage averages 53.9%, a moderate level for non-financial firms. Profitability, measured by net profit margin, stands at 4.2%, indicating an acceptable level. Growth opportunities, as indicated by the market-to-book price ratio for shares, average 1.5, suggesting generally positive market valuation of firms. Capital expenditures vary widely, with a mean of 3.8%, a maximum of 78%, and a minimum of –163%. Thus, some firms make huge investments while others decrease their capacities. Net working capital to total assets ratio averages 15%, while operating cash flow to total assets ratio stands at 5.4%. The age of firms averages 27 years, ranging from 1 to 158 years. The dividend dummy variable has a mean value of 0.58, indicating that dividend payment is prevalent among firms. The relative R&D spending (RD) is quite low, with a mean of 0.8%, suggesting limited investment in R&D activities. On a country level, the average inflation rate is 4.1%, with an average GDP growth rate of 5.7%.

Correlation Matrix

Table 4 shows the correlations among the independent variables of the empirical model.

Table 4. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Firm Size	1.000											
(2) Leverage	0.048*	1.000										
(3) Profitability	0.067*	–0.253*	1.000									
(4) Growth Opportunities	–0.037*	–0.151*	0.113*	1.000								
(5) Capital Expenditures	0.090*	–0.065*	0.133*	0.064*	1.000							
(6) Net Working Capital	–0.057*	–0.660*	0.266*	0.171*	–0.048*	1.000						
(7) Operating Cashflow	0.045*	–0.074*	0.314*	0.085*	0.201*	–0.004	1.000					
(8) Firm Age	–0.144*	0.092*	0.053*	–0.094*	–0.066*	–0.087*	0.058*	1.000				
(9) Dividend Payments	0.315*	–0.234*	0.316*	0.117*	0.148*	0.249*	0.172*	0.007	1.000			
(10) R&D Spending	0.148*	–0.144*	0.004	0.261*	0.051*	0.184*	0.024*	–0.182*	0.146*	1.000		
(11) Inflation	–0.346*	0.093*	0.097*	–0.208*	0.004	–0.081*	0.061*	0.295*	–0.139*	–0.272*	1.000	
(12) GDP Growth Rate	0.045*	–0.082*	–0.002	0.148*	0.057*	0.071*	–0.060*	–0.177*	0.078*	0.124*	–0.287*	1.000

* $p<0.01$/

The pairwise correlations among the independent variables are relatively low, confirming that the model does not suffer from multicollinearity problems.

Table 5. Variance Inflation Factor (VIF)

Variable	VIF	SQRT VIF	Tolerance	R-Squared	Eigenval	Cond. Index
(1) Firm Size	**1.34**	1.16	0.747	0.253	2.433	1.000
(2) Leverage	1.85	1.36	0.540	0.459	1.751	1.179
(3) Profitability	1.32	1.15	0.754	0.245	1.444	1.298
(4) Growth Opportunities	1.17	1.08	0.857	0.142	1.086	1.497
(5) Capital Expenditures	1.1	1.05	0.912	0.087	0.941	1.608
(6) Net Working Capital	1.94	1.39	0.514	0.485	0.877	1.665
(7) Operating Cashflow	1.18	1.08	0.850	0.149	0.790	1.755
(8) Firm Age	1.15	1.07	0.871	0.128	0.688	1.881
(9) Dividend Payments	1.35	1.16	0.743	0.256	0.651	1.934
(10) R&D Spending	1.19	1.09	0.842	0.157	0.557	2.091
(11) Inflation	1.44	1.2	0.695	0.304	0.461	2.297
(12) GDP Growth Rate	1.13	1.06	0.888	0.112	0.321	2.754
Mean VIF	1.34				Condition Number	2.754

Table 5 presents the variance inflation factors (VIF) for the independent variables used in the model. All VIF values for the independent variables are below 10, with a mean VIF of 1.34. This confirms the absence of multicollinearity issues within the model. Additionally, the condition index values are very low, and the overall condition number is 2.754, which is less than 30, further corroborating the VIF findings.

Regression Results

This section presents the results of the regressions and provides a discussion of these findings. Table 6a displays the results for the entire sample and broken down by country, while Table 6b presents the results by industry. The industries are numbered from 1 to 9, as outlined in Table 1.

Table 6a. Regression Results for the Entire Sample and by Country

CH	SIZE	LEV	PROF	GROW	CAPEX	NWC	OCF	AGE	DIV	RD	INF	GDPGR	CONS	OBS
All	–0.05***	0.11***	–0.02	0.01	–0.14***	0.37***	0.22***	–0.00***	0.03***	–1.29***	–0.14**	–0.02	1.09***	47,690
Brazil	–0.01	0.03**	0.03	–0.01	–0.07	0.08***	0.05*	–0.00	0.02***	–0.28	–0.06	–0.14*	0.39	2,000
China	–0.04***	0.26***	–0.10**	–0.02	–0.18***	0.79***	0.40***	–0.01***	0.01***	–1.42***	0.12	0.13*	0.83***	24,950
India	–0.01**	0.02***	–0.01	0.05**	–0.14***	0.08***	0.10***	0.00***	0.01*	–0.11	0.09*	–0.01	0.15	15,320
Russia	–0.01	0.07**	–0.04*	0.09	–0.08	0.14***	0.32***	0.00***	–0.00	0.59*	0.03	–0.02	–0.01	2,150
S. Africa	–0.02	0.12*	0.05	0.03**	–0.18*	0.34**	0.19*	0.00	0.00	1.11*	–0.20	–0.12	0.26	1,050
Turkey	0.02	0.13**	–0.02	0.05	–0.09	0.24***	0.23***	0.00***	0.03**	1.07	0.01	0.29***	-0.59**	2,220

***, **, * Significance at 1%, 5%, and 10% levels, respectively. OBS: Number of observations.

Table 6b. Regression Results by Industry

CH	SIZE	LEV	PROF	GROW	CAPEX	NWC	OCF	AGE	DIV	RD	INF	GDPGR	CONS	OBS
1	–0.04***	0.06***	–0.13	0.01	–0.12**	0.29***	0.16***	0.00	0.02***	–0.87**	0.15	0.01	0.74***	9,600
2	–0.05***	0.05**	0.04**	0.01***	–0.05**	0.20**	0.16**	–0.00***	0.02***	–0.57	-0.13*	-0.11**	1.02	9,430
3	–0.03**	0.15**	0.00**	0.01***	–0.35	0.37*	0.26*	–0.00***	0.03**	–0.49	0.08	0.18*	0.68	3,790
4	–0.04**	0.06**	0.02**	0.01**	–0.14	0.26*	0.15*	0.00***	0.03**	0.53	0.32	0.17	0.84	1,790
5	–0.07**	0.39*	–0.04*	–0.01***	–0.11*	0.82	0.31	–0.01***	0.02**	–3.28	-0.78	-0.11	1.37	3,300
6	–0.04***	0.21**	–0.03**	–0.00***	–0.13*	0.42**	0.29**	–0.01***	0.03***	–0.83	-0.38	-0.02**	0.94	9,890
7	–0.02***	-0.05**	0.06**	0.00***	0.03*	0.16**	0.25**	0.00***	0.02**	–2.77	-0.04*	0.04*	0.35	2,760
8	–0.07**	0.28*	–0.04**	–0.01***	–0.28	0.78*	0.24*	–0.01***	0.03**	–1.11	-0.58	-0.17	1.57	5,100
9	–0.04**	0.07**	0.04*	0.01**	–0.00*	0.22*	0.29*	0.00***	0.00***	–3.07	-0.05	0.01*	0.94	2,030

***, **, * Significance at 1%, 5%, and 10% levels, respectively. OBS: Number of observations.

Discussion of Results for the Entire Sample and by Country

The regression results for the entire sample and by country are presented in Table 6a. As described in the methodology section, we employed pooled OLS regressions and panel regressions using fixed effects (FE) and random effects (RE) models. Based on the LM test, panel models were deemed more appropriate in the initial step. Subsequently, the Hausman test [1] determined that the FE model was preferable over the RE model. Therefore, the results in both Tables 6a and 6b are derived from the FE model.

The findings indicate that firm size has a significantly negative impact on cash holdings, contradicting the pecking order theory yet aligning with the notion that smaller firms tend to hold more cash due to lower credibility and restricted access to financing compared to larger counterparts. This trend is observed in China and India at the country level, while insignificance is noted in other countries.

Across the entire sample and all countries therein, a positively significant relationship between leverage and cash holdings is identified, contrary to our hypotheses, the pecking order theory, and previous empirical findings.

Profitability is generally insignificant, except for China and Russia, where a negative relationship is observed, contrary to our expectations.

Regarding growth opportunities, insignificance is generally noted, except for India and South Africa, where a negative relationship is observed, consistent with our hypotheses and the pecking order theory.

Capital expenditures display a negative significant relationship with cash holdings in the overall sample and in China, India, and South Africa. In other countries, this relationship is insignificant. This suggests that increased capital expenditures diminish cash holdings, consistent with our hypotheses, the pecking order theory, and prior research [9; 17].

We found a highly positive and significant relationship between net working capital and cash holdings across the entire sample and at the country level for all countries. This finding aligns with the pecking order theory yet contradicts the trade-off theory and our hypotheses.

Similarly, a positive relationship between operating cash flow and cash holdings was observed for the entire sample and at the country level for all countries. This result is consistent with the pecking order theory.

Regarding firm age, we obtained mixed results with very low coefficients. For the entire sample and China, a negative relationship was found, while a positive relationship was observed in India, Russia, and Turkey. In Brazil and South Africa, the results were insignificant.

Concerning dividend payments, a significant positive relationship was identified for the entire sample and all countries except Russia and South Africa at the country level. This finding is intriguing as it contradicts both the pecking order theory and the trade-off theory. Theoretically, dividend payments are expected to have a negative effect on cash holdings. However, in our model and in most empirical studies, the dividend variable is included as a dummy variable rather than a continuous variable. This approach may impact the results and presents a potential area for future research.

Our findings regarding relative R&D expenditures yielded mixed results. We observed a significant negative relationship for the entire sample and China, while a positive relationship was identified for Russia and South Africa. In other countries, the relationship was deemed insignificant.

As for macroeconomic variables, our results also varied. The inflation rate demonstrated a negative relationship for the entire sample. In individual countries, this relationship was mostly insignificant, except for India, where a positive relationship was observed. The negative relationship for the overall sample suggests that firms tend to hold less cash during periods of higher inflation, possibly due to decreased purchasing power.

The GDP growth rate showed an insignificant relationship with corporate cash holdings for the entire sample, although significant coefficients were detected in three countries, each with different signs.

Discussion of Results by Industry

Table 6b presents the regression results by industry. Across all industries, firm size exhibited a significantly negative relationship with corporate cash holdings, consistent with the findings for the entire sample and at the country level. This contradicts the pecking order theory but aligns with the perspective that smaller firms tend to hold more cash relative to their larger counterparts within the same industry.

With regard to leverage, a positively significant relationship with cash holdings was observed in all industries except for real estate, mirroring the results at the country level.

The relationship between profitability and cash holdings varied across industries, being positive in five industries, negative in three industries, and insignificant in one industry. This variability could stem from differences in trade credit policies and supplier-customer relationships.

In most industries, growth opportunities exhibited a positively significant relationship with cash holdings, in line with our hypotheses. This indicates that growing sectors tend to hold more cash to finance their expansion.

Capital expenditures showed a significantly negative relationship with cash holdings in the majority of industries, consistent with our hypotheses and country-level findings.

Net working capital and operating cash flow both displayed a positive relationship with cash holdings across all industries except for healthcare, aligning with country-level results.

The relationship between firm age and cash holdings varied across industries, with some showing positive coefficients and others negative.

All industries demonstrated a positively significant relationship between dividend payments and cash holdings,

suggesting a need for increased cash reserves to accommodate dividend payouts.

R&D expenditures yielded mostly insignificant results across industries, except for the basic materials sector, which showed a negative relationship.

Inflation and GDP growth rates did not produce consistent results at the industry level, with varying significance across different sectors.

Conclusion

This study aimed to explore the determinants of corporate cash holdings using a comprehensive panel dataset spanning major emerging countries over a decade-long period from 2012 to 2021. The regression results, presented for the overall sample and dissected by country and industry, shed light on the factors influencing corporate cash reserves.

Across the board, firm size, leverage, capital expenditures, net working capital, operating cash flow, firm age, R&D expenditures, and dividend payments emerged as significant determinants of cash holdings, albeit with some variations observed at the country and industry levels. Notably, macroeconomic variables such as inflation and GDP growth rate exhibited limited significance compared to firm-level determinants. These findings give preference to the pecking order theory over the trade-off theory in elucidating the drivers of corporate cash holdings.

The results of this study carry significant implications for both corporate managers and policymakers. Understanding the determinants of corporate cash holdings can help managers to formulate effective short and long-term financial strategies tailored to their specific circumstances. Policymakers, particularly those in governmental regulatory bodies, can leverage these insights to shape new regulations aimed at fostering liquidity at both the firm and market levels.

These findings hold particular relevance in view of the pivotal role of cash holdings in firm liquidity, particularly in less developed financial systems and emerging economies. While our study focused on major emerging countries, its implications extend to other regions with similar characteristics, highlighting the broader applicability of our findings across diverse economic contexts.

Cash holdings play a central role in the liquidity management of the firms, while firm liquidity is crucial for the financial soundness of firms and for global financial markets, insofar as liquidity problems are among the primary causes of macroeconomic crises. Cash holdings are particularly important for developing countries where the financial system is relatively less developed. While our sample was limited to major emerging economies, the findings are also applicable to other emerging countries with similar characteristics.

Our study has several limitations that pave the way for future research avenues. Firstly, our analysis employed a static model to investigate the determinants of corporate cash holdings. Future studies could expand upon this by incorporating dynamic models.

Secondly, our study did not incorporate variables related to corporate governance characteristics. Future research endeavors could take such factors as board size, board gender diversity, and CEO duality into account.

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The Impact of Artificial Intelligence on Corporate Governance

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Abstract

The advent of artificial intelligence (AI) marks a pivotal shift in the landscape of corporate governance, catalyzing a reevaluation of traditional frameworks and necessitating a forward-looking approach to decision-making, risk management, and ethical considerations. This study explores the multifaceted impact of AI on corporate governance, offering a nuanced analysis of how AI technologies are transforming the operational, strategic, and ethical dimensions of organizations. The research underscores the potential of AI to enhance decision-making processes, optimize operational efficiencies, and foster innovation by providing advanced analytical capabilities and predictive insights. However, it concurrently highlights the emergence of unprecedented challenges, including data privacy concerns, algorithmic bias, and the need for robust regulatory frameworks to mitigate risks associated with AI deployment. The article advocates for a proactive stance in redefining corporate governance models to accommodate the disruptive nature of AI, emphasizing the integration of ethical considerations and transparency in AI applications. It calls for a collaborative effort among corporate leaders, policymakers, and stakeholders to develop governance structures that not only leverage AI's potential but also safeguard against its inherent risks. The study's recommendations include the establishment of ethical AI guidelines, the adoption of transparent AI practices, and the continuous monitoring of AI systems to ensure their alignment with corporate governance objectives and societal values. However, it is important to note that the approach and methods used in this study are based on a qualitative literature review and, therefore, the generalization of the findings across different sectors and corporate governance frameworks may be limited. Additionally, the rapidly evolving nature of AI technologies poses inherent challenges to keeping up with emerging trends and potential risks.

Keywords: corporate governance, artificial intelligence, digital transformation, decision-making, transparency, ethical considerations, legal and regulatory challenges

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Introduction

Artificial intelligence (AI) is emerging as an eminent force of transformation fundamentally shaking the business landscape to its roots and posing a powerful challenge to traditionally held convictions about corporate governance [1]. The growing acceptability of AI in the different modes of organizational function has kindled a debate about its possible implications for corporate governance structures and decision-making processes as well as its overall transparency.

Currently, the contemporary business environment is witnessing the integration of artificial intelligence at an unprecedented scale [2–4]. From predictive analytics to the implications of machine learning algorithms, AI technologies are sparking an era of innovation like never before, promising improvements in the efficiency of operations and data-driven decisions [5]. The impact of this technological transition on corporate governance frameworks bears significant potential for scholarly investigation. As artificial intelligence permeates corporate environments, an increasing number of enterprises are embracing AI to adeptly maneuver through the intricacies of the digital era [6].

More than just a technical innovation in business operations, AI is a development affecting the very core of organizational functionalities [1]. Perhaps more importantly, AI fundamentally alters the game with its ability to process large datasets, detect patterns, and generate business actions and insights, even in real time, thus totally transforming how – and with what architectures – decisions are made in organizations [4]. As a result, boards of directors, C-suite executives, and stakeholders must plot a course through a governance landscape in which the infusion of AI into their organizations not only blurs existing boundaries but also creates new territories [7].

For a proper understanding of how AI impacts corporate governance, it is imperative to meticulously examine the evolving roles and responsibilities within organizations in response to these changes. Such scrutiny is crucial not only for gaining insight into the ways AI shapes corporate governance but also for elucidating the accountability dynamics inherent in this transformation [1]. The increased dependence on AI-driven tools translates into questions of changing dynamics of leadership, accountability, and the distribution of decision-making authority [8], while provoking a reappraisal of the principles underpinning historically correct governance in the corporation.

Given the broad scope of AI applications in the corporate domain, this research seeks to accomplish three main objectives. First, it aims to study how AI impacts the structural elements of corporate governance [2; 9]. As the roles played by boards of directors, executives, and stakeholders are changing, understanding these changes is essential for realizing governance frameworks in the digital age.

Secondly, it aims for an in-depth understanding of the impact of AI on the decision-making process within organizations [10; 11]. The integration of AI makes the decision-making process not only data-driven but also automatic and predictive in its essence [12]. Unravelling the subtleties of these changes is critical for organizations seeking to harness the benefits of AI while retaining the integrity of their decision-making processes.

Thirdly, this study attempts to analyze the bigger picture with regard to transparency initiatives embraced by corporate entities upon integrating AI [13; 14]. A key foundation of effective corporate governance, transparency is arguably one of the most critical challenges on the path of integrating AI into company operations. It includes the concept of "transparency by design", which, in turn, recognizes the explicit choices organizations make in the process of revealing AI-driven processes in their decision-making [15].

This study deepens the discourse on corporate governance in the era of AI by throwing light on the all-around picture of challenges and opportunities companies face in this transformational era through a consideration of the specific impacts of AI on governance structures, decision-making processes, and transparency initiatives [16]. In view of corporate efforts to navigate the complex terrain of technological advancement, the present research tries to foster responsible and effective corporate governance in the age of AI [17].

The rest of this article is structured as follows. Second section "AI and Decision-Making Processes", examines the transformative role of AI in enhancing decision-making capabilities within corporate governance. Third section "Board Dynamics in the Era of AI", explores how AI influences boardroom interactions and governance structures. Fourth section "AI and Risk Management", delves into the utilization of AI for identifying, assessing, and mitigating corporate risks. Fifth section "Corporate Transparency and Stakeholder Engagement", discusses the impact of AI on improving transparency and fostering engagement with stakeholders. Sixth section "Challenges of AI Integration in Corporate Governance", addresses the obstacles and ethical considerations of incorporating AI into governance practices. Finally, seventh section concludes the article by summarizing the findings, discussing the implications for corporate governance, and suggesting avenues for future research. The following sections dive deeply into the academic literature, drawing from a rich array of sources that inform and buttress our research objectives.

AI and Decision-Making Processes

AI has emerged as an enabling force which redefines the landscape of decision-making within corporate governance. This section explores two dominant domains in which AI can be a game-changer: data-driven and algorithmic decision-making. Amalgamating the insights from diverse studies, we show the multifaceted role of AI in influencing strategic decisions and providing executive decision support.

Data-Driven Decision-Making: The Role of AI in Processing Large Datasets

The management of large data sets has undergone revolutionary changes, allowing organizations to gain strategic insights for informed decision-making [1]. Due to its bulk data processing capabilities, artificial intelligence enables companies to navigate complex business environments by providing strategic insights [18]. In doing so, AI becomes effective in formulating governance strategies in the public interest while skillfully addressing emerging challenges [7].

The impact of AI on corporate governance involves a lot more than simply facilitating data analysis. Artificial intelligence increases the precision and efficiency of decision-making processes [19]. Using advanced algorithms, AI allows companies to predict future values of their shares in markets and reduce potential business risks [3]. This forward-looking approach to internal decision-making requires organizations to quickly adapt to changing business environments. B. Kaya highlights the central role played by artificial intelligence in driving this revolutionary change in corporate governance practices, which calls for constant adaptation [20].

However, the use of artificial intelligence in corporate governance structures requires taking ethical issues into account and aligning efficiency with ethical responsibilities [19].

It is crucial to ensure that AI decisions are made ethically and in the best interest of stakeholders [4]. W. Shen emphasizes the application of artificial intelligence technologies to protecting corporate governance rights and interests. If artificial intelligence technologies are used correctly and in accordance with ethical rules, they can act as guardians in internal decision-making processes, ensuring the protection of rights and achieving operational efficiency [16].

In summary, while data-driven decision-making revolutionizes corporate governance practices [1; 7], it also generates ethical challenges that organizations must overcome [19; 20]. The sweeping impact of AI on corporate governance is both transformative and challenging, requiring a balanced approach that prioritizes strategic insights, efficiency and ethical responsibility.

Algorithmic Decision-Making: Implications for Executive Decision Support

AI algorithms play a very important role in executive decision support systems, especially in critical areas of business. Q. Yang et al. highlight the importance of incorporating AI into decision support systems to guarantee consistent interaction between human decision makers and AI algorithms [17]. M. Ashoori and J. Weisz also state that trust is a vital component in AI-driven decision-making processes [10]. The reliability of AI algorithms significantly affects managers' trust in AI-based recommendations and insights [21].

However, excessive reliance on AI-based advisory systems can hamper sound decision behavior, especially in critical areas such as research and development investments [22].

It is important to know the strengths and limitations of AI for proper decision-making. M. Jarrahi highlights the need for a symbiotic relationship between human reasoning and artificial intelligence algorithms to produce a stronger and more effective decision-making process [23].

A. Nassar and M. Kamal argue that ethical considerations should cast the foundations of AI-based decision-making. There is a continuing need to pay attention to ethical boundaries when processing large data sets and to address ethical issues arising from the application of artificial intelligence. Additionally, it is critical to understand and align the preferences and expectations of artificial intelligence system users [11].

This is consistent with the findings by S. Sharma et al., who argue that AI systems should be designed to be attractive to end users, especially in autonomous decision-making scenarios involving retail customers [24].

In summary, the relationship between AI algorithms and executive decision support requires a balanced approach that integrates technical progress with ethical considerations. AI demonstrates its importance in shaping the future of corporate governance by facilitating strategic decision-making and executive decision support systems. Aligning AI-based decisions with human judgment is crucial for effective governance [10; 23].

Board Dynamics in the Era of AI

As AI continues to transform industries, its impact on corporate governance is becoming increasingly significant. This section explores the evolving dynamics of corporate boards in the era of AI, with a specific focus on board composition and expertise, as well as the influence of AI on board decision-making processes.

Board Composition and Expertise

The incorporation of AI into corporate governance requires company boards to develop new skills and expertise. Traditionally, boards consisted of members with experience in finance, law, and business. However, given the growing significance of AI, board members are now expected to possess knowledge of technology, data analysis, and AI algorithms. Without tech-savvy members, boards will struggle to comprehend the impact of AI on organizations [1]. Therefore, it is essential to include individuals who can "decode the algorithm" on company boards.

Board composition has an important role in effective AI governance. The complexity of AI issues requires improving the representation of non-executive members on boards. For example, gender diversity has been shown to improve decision-making and innovation, which are central in the age of artificial intelligence [25]. Additionally, boards with diverse memberships are better equipped to detect biases in AI systems. Diverse boards ensure fairness and prevent unintentional discrimination by reviewing artificial intelligence algorithms [26].

In summary, technological expertise and diversity play essential roles in effective AI governance. Technologically

astute board members contribute to grasping the nuances of AI, while diverse boards offer improved scrutiny and fairness in decision-making processes [1; 26].

AI-Assisted Board Decision-Making

Integrating AI tools into the board of directors can significantly improve board decision-making processes. "A machine can process large amounts of data to identify patterns and draw nonlinear conclusions, something far beyond the capabilities of any director" [3]. This capability gives boards the ability to effectively manage strategic planning, risk management and financial forecasting. R. Rajendran et al. find that such analytical capabilities help boards adopt more data-driven decision-making processes, reducing reliance on intuition and gut instinct [27].

AI-powered tools also contribute to effective board processes. Artificial intelligence can automate routine tasks such as document analysis and compliance checks, allowing managers to focus on more strategic issues [28]. This not only saves time but also reduces the risk of human error in manual tasks. Moreover, artificial intelligence can enable boards to act quickly when faced with new challenges and opportunities by providing real-time information and predictive analytics [29]. In today's world, the speed of decision-making is increasingly important, and artificial intelligence increases the board's ability to adapt.

The growth of AI offers both opportunities and challenges for companies. To harness AI's potential, boards need more tech-savvy members. AI can make board decisions more efficient and effective. By embracing AI and tackling its ethical and governance issues, boards can thrive in the digital era [30].

AI and Risk Management

AI is continuing to find its way into a multitude of sectors, and its applications in risk management are crucial. This section examines two core facets: predictive analytics and cybersecurity. We will try to get a feel of how AI is used to forecast risks and shore up cybersecurity in corporate governance.

Predictive Analytics: Forecasting and Identifying Potential Risks

Predictive analytics, powered through artificial intelligence and especially machine learning algorithms, plays a crucial role in risk management by analyzing large data sets to uncover patterns and generate accurate predictions, while traditional risk assessment models often struggle to achieve this amid the complexity of contemporary business environments [31]. S. Aziz and M. Dowling show how machine learning and artificial intelligence improve risk management through more accurate predictions. By analyzing historical data, AI can pre-emptively identify trends and potential risks that cannot be easily spotted through traditional methods [32].

In the fintech sector, predictive analytics is increasingly used to manage risk. N. Bussmann et al. explore the role played in fintech risk management by explainable artificial intelligence (XAI), which refers to artificial intelligence models in which the decision-making process is transparent and understandable. This transparency is critical in highly regulated industries such as financial services [33]. I. Ivashkovskaya and I. Ivaninskiy emphasize the importance of ensuring that AI algorithms are explainable to stakeholders, especially in sectors such as financial services where regulatory compliance is vital [19].

Discussing the challenges of AI in finance, P. Giudici emphasizes that AI's real strength lies in providing real-time risk monitoring and adaptive responses to ever-shifting market conditions [34].

To summarize, predictive analytics is reshaping risk management by:

- **Identifying Potential Risks**. Leveraging machine learning algorithms to detect patterns and trends in large datasets [32].
- **Ensuring Regulatory Compliance**. Providing transparency through Explainable AI models, particularly in highly regulated sectors [19; 33].
- **Adapting to Market Conditions**. Offering real-time risk monitoring and adaptive responses [34].

These insights demonstrate how predictive analytics, combined with regulatory compliance measures, can significantly enhance risk management strategies in the AI era.

Addressing Cybersecurity Challenges with AI

The exponential growth of digitalization has brought about an increase in cybersecurity threats. However, artificial intelligence presents both challenges and opportunities in the field of cybersecurity within corporate governance. In this context, J. Schuett discusses the implications of the Artificial Intelligence Act for risk management. He argues that a strong regulatory framework is vital to ensure that machine learning risk management practices remain safe and accountable [35]. M. Gupta et al. review how artificial intelligence and machine learning are revolutionizing cybersecurity practices and how these technologies are being used to address a wide range of ever-evolving threats, similar to broader applications in risk management [36].

In the context of risk management and AI governance, explainable artificial intelligence (XAI) plays an important role in identifying vulnerabilities and supporting compliance [34]. XAI models make the decision-making process transparent and understandable, which is especially important in highly regulated industries such as financial services.

In summary, AI plays a game-changing role in risk management for corporate governance in several different ways:

- Predictive analytics leverages AI to provide a sophisticated methodology for identifying and forecasting potential risks [32].
- Financial risk management integrates AI for improved decision-making processes and real-time insights [33].

- Dynamic cybersecurity response offers a dynamic response to cybersecurity challenges by bolstering defenses, detecting vulnerabilities, and proactively responding to emerging risks [36].

As AI continues to advance, the interplay between predictive analytics and cybersecurity becomes increasingly important for organizations navigating the complexities of the digital age. Studies cited throughout this article underscore the growing importance of responsible AI governance, regulatory frameworks, and ongoing research to ensure the safe integration of AI into risk management practices [34; 35].

Corporate Transparency and Stakeholder Engagement

In the fast-evolving corporate governance landscape, the principles of transparency, stakeholder engagement and sustainable practices are essential building blocks of trust and accountability within organizations [37].

In this section, we consider the intersection of these principles and how the infusion of AI into corporate practices may further enhance transparency and engagement with stakeholders, drawing on recent scholarly work that explores how AI impacts corporate reporting, disclosure, and communication with stakeholders.

Automated Reporting and Disclosure

The integration of AI into corporate reporting promises to open the doors for real-time and accurate disclosure.

A. Karbekova et al. explore how AI and dataset automation can revolutionize corporate accounting and sustainability reporting within the framework of Industry 4.0, emphasizing the role of AI in improving reporting quality and management practices. With businesses increasingly using AI for reporting and disclosure, the idea of "transparency by design" is gaining traction [38]. H. Felzmann et al. argue that embedding transparency in AI systems promotes openness and accountability while ensuring that companies meet legal standards [15]. M. Hosain et al. also argue that AI systems should not only be transparent but also provide meaningful explanations to stakeholders [13].

Leveraging Stakeholder Communication: Enhancing Dialogue through AI

AI has the capacity not only to automate reporting but also to enrich the dialogue with stakeholders. H. Güngör examines the multi-stakeholder perspective of creating value with AI, delineating how AI may provide value for divergent stakeholders via efficient and effective communication and thus promote informed decision-making [14].

M. Hosain et al. argue that meaningful disclosures made with the help of artificial intelligence facilitate stakeholder communication beyond transparency [13]. C. Zehir et al. argue that transparency should be seen as a corporate requirement that involves stakeholders in the decision-making process, emphasizing how participating stakeholders can help bridge the gap between transparency initiatives and corporate results [39].

In summary, the integration of AI into corporate reporting and communication fundamentally transforms transparency, accountability, and stakeholder engagement. The academic research presented here emphasizes the importance of transparency by design, meaningful explainability, and proactive stakeholder engagement in an AI-focused corporate environment. For businesses that navigate these complexities, leveraging AI to enhance transparency and stakeholder engagement is crucial for promoting accountable and sustainable corporate governance. The proactive adoption of these technologies not only addresses immediate business needs but also fosters a more collaborative and informed relationship with stakeholders.

Challenges of AI Integration in Corporate Governance

The processes for integrating artificial intelligence into corporate governance are extensive, ranging from improving decision-making and operational efficiency to fostering innovation. While the integration of AI into corporate governance is associated with numerous benefits, it also presents challenges [40]. There are ethical issues surrounding the use of AI, while accountability and algorithm bias need to be addressed [41]. Striking the right balance between human judgment and AI-driven insights is a good measure of responsible and effective decision-making. The need for board members to continuously educate themselves about AI developments and implications is critical. This requires a commitment to a culture of continuous learning and adaptation in the boardroom [42].

This section delves into the key challenges facing AI integrated corporate governance: ethical considerations, legal and regulatory challenges and the broader implications for organizational practices.

Ethical Considerations

Embedding AI into corporate governance processes raises profound ethical considerations [43]. Such considerations require a thorough examination of the impact of AI decision-making on societal values and the ideas of corporate responsibility and accountability. Camilleri delves into the ethical dimensions of AI governance and calls for the alignment between AI applications and social responsibility and ethical norms, noting the risks of unfettered AI use in corporate decision-making [44]. L. Xue and Z. Pang argue for an integrated analytical framework for governing ethical AI applications. They stress that transparency, fairness and accountability are all essential to AI decision-making in the corporate governance landscape to address ethical concerns [45]. J. Mökander et al. explore the ethical challenges and best practices of AI governance in the biopharmaceutical industry. This sector provides a valuable case study due to its early adoption of AI and consistent examination of AI governance at the company level [40]. B. Stahl et al. argue that organizations must be prepared to respond to ethical

issues as they emerge, acknowledging that these issues are dynamic and evolve with the development of AI and its applications, necessitating adaptive organizational strategies [46]. In a novel twist on integrating responsible AI into governance, G. Baloğlu and K. Çakalı question whether artificial intelligence poses a new threat to academic ethics and emphasize the importance of considering the ethical consequences of artificial intelligence in corporate governance [47].

Legal and Regulatory Challenges

The rapid advancement of AI technologies demands a legal and conceptual framework distinct from conventional systems [48]. G. Schildge addresses AI and corporate governance issues, arguing for a solid legal construct and the proactive development of legal guidelines to adapt to the evolving nature of corporate governance influenced by AI technology [49]. J. Thomas discusses the potential legal consequences of AI decision-making, highlighting the need for boards to evolve in order to address the emerging legal challenges associated with AI integration [50]. R. Tallarita examines how AI governance is "testing the limits of corporate law", focusing on the importance of managing risk and adapting to fast-paced advancements in AI, which often render traditional laws obsolete [51]. E. Papagiannidis et al. recognize the legal hurdles to AI governance and suggest the best practices for overcoming these challenges, underscoring the importance of organizations contributing to the development of effective legal frameworks for AI governance [52].

In summary, the challenges of integrating AI into corporate governance extend beyond technical considerations and incorporate ethical, legal, and regulatory dimensions. Organizations adopting AI must fully understand the implications of AI-driven decisions on ethics, societal values, and legal compliance. Drawing on academic research, proactive measures can ensure that corporate governance structures manage the transformative potential of AI effectively, while respecting foundational values and norms.

Conclusion

Throughout this exploration of the intersection between AI and corporate governance, a comprehensive understanding of the multifaceted implications of AI technologies on decision-making processes, transparency, stakeholder engagement, and ethical considerations has emerged. Drawing insights from a range of academic sources, the following key findings encapsulate the transformative effects of AI on corporate governance:

- **Enhanced Decision-Making**. The integration of AI into corporate governance processes contributes to enhanced decision-making efficiency and effectiveness [1; 29; 22].
- **Improved Transparency**. AI facilitates real-time and accurate disclosure, promoting transparency in corporate reporting [13; 15].
- **Stakeholder Engagement**. AI serves as a powerful tool for stakeholder engagement by facilitating efficient communication channels and providing meaningful explanations for AI-driven decisions [14; 39].
- **Ethical Considerations**. The ethical dimensions of AI governance underscore the need for aligning AI applications with social responsibilities and ethical norms [44–47].
- **Legal and Regulatory Challenges**. The rapid evolution of AI technologies has outpaced the development of comprehensive legal and regulatory frameworks, presenting challenges for corporations [49; 52].

Looking toward the future, several trends and challenges are anticipated in the ongoing integration of AI into corporate governance:

- **Advancements in Decision-Making**. Continuous advancements in AI technologies will likely lead to further improvements in decision-making processes, enabling organizations to adapt to dynamic business environments [10; 23].
- **Evolution of Transparency Standards**. The concept of "transparency by design" is expected to evolve, with organizations placing even greater emphasis on intentional design choices that prioritize transparency and align with evolving ethical standards [3; 15].
- **Deepened Stakeholder Engagement**. AI will continue to play a pivotal role in stakeholder engagement by facilitating more meaningful explanations for AI-driven decisions. Organizations will need to focus on effective communication strategies tailored to diverse stakeholder expectations [14; 39].
- **Ethical and Legal Frameworks**. The development of ethical and legal frameworks for AI governance is likely to gain momentum, with regulators and organizations working collaboratively to address emerging challenges and ensure responsible AI practices [44–47].

In conclusion, the integration of AI into corporate governance is an ongoing journey marked by transformative impacts and evolving challenges. Organizations that proactively address ethical considerations, enhance transparency, and navigate legal landscapes will be better positioned to harness the full potential of AI in shaping the future of corporate governance [3; 17; 52]. As AI continues to advance, a commitment to responsible governance and a proactive approach to emerging challenges will be essential for fostering sustainable and effective corporate practices.

The integration of AI into corporate governance has ushered in a new era by transforming decision-making processes, stakeholder relationships and ethical considerations. With insights from academic sources, an intriguing call for future trends research in the field of AI and corpo-

rate governance emerges. M. Hilb, P. Cihon et al., M. Fenwick and E. Vermeulen, and others have shed light on the multifaceted effects of AI [1; 2; 7].

Looking ahead, predicting and minutely examining future trends shaping the intersection of artificial intelligence and corporate governance will greatly contribute to development in this field.

1. Long-term Implications of AI Adoption on Decision-Making Structures

Future research should focus on discerning the long-term implications of AI adoption on decision-making structures within organizations. B. Kaya emphasizes the need to explore how AI will continue to redefine roles and responsibilities, ensuring a harmonious integration that leverages the strengths of both human and machine decision-making processes [20].

Specific recommendations:

Organizational Hierarchies. Investigating how AI influences hierarchical decision-making structures and whether it necessitates flatter hierarchies.

Human-AI Collaboration. Examining the interplay between human intuition and AI analytics, developing frameworks to maximize their combined potential.

Governance Strategies. Exploring the strategic implications of AI-driven decision-making, particularly in diversifying board composition and expertise.

AI Literacy Training. Advocating for AI literacy training at all levels of corporate leadership to ensure informed decision-making.

2. Evolving Ethical Governance Frameworks for AI

As AI continues to transform corporate governance, it generates new ethical challenges that require adaptive strategies. H. Han's exploration of AI and blockchain, A. Nassar and M. Kamal's study of large data-driven ethical considerations, along with papers by M. Camilleri and by L. Xue and Z. Pang underscore the importance of ethical governance frameworks. Future research should identify best practices, potential barriers, and outcomes in AI governance, contributing to the establishment of robust guidelines for responsible and effective AI use [4; 11; 44; 45].

Specific recommendations:

- **Algorithmic Accountability**. Developing metrics and guidelines to ensure that AI algorithms are accountable and transparent in decision-making.
- **Ethical Auditing**. Exploring methodologies for auditing AI systems to ensure adherence to ethical governance principles.
- **Best Practice Frameworks**. Developing comprehensive best-practice frameworks for ethical AI governance.
- **Regulatory Compliance**. Researching the implications of global regulatory standards for AI governance and how organizations can align with them.

3. Intersection of AI and Stakeholder Relations

The intersection of AI and stakeholder relations, as examined by H. Güngör and C. Zehir et al., presents a rich area for exploration [14; 39]. Future trends research should aim to unravel the evolving dynamics between organizations, AI technologies, and stakeholders, ensuring transparency and accountability in this multifaceted relationship.

Specific recommendations:

- **Stakeholder Engagement Models**. Creating models that enhance stakeholder engagement through AI-driven communication tools.
- **Transparency Standards**. Researching new standards for transparency in AI-enabled corporate reporting and stakeholder communication.
- **Trust Building**. Investigating approaches to build trust in AI systems among stakeholders, emphasizing meaningful explainability.

In conclusion, the transformative impact of artificial intelligence on corporate governance is an ever-evolving field. In the future, exploring the effects of artificial intelligence on corporate governance with the specific recommendations provided above will offer valuable contributions to academics, practitioners, and policymakers. This endeavor not only enhances our understanding of the role of artificial intelligence but also holds promise for guiding organizations toward ethical, responsible, and effective governance in an AI-driven future.

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Is the Russian Green Bond Market Strong Enough to Hedge in the Crisis Times?

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Abstract

The scope of this research has two facets. First, we study the spillover effects between the Russian green bonds and the leading capital market's 'indexes before and after the February 2022 events. Second, the identified level of asset connectedness permits to identify portfolio management implications for the analyzed assets. To reveal the spillover effects, we applied the vector autoregressive model and created a synthetic index to capture the dynamics of the green bonds market which included 14 green bond issues between 2021 and 2023 in Russia. We analyze oil & gas, electrical utilities, metals & extraction, chemical sectors collectively referred to as "pollution intensive indexes". The paper contributes by discovering that the total connectedness index (TCI) between Russian green bond market and pollution intensive indexes changed over time and increased after the outbreak of the conflict. Additionally, the paper is novel on revealing the relationship between low hedging effectiveness and hedging ratio of green bond and energy, metals and extraction, sustainability and oil and gas indexes which indicate no need for hedging after February events. The optimal bivariate portfolio weights analysis shows that Russian green bonds market is an outstanding instrument for assets portfolio management during geopolitical conflict. These findings have implications for the government and other stakeholders to manage both the contagion and climate risks during the military conflict.

Keywords: green bonds, Russian capital market, spillover, hedging, economic shocks

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Introduction

The current geopolitical context between Russia and Ukraine, which is determined by the military conflict, caused major structural changes and turbulence in the Russian economy and its capital market. In response to the military conflict, Western countries isolated the Russian economy through sanctions. This policy along with changes in the global and regional energy markets significantly influenced the development path towards sustainability for Russia and rest of the world. Even though the Russian Federation adhered to its sustainable development trajectory, its commitment to achieve the climate targets underwent some tectonic changes, e.g., changes in the legislation design, level of development of the sustainable financial market, access to foreign green technology, international green resources, capabilities, etc. Despite this macroeconomic shock, the Russian green bond market continued its development and increased by 168%[1] since the beginning of the military conflict. Additionally, the Russian capital market experienced crisis dynamics but it stabilized and shifted to a development trend within one year (e.g., the RTS Index increased by 25% in January 2023 compared to February 2022). According to the green finance platform and climate policy database, since the conflict between Russia and Ukraine started, only two regulatory frameworks have been launched (e.g., Decree regarding banned timber-related exports to the EU (2022); Long-term Strategy Russian Federation (2022))[2], while all other policies were implemented before the conflict, which indicates that the priority of sustainable development for the economy was downgraded.

The main scope of this research is to reveal the spillover effects of Russian green bonds towards the main capital market indexes before and after the outbreak of the military conflict, also including the direction of these relationships (either "FROM" or "TO"). It is important to reveal the level of connectedness and to identify the extent to which the Russian green bond market can be used for hedging and portfolio management solutions in the context of macroeconomic shocks. The importance of this research also stems from the fact that the options for hedging against macroeconomic shocks are limited due to Western sanctions on the Russian economy.

Current literature shows that international capital markets were shocked by the geopolitical conflict from the perspective of the general financial market risk and the dynamics of relationships between different capital market assets (e.g., energy companies, etc.) W. Jiang et al. [1] found that during period 2020–2022 the connectedness between traditional, new energy, ESG and green bond markets increased from 19.35% (before February 2022) to almost 30% (after February 2022), showing that there were high transmission forces between these assets for the Chinese economy in the crisis period. O.B. Adekoya and J.A. Oliyide [2] found that the geopolitical crisis increased the connectedness between analyzed capital markets assets during the conflict compared to the preceding period. A similar conclusion was reached by W. Jiang et al. [1], who found that the spillover direction among the assets changed significantly in the crisis period, indicating that investors should change the hedging strategy and portfolio management structure accordingly (e.g., bonds, oil, gold cryptocurrency, etc.). R. Karkowska and S. Urjasz [3] analyzed how the connectedness changed across capital market assets (renewable and non-renewable energy and stock markets), in Europe, US and Asia before and after geopolitical conflict. They found that the US is a net transmitter of spillover, while Europe is a net receiver of the market shocks because European countries were more affected by geopolitical conflict.

To achieve the research objectives, we employed a unique methodological approach for simulating the Russian green bond market through a synthetic index with regard to the price dynamics of all the green bond issuances between January 2021 and December 2023. Further, we have used the F. Diebold and K. Yilmaz's DY model [4] to reveal the connectedness between Russian green bonds and other leading capital market indexes, including pollution-intensive ones (e.g. Electric Utilities, Metals & Mining, Oil & Gas etc.)

First, our findings show that the spillover effects of the Russian green bond market have a different trajectory compared with the other capital market indexes before and after the February 2022 events. The Russian green bond market index is a net receiver of return volatility spillover both in 2021 and 2022 comparing with the other assets that changed their spillover direction. This trajectory change revealed that the green bond market was not significantly affected by the geopolitical conflict.

Even though the structure of the analyzed capital market indexes is different from the existing literature, we found that the value of the connectedness index among the analyzed assets during the crisis period increased from 49.6 to 64.5%. This result validates the idea that during the crisis capital market asset interdependences create a certain dynamic pattern driven by hedging mechanisms and the restructuring of the portfolio management mechanisms. The connectedness index indicates that market inter-relationships between assets have changed, and investors and asset managers should react accordingly.

The study of the spillover effects between capital market assets requires an analysis of the asset risk management implications, hedging and asset portfolio management aspects (e.g., hedging ratio, portfolio weights and hedging effectiveness). Further, as hedging effectiveness measures the risk reduction in the variance of the unhedged position, we found that Russian green bond index demonstrates low values and is statistically significant when the index is in a long position. This aspect, corroborated by the fact that the Russian green bond index is a net receiver of spillover

[1] URL: https://www.moex.com/en / – the figure reflects the market increase in 2022 and 2023 comparing with the green bonds issuance in 2021.

[2] URL: https://climatepolicydatabase.org/

effects, preliminary indicates there is no need for hedging with a short position in other assets when investing in green bonds (long position).

As far as we know, we are the first to analyze the behavior of the Russian green bond market using a synthetic aggregated index before and after the outbreak of the military conflict through the spillover analysis using the DY model. The main conclusion is that the green bonds still represent a reliable asset to hedge in the Russian capital market and are a good instrument to be used in asset portfolio management even during the turmoil period. The remainder of this study is structured as follows: second section highlights the main literature results and existing research gaps, third section develops the data sample and hypotheses, fourth section provides details about the employed methodology, fifth section presents empirical specifications, and sixth section concludes with the findings.

Literature Review

The geopolitical conflict between Russia and Ukraine triggered global macroeconomic shocks that negatively affected many economies and created commercial and financial disturbances between Western and Eastern countries, the Global North, and the Global South. The non-typical military conflict that started between Russia and Ukraine propelled the academia to investigate the effects of such shocks, especially revealing its impact on the sustainable development path assumed by almost all the nations through the 2015 Paris Agreement. Even though Russia was isolated from the Western economies, it continues its efforts to implement its sustainable development agenda, because climate risks and pollution have no borders. As indicated in the existing literature, green bonds are considered a powerful sustainable finance instrument to support the green transition in developed and emerging capital markets. Moreover, green bonds include environmental benefits dividends, which exhibit high liquidity, lower risks, and higher returns in stable macroeconomic contexts [5]. Other papers analyze the nexus between green bonds as instrument for supporting the green transition and other capital market assets during macroeconomic shocks through risk and return spillover effects [e.g. 4]. In other words, the spillover will reveal a complex array of interdependences between the green bond returns and other assets both between and within the capital market indexes.

The researchers analyzed the spillover effects between green and brown assets, seeking to manage the exposure to idiosyncratic risk determined by climate risks overlapping with macroeconomic shocks [6]. Thus, showing the intensity and direction of risk-return spillover between green bonds and other capital market indexes from the MOEX will allow to build the risk map of the assets [1] and to arrive at the optimal portfolio structure through asset rebalancing by including green bonds as sustainability factors [e.g., 3; 7]. As green bonds are linked to different sustainable development scopes and different industries in the Russian economy, the examination of green bond spillover effects identifies three distinct themes in literature.

First, a certain section of literature focuses on the connectedness between green bonds and other capital market assets during macroeconomic shocks by analyzing the return spillover between the assets before and after the tectonic macroeconomic shift happened. W. Jiang et al. analyzed the level of connectedness and spillover transmission between conventional, new energy, green finance and ESG assets before and after the start of the geopolitical conflict between Russia and Ukraine. Although, the Chinese capital market is far from the epicenter of the conflict, the authors found that the total level of connectedness between assets increased immediately after the conflict had begun. Specifically, it was revealed that green bonds were the net receiver of the spillover effect before the shock and became the net transmitter of spillover after the shock [1]. The COVID-19 pandemic was also considered a macroeconomic shock, albeit with different characteristics; for this reason, academia was comparatively analyzing the level of the green bond spillover effect during different capital market shocks [8–10]. E. Abakah et al. [11] used the S&P green bond index as a proxy to analyze their spillover effect on the blockchain market and other eco-friendly financial assets in the context of macroeconomic instability. They found similar results, namely, that at times of geopolitical instability the level of connectedness between green bonds and other assets is much higher, which makes these assets good instruments for hedging and asset portfolio management, and has similar implications for developed capital markets as well [12].

The second line of research refers to the analysis of green bonds as an instrument of mitigating climate risks used for hedging purposes and portfolio management decisions. Green bonds, as the most important global component of sustainable finance, are highly correlated with the regulatory ecosystem, which is set up either at the country or the regional level [13]. For example, the climate policy uncertainty (CPU) index is an instrument developed by K. Gavriilidis [14], which measures the uncertainty related to climate policies implemented in the US. An analysis of the connectedness between CPU and green bonds reveals the level of risks associated the climate changes and the level of relevant regulatory development in the country – a higher level of CPU will imply a higher level of green bond spillover, and vice versa [15]. Climate risk can be managed properly with green bonds only in those jurisdictions where the level of climate regulatory ecosystem is sufficiently high. To analyze the level of connectedness between green bonds and other assets to reveal the implications on climate risks, studies often include CO_2 emissions or brown energy sources (e.g., Coal) as a proxy. The spillover effect between green bonds and assets that represent climate risks is high, and green bonds are usually the net receivers of these effects [16; 17].

The third theme in literature is the financialization and the decision-making process that derives from the analysis of the spillover effects between green bonds and other capital market assets. It is important to withdraw the maximization factors of economic benefits and long-term value creation and minimize the associated risks, especially those linked

to the climate aspects. Different methods of spillover representation, such as: DCC-GARCH and VAR developed by F. Diebold and K. Yilmaz [4], quartile regression model developed by R. Koenker and G. Bassett [18], time-frequency generalized spillover index method and the MVMQ-CAViaR, empirically reveal that green bonds are reliable instruments for hedging and optimal portfolio management [19]. To create an effective hedging structure or to build an optimal portfolio balance between green bonds and other assets, it is important to select the proper assets from a specific capital market. T. Tian et al. [16] found that green bonds can be effectively associated with coal, oil, copper and CHY (the Chinese yuan) in order to reduce significantly the investments risks in the Chinese financial and commodity market. W. Zhang et al. [17] delved into the analysis of the connectedness between green bonds and carbon emission futures and found that a combination of a short position to offset CO_2 emissions and a long position in green bonds is statistically significant, and consequently hedges the risk effectively by taking into account the US and international capital markets indexes. A different approach was developed by L. Pham and H. Do [10], who analyzed the hedging effectiveness of green bonds against the implied volatility to measure the forward-looking market risks in the U.S., European and Chinese stock markets. Overall, it was determined that the level of connectedness between green bonds and other assets is much higher for the US and European than the Chinese capital market in case of forward-looking market risks (e.g., different types of implied volatilities were considered) [20]. Consequently, the optimal portfolio structure and risk management initiatives should also consider cross-market indexes and assets when connecting with the green bonds.

Green bonds create risks and opportunities for national financial markets, and mainly focus on supporting the economies to mitigate and reduce climate risks and strive towards a new economic model based on sustainable development mechanisms. The Russian economy is actively participating in the transition process, despite the geopolitical context, therefore the green bond market is an important capital market enabler for this transition towards the net-zero economy. The spillover analysis shows the connectedness of the green bonds and other capital market assets that allow to mitigate climate risks and are used for hedging and building an optimal capital portfolio structure. This is a research gap in case of the Russian economy. Addressing this gap in the current literature, we have created a synthetic index for capturing the dynamics of the Russian green bond market, aiming to show its return spillover effects on the main indexes from the MOEX.

Data, Variables and Hypotheses

The research uses different data sources to investigate the dynamic causality and spillover effects between the Russian green bond market and other capital market indexes from the Moscow Stock Exchange. To capture the dynamics of the Russian green bond market, a synthetic index was created.

The empirical analysis considers not only the traditional risk spillover between Russian capital market indexes, but also examines the implications of the level of connectedness before and after the outbreak of the military conflict. Moreover, the importance of analyzing the risk and return spillover between green bonds and other Russian capital market indexes is underscored by the fact that the global initiatives towards mitigating climate changes have been threatened and the mechanisms of transition have changed.

Indeed, the conflict between Russia and Ukraine put pressure on the EU and other Western countries' climate agenda due to the energy crisis, global supply chain redesign, sanctions against Russia, etc. The transition towards net-zero economy is supposed to be a collective action undertaken jointly, because climate risks and subsequent global warming do not have any borders. This was the reason for the 2015 Paris Agreement COP-21, which for the first time in the human history aligned the engagement of 196 signatory nations to fight collectively against climate change, bringing together developed and developing countries from the Global South and the Global North.

The current geopolitical conflict changed the roadmap of climate agenda because the global collective initiatives and actions have been broken down. As a result of this geopolitical conflict, Western countries imposed sanctions that decoupled the Russian economy from the global processes that aim to mitigate climate change, with implications on the following: access to Western green technologies, access to the international sustainable financial resources to implement the Russian climate agenda, the implications on the regulatory deployment for climate change (both at national and international levels), or the access to green metals[3].

Considering these aspects, in order to achieve the research objective, 4 categories of indexes from MOEX were used in the analysis: (i) pollution-intensive and climate risk indexes that include the industries with high and negative impact on climate change (Electric Utilities, Metals and Mining, Chemicals, Oil and Gas, Gazprom); (ii) financial sector indexes (Aggregate bond index and Financials); (iii) ESG (Sustainability Vector Index); (iv) digital market index (see Appendix 1). The main reason to include a wide variety of indexes is to reveal the risk and return spillover effect of the green bonds and other capital market assets in the context of geopolitical conflict and economic and financial isolation.

To reach the research objective, we utilize data from January 2021 to December 2023 to capture the spillover effect before and after the start of the conflict between Russia and Ukraine. To analyze the risk of contagion and the spillover effect between the Russian green bond market and other capital market assets, the following research hypotheses can be formulated:

[3] URL: https://www.economist.com/finance-and-economics/2023/09/11/how-to-avoid-a-green-metals-crunch

H.1. Assets that offset climate risks are net transmitters of return spillover towards green bonds, and the connectedness strengthens during economic shocks (e.g., COVID-19, geopolitical conflict between Russia and Ukraine) in the emerging capital market [16; 21]. Thus, the level of connectedness between Russia green bonds and the leading capital market indexes will strengthen after February 2022.

H.2. In both developed and emerging capital markets, the green bond index is highly correlated with ESG assets, especially in the periods after macroeconomic shocks [17; 19; 22]. As a result, the Russian green bond market is highly correlated with the MOEX ESG index in the post-conflict period.

H.3. The Russian green bond index is a good hedging instrument against assets with inherent climate risks after the outbreak of the geopolitical conflict and is an important portfolio rebalancing asset for optimal portfolio weights [23].

H.4. The level of connectedness between the Russian green bond index and other capital market assets is time-varying after February 2022, which is characteristic of green bonds in other emerging capital markets [7].

To reveal the dynamic causality and spillovers between the Russian green bond market and other assets from the Moscow Stock Exchange (MOEX), a synthetic green bond index was created from the daily price dynamics of the green bond issuances on MOEX. The weighted average computation included all the green bond issuances denominated in RUB, which allowed to compile an unbiased index that revealed the dynamics of green bonds in the Russian capital market.

Data on green bond issuances and daily price dynamics were sourced from the Cbonds database and MOEX website. We are among the first to aggregate the price dynamics of the Russian green bond market, which is a pioneering effort as there is no evidence that MOEX had created a similar instrument to capture the dynamics of the green bond market. The final green bond index computation included 14 GB issuances denominated in RUB, and the full price index method was used to calculate the synthetic index:

$$I_T = I_{T-1} \sum_{i=1}^{N} \left(W_i^c \bullet \left[\frac{P_{i,T} / 100}{P_{i,T-1} / 100} \right] \right), \quad (1)$$

where I_T is the value of the index during period T; I_{T-1} is the value of the index during period T–1; W_i is the GB issue weight; P_i, T is the price of the issue during period T; and P_i, T–1 is the price of the issue during period T–1.

To increase the accuracy of our results, a stationary series is used in the analysis. Thus, the logarithm calculation of the index return is included in the model of two consecutive prices as follows: $R_t = \ln(P_t) - \ln(P_{t-1})$, where P_t is the price of assets at time t.

To reveal the characteristics of the data included in the analysis, the descriptive statistics is presented in Table 1.

Table 1. Descriptive statistics of return series

	vars	n	mean	sd	median	min	max	skew	kurtosis	ADF	LB(20)
Rus_GB_index	1	743	–0.00004	0.00183	0.00000	–0.01211	0.01607	0.3895	24.9167	–34.6391	516.82
RUABITR	2	741	0.00000	0.00111	0.00003	–0.02288	0.00674	–11.2063	243.3267	–24.8928	97.98
MOEXEU	3	741	–0.00003	0.00285	0.00006	–0.04891	0.02615	–6.1846	128.5264	–34.8737	105.54
MOEXMM	4	741	–0.00004	0.00217	0.00001	–0.03505	0.01801	–5.2700	97.8475	–31.4232	122.59
MOEXCH	5	741	0.00009	0.00233	0.00009	–0.02482	0.03474	3.1827	86.1870	–25.5218	89.19
MOEXFN	6	741	0.00002	0.00277	0.00015	–0.04889	0.01421	–7.4887	131.5320	–28.4184	98.76
MOEXOG	7	741	0.00003	0.00252	0.00015	–0.04290	0.02707	–5.3836	130.6746	–32.9021	152.31
MOEXIT	8	741	–0.00010	0.00419	0.00011	–0.07594	0.01400	–8.1721	144.2175	–28.7019	91.00
GAZP	9	743	–0.00006	0.00545	–0.00004	–0.06376	0.04189	–3.1786	45.4437	–27.7020	71.22
MRSV	10	741	–0.00002	0.00241	0.00012	–0.04144	0.02191	–6.3057	127.7759	–32.5560	149.04

The average value of the analyzed indexes has both positive and negative values that are attributed to the specifics of the sample period: the post-COVID-19 recovery period and the geopolitical conflict between Russia and Ukraine. The negative average returns of the indexes for 2021–2023 is a sign of a bear market, and positive average returns indicate bullish market conditions. Summary statistics reveal that the standard deviation of the synthetic green bond index is low compared with the other indexes (except RUABITR), which indicates that the green bond market exhibits relative stability comparing with the other indexes in the context of macroeconomic turmoil. The results of the augmented Dickey-Fuller test show that the time series are stationary. The RUGBI and MOEXCH series have a positive skewness, which differs from the other indexes. This variance in distribution indicates the index's unique behavior in the context of continuous macroeconomic instability specific for the sample period.

Empirical methodology

The analysis of the connectedness of green bonds with other assets can be undertaken in different ways, often employing multivariate time-series methods. For example, J. Reboredo and G. Uddin [13] used wavelet analysis to study the spillover effects of green bonds across different capital markets, A. Tiwari et al. [7] employed TVP-VAR to reveal the risk of contagion of green bonds, EU Emissions Trading System (EU ETS) and renewable assets; cross-quantilogram analysis was employed by M. Naeem et al. [24] to show the asymmetric spillovers between green bonds and commodities, etc. Among the existing methods used by authors to empirically determine the dynamic causality and spillovers between green bonds and other capital market assets, the method developed by F. Diebold and K. Yilmaz [4] seems to be more comprehensive than the other methods. The method entails the consideration of the generalized vector autoregression (GVAR) and the generalized variance decomposition matrix (GVD) to reveal the relatedness of capital market assets. We used this method in our research because it is much simpler and more intuitive for assessing asset volatility and also represents a methodological approach to various papers that explore the spillover analysis between green bonds and other capital market assets [16; 25]. To evaluate an asset's risk implications that derive from the spillover analysis and asset portfolio management, the following methodological approaches are used: the DCC-GARCH model was utilized to calculate the hedging ratio employing conditional variance and covariance (method proposed by K. Kroner and J. Sultan [26]; and optimal portfolio weights calculation proposed by K. Kroner and V. Ng [27], which is methodologically associated with the computation of asset hedging effectiveness proposed by L. Ederington [28].

To fulfill the research objective, the method developed by F. Diebold and K. Yilmaz [4] is employed to show both the dynamics and static volatility spillover effects between the analyzed assets from the MOEX. The D&Y method implies the following calculation steps:

First, the n-dimensional covariance stationary variable is calculated:

$$y_t = \Phi(L)y_t + \varepsilon_t = \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \ldots + \Phi_p y_{t-p} + \varepsilon_t, \quad (2)$$

where $\Phi(L)$ is an $n \times n$ coefficient matrix and ε_t is a vector of distributed disturbances with the covariance matrix Σ.

Second, the moving average of *yi* is calculated by using VAR:

$$y_i = \Psi(L)\varepsilon_t = \Psi_0\varepsilon_t + \Psi_1\varepsilon_{t-1} + \ldots + \Psi_h\varepsilon_{t-h} + \ldots, \quad (3)$$

where vector Ψ_h represents an $n \times n$ polynomial matrix with lag h (h-step-ahead error variance in forecasting y_i). Next, the generalized forecast error variance decomposition (GFEVD) is calculated:

$$\theta_{ij}^H = \frac{\sum_{h=0}^{H-1}\left(e_i'\Psi_h\Sigma e_j\right)^2}{e_j'\Sigma e_j \bullet \sum_{h=0}^{H-1} e_i'\left(\Psi_h\Sigma\Psi_h'\right)e_i} =$$

$$= \frac{1}{\sigma_{jj}} \bullet \frac{\sum_{h=0}^{H-1}\left(\left(\Psi_h\Sigma\right)_{ij}\right)^2}{\sum_{h=0}^{H-1}\left(\Psi_h\Sigma\Psi_h'\right)_{ii}}, \quad (4)$$

where σ_{jj} is standard deviation of the error term for the j-th equation and e_j is the vector with the j-th element which is 1 and the rest being 0. The j-th series' contribution to the forecast error variance of the variable i at the horizontal h is equal to θ_{ij}^H.

The above equation is normalized for every entry of the matrix with variance decomposition by the raw sum:

$$C^H = \frac{\sum_{i,j=1,i\neq j}^{n}\bar{\theta}_{ij}^H}{\sum_{i,j=1}^{n}\bar{\theta}_{ij}^{\mathrm{H}}} \bullet 100 = \frac{1}{n}\sum_{i,j=1,i\neq j}^{n}\bar{\theta}_{ij}^H \nu \bullet 100. \quad (5)$$

In the last stage, the directional spillover (TO/FROM) is determined from variable i to variable j and vice-versa (TO/FROM), which also includes the net spillover position of variable i as a difference between the other two as follows:

$$C_{i\rightarrow\bullet}^H = \frac{1}{n}\sum_{j=1,j\neq i}^{n}\bar{\theta}_{ji}^H \bullet 100 \quad \text{(TO)} \quad (6)$$

$$C_{i\leftarrow\bullet}^H = \frac{1}{n}\sum_{j=1,j\neq i}^{n}\bar{\theta}_{ij}^H \bullet 100 \quad \text{(FROM)} \quad (7)$$

$$C_{i,net}^H = C_{i\rightarrow\bullet}^H - C_{i\leftarrow\bullet}^H \quad \text{(NET)} \quad (8)$$

At this stage the spillover matrix is obtained to determine the directional spillover between the Russian green bond index and the rest of the analysed assets, thus methodologically supporting the validation of Hypothesis 1 and 2. The F. Diebold and K. Yilmaz [4] method is used to determine both static and dynamic spillover effects. Both methodological approaches provide empirical results that have a complementary role in analyzing the level of connectedness between the Russian green bond market and capital market indexes.

Bilateral hedging ratio and portfolio weights

The calculation of the spillover and the analysis of the connectedness among the assets is often used to determine the hedging performance of the target assets compared to other assets and lead to portfolio rebalancing. To validate hypothesis 3, the following methodological approach is defined. First, the model developed by K. Kroner and J. Sultan [26] is employed in the research. To calculate the optimal hedging ratio, the estimation of conditional variance and covariance from DCC-GARCH is utilized as follows:

$$\beta_{ijt} = h_{ijt} / h_{jjt}, \quad (9)$$

where h_{ijt} represents the conditional covariance of asset *i* and asset *j*, and h_{jjt} is the conditional variance of asset *j*. Next, the model developed by K. Kroner and V. Ng [27] is employed to determine the optimal portfolio weights (W_{ijt}) as follows:

$$W_{ijt} = \frac{h_{jjt} - h_{ijt}}{h_{iit} - 2h_{ijt} + h_{jjt}}, \quad (10)$$

where W_{ijt} represents the weight of asset *i* in a 1-dollar portfolio of two assets *i* and *j* at time *t*, while the weight of the asset W_{jit} is (1 – W_{jit}).

In the last stage we calculate the hedging effectiveness of the determined portfolio weights and the hedging ratio, which were calculated earlier by following the methodology developed by L. Ederington [28].

$$HE_{ijt} = 1 - \left[\left(Var\left(r_{\beta ijt}\right), Var\left(r_{wijt}\right) \right) / Var\left(r_{unhedged}\right) \right], \quad (11)$$

where

$$r_{wijt} = W_{ijt} x_{it} + W_{ijt} x_{jt} \quad (12)$$

$$r_{\beta ijt} = x_{it} - \beta_{jit} x_{jt}. \quad (13)$$

The ($Var(r_{\beta ijt})$, $Var\ (r_{wijt})$) denotes the hedged portfolio variance of the optimal hedging ratio or the optimal portfolio weight. Var (unhedged) represents the variance of the unhedged position between variable *i* and variable *j*.

Empirical Results

In the last five years, the Russian capital market experienced a unique development characterized by post-COVID-19 market specifics, geopolitical conflict with Ukraine, marked by the cancel culture with a multitude of sanctions [29]. Currently the Russian economy and its capital market are adapting to the new reality and at the same time keeping up the development pace and striving towards sustainable development, like other emerging capital markets [30; 31]. The geopolitical conflict between Russia and Ukraine turned to be a macroeconomic shock, especially for Western economies (e.g., EU countries) and Asian countries, as it changed the flow of energy supply factors (e.g., natural gas, oil, etc.) and affected logistics and global supply.

Given these aspects, empirical research reveals the risk and spillover effect between green bonds and other capital market indexes on the Moscow Stock Exchange. This analysis intends to show the benefits of green bonds for hedging and optimal portfolio asset management reasons, as well as their propensity for the sustainable development of Russian economy since green bonds turned to be one of the main drivers for sustainable development in other economies [e.g. 22; 32].

Static connectedness

To analyze comparatively the risk and return volatility spillover between the Russian green bond market and other indexes, static spillover connectedness is calculated across the following periods: 2021–2023 (the sample period); Jan. 2021 – Jan. 2022 (post-COVID-19 period); Jan. 2022 – Dec. 2023 (geopolitical period for Russian economy and its capital market). Thus, we follow the methodological approach proposed by [3; 8] to show a comparative analysis within different time periods for hedging and portfolio management reasons.

The post-COVID-19 period was marked by the restoration of economic stability and growth in different sectors of activity that were affected in the entire global economy, including Russia, during the pandemic. Thus, by employing vector autoregressive models (VAR) proposed by F. Diebold and K. Yilmaz, we determine the total connectedness index between the Russian green bond index and other assets before the geopolitical conflict started. As the period was still marked by post-COVID effects, the TCI amounted to 49,61% (Table 2), which is considered to be high compared with the pre-pandemic period [2; 11]. The analysis demonstrates that many countries, including the Russian Federation were involved in sustainable development processes at different levels (e.g., regulatory, capital market structuring, strategic environment projects, etc.).

Table 2. Static connectedness between assets in 2021, %

	RUGBI	RUABITR	MOEXEU	MOEXMM	MOEXCH	MOEXFN	MOEXOG	MOEXIT	GAZP	MRSV	FROM
RUGBI	90.45	0.52	2.83	2.09	0.31	1.56	0.55	0.56	0.78	0.34	9.55
RUABITR	0.84	81.31	2.74	3.3	3.34	1.65	0.87	0.83	1.54	3.58	18.69
MOEXEU	1.07	1.03	33.97	9.07	4.18	7.51	10.41	5.18	6.94	20.64	66.03

	RUGBI	RUABITR	MOEXEU	MOEXMM	MOEXCH	MOEXFN	MOEXOG	MOEXIT	GAZP	MRSV	FROM
MOEXMM	0.51	1.73	10.83	40.28	5.1	5.29	5.12	5.52	1.53	24.1	59.72
MOEXCH	0.14	0.91	7.11	7.7	60.22	2.68	4.14	1.53	2.65	12.91	39.78
MOEXFN	0.07	1.02	9.61	5.42	1.72	41.45	8.62	10.25	5.56	16.3	58.55
MOEXOG	0.03	0.52	10.76	4.89	2.56	7.99	34.38	5.49	13.3	20.09	65.62
MOEXIT	0.09	0.41	5.78	6.6	0.94	12.49	5.59	53.8	2.44	11.87	46.2
GAZP	0.25	0.79	9.7	3.29	2.41	7.85	16.14	5.42	42.55	11.6	57.45
MRSV	0.12	1.02	15.54	15.26	5.43	10.14	14.54	6.21	6.19	25.54	74.46
TO	3.13	7.94	74.91	57.62	25.98	57.16	65.97	40.98	40.93	121.43	496.05
NET	−6.43	−10.75	8.88	−2.1	−13.8	−1.39	0.35	−5.22	−16.52	46.98	49.61

A detailed analysis of the connectedness between the assets shows that "to" volatility connectedness varies between 3.13 and 121.43%, while the "from" connectedness between the assets varies from 9.55 to 74.46%. This level of connectedness indicates that the level of return spillover transmission is much higher compared with the level of spillover received [1; 8]. As the spillover analysis includes capital market indexes from different sectors of activity, which are divided into high (e.g., MOEXEU, MOEXMM, MOEXCH) and low pollution impact (e.g., MOEXFN, IT), the results shows that most of the indexes are net receivers of the risk and return spillover except electricity and utilities, and MRSV, which are net transmitters. The net transmitting effects of the volatility spillover of the Russian green bond market, which records only –6.43% and MRSV, which transmits a net spillover effect of 46.98%, indicate that in the post-COVID period the propensity of the Russian capital market towards sustainable development was high. A decomposition analysis of the spillover receiving factors shows that the Russian green bond market receives spillover effects from the following sectors of activity: MOEXEU (2.83%), MOEXMM (2.09), MOEXFN (1.56%) and GAZP (0.78%), which are pollution-intensive industries except the financial sector. The analysis of the opposite spillover direction indicates that the green bond market sends the spillover effect to the following capital market indexes: MOEXEU (1.07%), RUABITR (0.84%), MOEXMM (0.51%) and GAZP (0.25%). The net spillover effects indicate that green bonds in the Russian capital market were good instruments for hedging between two macroeconomic shocks, which is in line with the existing literature about emerging capital markets [1; 33].

The period after the outbreak of the conflict between Russia and Ukraine had changed the structure of the internal capital market. In the short-term, the Russian capital market has been characterized by high volatility and uncertainty, and massive outflow of capital. For example, in the first few weeks after February 24, 2022, the RTS Index went down by approximately 50% compared with January 2022 values (https://www.moex.com/en/index/RTSI). The empirical results show that the return volatility spillover changed its trajectory and structure during the onset of the cancel culture. The total connectedness index went up from 49.61 to 64.58% (Table 3). The first implication of this tectonic geopolitical change indicates that the macroeconomic shock is much higher than during the COVID-19 pandemic, which is also supported by R. Karkowska and S. Urjasz [3]. Moreover, the isolation of the Russian economy and Russian capital market through cancel culture has led to the dominance of certain sectors of activity over others through the spillover effects. For example, before the outbreak of the conflict MOEXMM and MOEXFN were net receivers and MOEXOG had very little spillover implications, while after the start of the conflict, the following indexes turned to be net positive and strong return spillover transmitters: MOEXMM (6.99%), MOEXFN (11,41%) and MOEXOG (24.54%).

Table 3. Detailed static connectedness between assets in 2022–2023, %

	RUGBI	RUABITR	MOEXEU	MOEXMM	MOEXCH	MOEXFN	MOEXOG	MOEXIT	GAZP	MRSV	FROM
RUGBI	93.62	0.87	0.74	1.08	1.11	0.39	0.78	0.46	0.08	0.85	6.38
RUABITR	0.28	48.04	11.09	7.13	0.63	7.14	9.12	4.76	1.75	10.06	51.96

	RUGBI	RUABITR	MOEXEU	MOEXMM	MOEXCH	MOEXFN	MOEXOG	MOEXIT	GAZP	MRSV	FROM
MOEXEU	0.16	5.26	22.07	12.34	3.1	12.6	13.99	8.43	5.61	16.44	77.93
MOEXMM	0.22	3.49	12.16	22.23	3.44	12.06	14.07	8.98	4.72	18.63	77.77
MOEXCH	1.32	1.95	6.65	6.69	45.46	7.31	10.64	6.96	2.99	10.04	54.54
MOEXFN	0.1	3.16	11.86	11.71	3.37	22.44	14.22	11.73	5.61	15.79	77.56
MOEXOG	0.18	4.35	12.09	12.31	4.59	13.06	19.62	9.06	7.64	17.1	80.38
MOEXIT	0.2	2.55	9.73	10.63	3.71	14.07	12.02	26.93	6.14	14	73.07
GAZP	0.02	1.34	8.69	7.73	2.7	9.1	14.16	8.12	35.54	12.61	64.46
MRSV	0.17	4.08	13.25	15.15	4.02	13.24	15.91	9.64	6.36	18.2	81.8
TO	2.65	27.05	86.26	84.76	26.65	88.97	104.92	68.15	40.9	115.52	645.84
NET	−3.73	−24.9	8.34	6.99	−27.89	11.41	24.54	−4.91	−23.56	33.72	64.58

Comparing with the period before the conflict, the return volatility spillover of the Russian green bond market after the outbreak of the conflict was reduced, thus it received only 6.38% from the other assets and transmitted only 2.65% of the spillover effects to the other assets. These aspects indicate the green bond market turned out to be a good instrument for hedging [e.g., 16] during the macroeconomic shock instigated by the Russia-Ukraine conflict and cancel culture. Thus, the green bond market receives the spillover effects mainly from the MOEXCH (1.11%), MOEXMM (1.08%), MOEXEU (0.74%), MOEXOG (0.78%) for pollution-intensive industries, which validates Hypothesis 1. The GB index sends the spillover effects consistently to the MOEXCH (1.32%), and to a much smaller extent - to the MOEXMM (0.22%), MOEXOG (0.18%) and MOEXIT (0.20%). The results also indicate that RUGBI receives return spillover volatility from the ESG index of 0.85% and sends only 0.17%, thus supporting Hypothesis 2, which states that it is highly correlated. Additionally, it was found that these results are in line with the existing literature about the spillover effects of green bonds in emerging countries during macroeconomic shocks, which indicates that the Russian GB market also creates good premises for hedging and portfolio management. When comparing the volatility spillover of GB with that of other assets from the analysis, we see that the top 3 least volatile assets are RUGBI, RUABITR, MOEXCH and GAZP. This supports the idea that, despite Russia's striving to adhere to the sustainable development model, pollution-intensive businesses are still dominant, which is typical for an oil exporting country.

The total spillover index across the entire sample period (2021–2023), which is equal to 62.26%, is specific to those capital market conditions that persist during macroeconomic shocks, which is the case for both Russia and Western countries. The empirical results reveal that the green bond market index receives the spillover effects from MOEXEU (0.78%), MOEXMM (1.25%), MOEXOG (0.64%) and MRSV (0.68%) and send them only to MOEXMM and MOEXCH. Even though both internal and external markets were affected by the cancel culture against Russian Federation, the green bond market shows a certain stability, which validates the main idea that, as for other economies, it is a reliable and stable hedging and portfolio management instrument.

By analyzing the static spillover effects between the Russian green bond market and other indexes that reflect both pollution-intensive and non-pollution-intensive businesses, we can conclude that Russian green bonds market was less volatile and turned to be a good instrument for hedging against macroeconomic shocks and climate risks. This aspect indicates that even though Russian economy is struggling with sanctions and cancel culture, it continues its movement towards achieving the sustainable development goals and climate targets. Moreover, the results send strong signals to the regulators that the Russian green bond market is effective and needs further regulatory assistance to strengthen its future development.

Dynamics spillover effects

Static connectedness analysis between the green bonds and other capital market indexes reveals volatility spillover over a certain period, which is a limitation of this method. To address this drawback in the research, we employed rolling-window analysis to delve deeper into the analysis of the connectedness between assets, which changes over time, especially during tectonic macroeconomic shifts. For this reason, the D&Y method was used to analyze the dynamic volatility spillover for the entire period to identify the exact timing of the changes in the assets' connectedness, because we used the calendar timing split in the static spillover representation. Following the existing literature, we used a 100-day rolling window with a horizon forecast period of 100 days. Figure 1 shows the dynamics of the to-

tal connectedness index for 2021–2023, thus indicating a more accurate representation of the return volatility spillover before and after the outbreak of the conflict between Russia and Ukraine.

Static analysis of the 2021–2023 period produces a total connectedness index of 62.26%, which indicates high spillover effects between green bonds and other capital market assets, but relevant information is still missing. A detailed analysis of the dynamic connectedness index indicates that the maximum connectedness between assets has been achieved not at the start of the conflict or immediately after, but in December 2022, when it reached the value of 90%. The main argument for this dynamic is that the capital market needed some time to absorb the new realities and adjust correspondingly. Moreover, we witnessed a decrease of the total connectedness index in mid-2023 (e.g., it reached about 51%), which reveals more stable capital market conditions compared with 2022 in the new era of cancel culture for Russian economy. Thus, Hypothesis 4 is validated, indicating that connectedness between green bonds and other capital market assets is time-varying and requires special attention from investors and policymakers. The importance of the dynamic net spillover analysis has two important implications: first, investors should adjust the hedging strategy and portfolio management structure more often during macroeconomic shocks as the capital market conditions change more dynamically. Second, policymakers should revise and update the existing regulatory framework to make the market more agile and resilient to the new macroeconomic context determined by the cancel culture market state.

Figure 1. Dynamic Total Connectedness Index, 2021–2023

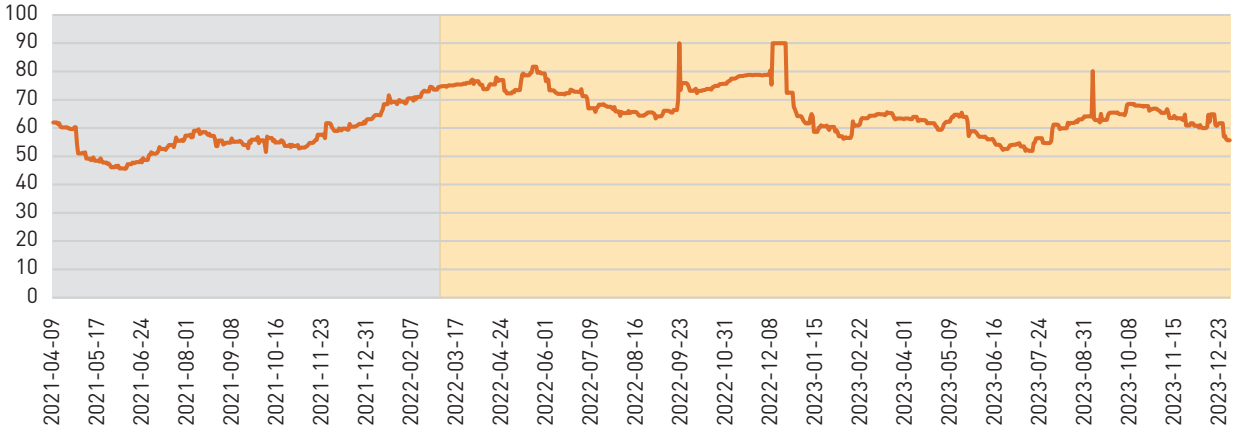
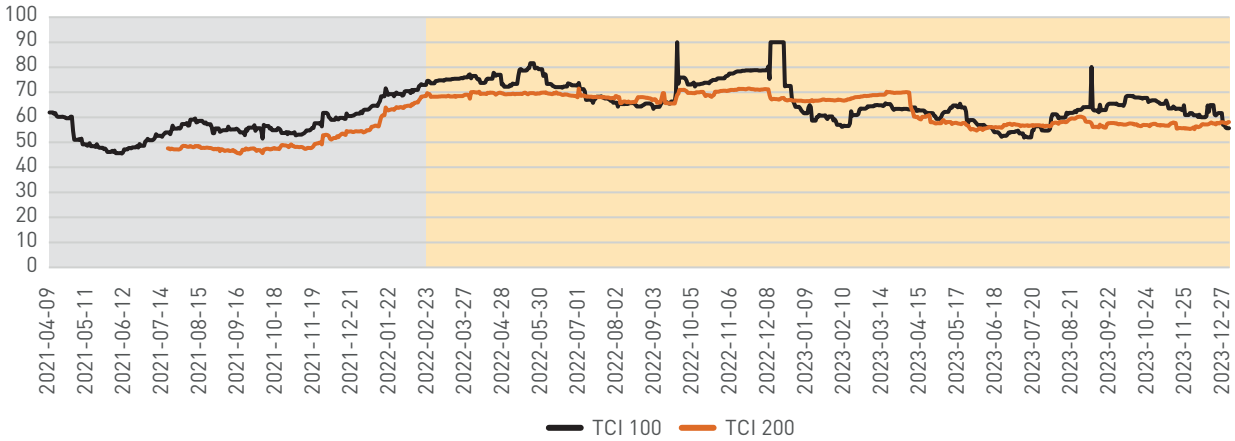


Figure 2. Dynamic TCI calculated using the D&Y method with rolling windows (100, and 200 days)



Robustness check

To assess the robustness of the results, it will be necessary to validate the dynamic net spillover since it contains more information about the market's responsiveness to macroeconomic shocks as it is time-varying. For this reason, the method proposed by W. Jiang et al. [1] is used. As in the calculation and representation of the dynamic spillover index, 100 days were used as the parameter for varying rolling windows, while for robustness check purposes we extend this period to 200 days. The main reason is to test the pattern of the total connectedness index compared to the one calculated by using the 100-day rolling windows because the volatility spillover is sensitive to the changes in the analyzed period. Figure 2 illustrates robustness analysis, and as is apparent, even though two different rolling windows were used, the dynamics of the total connectedness index does not change significantly and maintains its trend across the analyzed period. Additionally, both rolling windows' representations capture the moment of the outbreak of the military conflict and the stabilization of the TCI in 2023, when the Russian economy stabilized under the new cancel culture conditions. An extended analysis illustrated in Ta-

ble 4 indicated the minimum, maximum, and average TCI values for different rolling time windows in each period. Small differences are shown between different times periods, indicating that the obtained results are robust.

Table 4. Dynamics of the Total Connectedness Index across different rolling windows

	Min	Max	Average	Median	SD
TCI 100	46	90	64	63	8.87
TCI 200	45	71	61	61	7.88

Hedging and portfolio management

The analysis of the interconnectedness between green bonds and other Russian capital market indexes implies subsequent actions for hedging and optimal portfolio management decisions. For these reasons investors and asset managers will utilize the information provided by the analysis of asset spillover between green bonds and pollution-intensive industries to construct optimal portfolio weights and hedging strategies to minimize the risks and maximize portfolio returns as proposed by G. Markowitz (1952), while internalizing sustainability drivers. Besides the cancel culture that tectonically changed the structure of the Russian economy, the risk of climate change persists, therefore Russian Federation should continue its engagement in international programs with climate targets. Moreover, in the context of economic and political sanctions, the country should continue its adherence and participation to the international initiative for sustainable development and climate change, in order to not allow Russia to lose its competitiveness through sustainability. Thus, to reveal the contribution of the newly designed Russian Green Bond index for climate risk mitigation and designing portfolio weights, a bivariate portfolio was constructed as illustrated in Tables 5 and 6.

Methodologically, the analysis shows the relationships between the hedging ratio, portfolio weights and hedging effectiveness across all 3 examined periods for each RUGBI pair.

Table 5 illustrates the values of hedging ratios and corresponding hedging effectiveness for the sample period 2021–2023, the period before and after the outbreak of the geopolitical conflict. During the sample period, the hedging ratio varies between 9.9 and 32.8, which means that for a $1 long position in green bonds, the index equates a cost that varies between 10 and 33 cents in a short position of paired assets. In our research we invoke bivariate portfolio analysis from Panel B, when green bonds are equated to a long position. Even though the hedging effectiveness is low, it is statistically significant at 1%, indicating that the portfolio ratio effectively reflects its usability. The 3% hedging effectiveness that is statistically significant at 1% was identified showing paired indexes with the Russian green bond index: MOEXEE, MOEXFN, MOEXMM, MRSV that ultimately seems to be a good combination for hedging. A rough analysis of the hedging ratio in each sub-period shows that before the conflict the Russian green bond market was not supposed to be efficient for hedging, but the situation changed significantly after the eruption of the conflict. Thus, with a hedging effectiveness that varies between 5 and 7% and is statistically significant at 1%, both pollution-intensive and non-pollution-intensive industries turned to be effective for hedging: MOEXEU, MOEXFN, MOEXIT, MOEXMM, MOEXOG, MRSV.

Table 5. Optimal hedging ratio (HR) and hedging effectiveness (HE) index

Pair indexs	2021–2023 HR	2021–2023 HE	2021 HR	2021 HE	2022–2023 HR	2022–2023 HE
Panel A						
GAZP/RUGBI	0.0057	−0.01	0.0000	0.00	0.0097	−0.02
MOEXCH/RUGBI	0.0144	−0.07	0.0030	0.00	0.0298	−0.09
MOEXEU/RUGBI	0.0240	0.11	0.0840	−0.09	0.0255	0.12
MOEXFN/RUGBI	0.0247	0.09	−0.0031	0.00	0.0365	0.10
MOEXIT/RUGBI	0.0126	0.03	−0.0110	−0.02	0.0244	0.01
MOEXMM/RUGBI	0.0325	0.04	0.1040	−0.20	0.0278	0.04
MOEXOG/RUGBI	0.0188	0.05	−0.0248	0.00	0.0408	0.05
MRSV/RUGBI	0.0284	0.06	0.0246	−0.02	0.0347	0.07
RUABITR/RUGBI	0.3998	0.20	−0.0024	0.00	0.6857	0.22

Pair indexs	2021–2023 HR	2021–2023 HE	2021 HR	2021 HE	2022–2023 HR	2022–2023 HE
Panel B						
RUGBI/GAZP	0.3004	0.00	−0.0005	0.00***	0.3908	0.01
RUGBI/MOEXCH	0.0999	−0.02***	0.0093	0.00**	0.1668	−0.01***
RUGBI/MOEXEU	0.1718	0.03***	0.0524	0.01***	0.2694	0.05***
RUGBI/MOEXFN	0.2233	0.03***	−0.0082	0.00***	0.3172	0.06***
RUGBI/MOEXIT	0.3280	0.02***	−0.0349	0.00**	0.5099	0.07***
RUGBI/MOEXMM	0.1976	0.03***	0.0812	0.00***	0.2068	0.05***
RUGBI/MOEXOG	0.1583	0.02***	−0.0296	0.00***	0.3120	0.05***
RUGBI/MRSV	0.1911	0.03***	0.0214	0.00***	0.2717	0.06***
RUGBI/RUABITR	0.1175	−0.03***	−0.0003	0.00	0.1871	−0.17***

*** p<0.01, ** p<0.05, * p<0.1.

Note: Panel B displays the hedging position of RUGBI paired with each of the analyzed assets. This configuration involves taking a $1 long position in RUGBI and simultaneously establishing a short position in another asset with a corresponding value in USD. Panel A illustrates the converse scenario, depicting the hedging of a $1 long position for each asset, paired with a short position in RUGBI with a corresponding value in USD.

The empirical analysis shows that the reverse direction of the hedging methodology, where the Russian green bond market is supposed to be in a short position paired with other assets in a long position, is not efficient due to the low parameter value for the hedging ratio and being statistically non-significant.

Continuing the analysis that derives from the calculation of the level of connectedness between green bonds and other capital market assets, we should determine portfolio weights and the corresponding hedging effectiveness of the Russian green bond market paired with other indexes. Table 6 illustrates the results of the analysis for all periods in question. The portfolio weights are empirically studied using the bivariate relationship analysis. The results reveal that the Russian green bond market plays an important role in the construction of optimal portfolio weights in both short and long positions in a bivariate relationship with the analyzed assets for the entire period, as well as separately for 2021 and 2022–2023. As it can be seen, the hedging effectiveness parameter is high and is statistically at 1% for almost all the pairs, but the level of effectiveness changes across different periods. Thus, MOEXMM, MOEXCH and MOEXFN were found to be good, paired assets for optimal portfolio weights for all 3 periods, while oil and gas and the sustainability index were a good option for optimal portfolio weights in connection with the Russian green bond index only in 2021 and the entire sample period.

Table 6. Optimal portfolio weights (PW) and hedging effectiveness (HE) index

Index pair	2021–2023 PW	2021–2023 HE	2021 PW	2021 HE	2022–2023 PW	2022–2023 HE
Panel A						
RUGBI/RUABITR	0.29	0.67*	0.21	0.94***	0.25	0.51
RUGBI/MOEXEU	0.77	0.61***	0.50	0.72	0.87	0.47***
RUGBI/MOEXMM	0.75	0.55***	0.55	0.70***	0.82	0.41***
RUGBI/MOEXCH	0.74	0.62***	0.60	0.66***	0.79	0.53***
RUGBI/MOEXFN	0.77	0.58***	0.64	0.63***	0.84	0.47***
RUGBI/MOEXOG	0.75	0.54***	0.60	0.67***	0.83	0.33***

Index pair	2021–2023 PW	2021–2023 HE	2021 PW	2021 HE	2022–2023 PW	2022–2023 HE
RUGBI/MOEXIT	0.84	0.47***	0.73	0.50***	0.91	0.27***
RUGBI/GAZP	0.90	0.43***	0.83	0.31***	0.94	0.46***
RUGBI/MRSV	0.74	0.57***	0.51	0.74***	0.83	0.40***
Panel B						
RUABITR/RUGBI	0.71	0.12***	0.79	–0.39***	0.75	0.06***
MOEXEU/RUGBI	0.23	0.84***	0.50	0.10***	0.13	0.85***
MOEXMM/RUGBI	0.25	0.68***	0.45	0.29***	0.18	0.68***
MOEXCH/RUGBI	0.26	0.76***	0.40	0.32***	0.21	0.78***
MOEXFN/RUGBI	0.23	0.81***	0.36	0.49***	0.16	0.83***
MOEXOG/RUGBI	0.25	0.76***	0.40	0.42***	0.17	0.74***
MOEXIT/RUGBI	0.16	0.90***	0.27	0.60***	0.09	0.90***
GAZP/RUGBI	0.10	0.93***	0.17	0.75***	0.06	0.95***
MRSV/RUGBI	0.26	0.75***	0.49	0.26***	0.17	0.75***

*** p<0.01, ** p<0.05, * p<0.1.

Note: Panel A displays the hedging position of RUGBI paired with each of the analyzed assets. This configuration involves taking a $1 long position in RUGBI and simultaneously establishing a short position in another asset with a corresponding value in USD. Panel B illustrates the converse scenario, depicting the hedging of a $1 long position for each asset, paired with a short position in RUGBI with a corresponding value in USD.

Panel B from Table 6 illustrates the reverse relationship between RUGBI and other MOEX indexes. Thus, for a $1 long position in pollution-intensive indexes and a short RUGBI position that is equivalent in USD dollars, it is demonstrated that for almost all the indexes the short position in US dollar equivalent is lower than $1, varying between 0.1 and 0.71 cents, while the hedging effectiveness is statistically significant and varies between 12 and 93%. For this reason the optimal portfolio weight strengthened after the outbreak of the conflict. Moreover, only GAZP and MOEXIT show higher value parameters across all the periods. After the conflict started, the highest (e.g., above 80%) hedging effectiveness was demonstrated by the MOEXEU, MOEXFN, MOEXIT and GAZP.

To conclude, the RUGBI should be included in a hedging strategy and portfolio management, but tailored to specific macroeconomic conditions in a prudent manner. This is because the analyzed period was characterized by instabilities marked by the post-COVID-19 pandemic period of economic recovery and the outbreak of the military conflict between Russia and Ukraine that triggered another macroeconomic shock. It offered the optimal hedging strategy to include energy, financial, materials and mining and sustainability indexes. In terms of optimal portfolio weights, RUGBI can be combined with almost every capital market asset, but asset managers and investors should be careful to change the investment strategy every time when the economy goes through instabilities periods.

Conclusions

The cancel culture against Russian economy emerged after the outbreak of the military conflict with Ukraine and transformed the national economy and its capital market into the "new normal" state, signifying turbulence with direct impact on its anticipated national sustainable development targets. This conflict created a macroeconomic shock to the global economy that still persists, having changed the climate agenda for many nations, especially because of the energy crisis that has intensified. Given the importance of the new normal and the impact of cancel culture for the Russian economy, there has been a surge in research of spillover effects in the emerging financial markets, especially in reference to green bonds as the key driver in promoting sustainable development. The paper intends to reveal the return spillover effect between the Russian green bond market and other capital market indexes, both pollution and non-pollution intensive, before and after the outbreak of the military conflict. To capture the dynamics of the Russian green bond market, a synthetic index is

introduced, leveraging the F. Diebold and K. Yilmaz [4] model to investigate the conditional mean connectedness between the Russian green bond index and leading capital market indexes.

The subsequent implications of the spillover analysis during macroeconomic shocks refer to the investors' and asset managers' decisions for asset hedging and determining optimal portfolio structures.

First it was discovered that the level of connectedness between the Russian green bond index pollution intensive assets was still high in the post-COVID-19 pandemic period (e.g., 2021), indicating that this category of sustainable finance was a good instrument for mitigating climate risks. The green bond index was the net receiver of the spillover effects compared with the other assets, which apparently provided a good option for hedging, especially important for Electricity and Utility, Oil and Gas, Chemicals and Materials, and Mining sectors. Additionally, it was found that the level of connectedness of the green bond index and Sustainability Vector Index is low, indicating that the ESG index is not a good option for constructing a hedging strategy, which is contrary to the existing literature. The level of connectedness between green bonds and the ESG asset is increasing after the outbreak, thus being the only assets where the return volatility spillover is rising, which makes the asset a good option for hedging.

After the military conflict started, the level of connectedness between green bonds and Russian leading capital market indexes increased, indicating that the Russian capital market reacted to the new normal determined by the cancel culture. The Russian green bond index still remains a return volatility spillover receiver in relation to the high-pollution capacity indexes, which creates good prerequisites for hedging and building an optimal asset portfolio structure. These findings are strengthened by the hedging ratio and portfolio weight analysis. In this research, the DCC-GARCH was employed together with the methods developed by K. Kroner and V. Ng [27] and L. Ederington [28] to find the best bivariate asset combination with the Russian green bond index across different time periods. Thus, it was found that the optimal hedging ratio is obtained for a $1 long position in RUGBI and a short position in the leading capital market indexes with high pollution impact (e.g., Oil and Gas, Mineral and Mining etc.). Even though hedging effectiveness is low, the values are statistically significant at 1%, therefore, it is best to include the RUGBI in the hedging strategy after the outbreak of the conflict (e.g., 2022–2023). In regard to the optimal portfolio weights between RUGBI and other capital market assets, asset bivariate analysis indicates that green bonds play an important role in constructing the optimal structure to maximize the return and minimize the costs. Thus, the conclusion is supported by the high value of hedging effectiveness, which is also statistically significant.

The research has some limitations. First the representativeness of the Russian green bond market reflected in the synthetic index is still low because of the low number of green bond issuances marketed in 2021–2023. Second, for some green bonds low liquidity might affect the correctness of the level of volatility of the Russian green bond market, which may also ultimately affect the spillover effects on the assets. Further analysis is still required in this regard.

This study has several implications. First, the volatility spillover direction between RUGBI and leading Russian capital market indexes can help investors and asset managers to expand their portfolio management decisions and hedging strategies to Moscow Stock Exchange. This aspect will support the subsequent development of the Russian green bond market that will accelerate the transition of the Russian economy towards a sustainable development model. Second, policymakers can draw valuable insights for designing or consolidating the sustainable finance regulatory frameworks. Russian policy-related factors might support some strategic sustainable development projects, stimulating the production of a renewable energy system, supportive policies for conventional energy sources, and the financialization of energy markets.

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Appendix 1. Description of capital markets indexes and variables

Group of Indexes	Index ID	Index Name	Description
Financial	RUABITR	Aggregate bond index	MOEX Aggregate Bond Index is a broad-based benchmark that measures the performance of the entire Russian bond market. It consists of most liquid Russian government bonds (OFZ), municipal, subfederal and corporporate bonds with duration more than 1 year
Pollution – Energy	MOEXEU	Electric Utilities	The sector capitalization-weighted indices calculated based on prices of the most liquid shares of Russian issuers admitted to trading in PJSC-MOEX
Pollution – NonEnergy	MOEXMM	Metals & Mining	
Pollution – NonEnergy	MOEXCH	Chemicals	
Financial	MOEXFN	Financials	
Pollution – Energy	MOEXOG	Oil&Gas	
Other	MOEXIT	IT	
Pollution – Energy	GAZP	Gazprom	The share price of the company with the highest market capitalization on the MOEX
ESG	MRSV	Sustainability Vector Index	The ESG index with calculation base including shares of companies, which show the best dynamics of indicators in the field of sustainable development and corporate social responsibility. The index was awarded the UNCTAD ISAR HONOURS-2019 award

Source: Moscow Exchange.

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Characteristics and Development Trends of the Digital Assets Segment in Modern Practice in Russia and Abroad

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Abstract

The paper aims to identify the key trends and risks associated with the introduction and spread of digital assets, including the digital ruble, in the Russian financial market. This study is timely due to the rapid growth of market capitalization for digital financial assets based on blockchain technology in both international and Russian financial markets, as more and more countries prepare to launch their own national digital currencies. However, there is a dearth of information in scientific and practical literature regarding the prospects, challenges, and risks associated with introducing digital financial assets, including the digital ruble, into Russia. The data for the analysis included official statistics and analytics from the Bank of Russia and central banks of countries considering introducing digital national currencies. It also included the content of key Russian legislative acts related to digital currencies, as well as examples of the implementation of digital financial assets from Russian and international practices. The main research methods employed were a systematic approach, analysis of fundamental theoretical propositions in the literature, and case analysis. The paper discusses the existing types of digital financial assets, both internationally and in Russia, and assesses the demand for these assets in the Russian capital market, as well as their potential for lending to small and medium-sized businesses. It also considers the most common problems associated with the development of this segment and possible solutions, including regulatory measures. The second part of the paper explores the prospects and challenges of introducing a digital ruble into the Russian financial system. It assesses the potential impact of this new currency on the stability of domestic banks and monetary conditions in Russia, including inflation. Future research could focus on quantifying a wide range of risks associated with the introduction of digital financial assets, as well as modelling supply and demand for these assets.

Keywords: digital assets, digital financial assets, digital finance, blockchain technology, cryptocurrency, cryptocurrency market, digital currencies, digital ruble, national cryptocurrencies

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Introduction

The academic research of the chosen topic is relevant because of the currently ongoing transformation of the global economic and financial system prompted by technological development, with the latest information and communications technologies advancing the improvement of the financial instruments segment. The emergence of blockchain technology, which provides an opportunity to create digital tokens and cryptocurrencies by means of "smart contracts," stands out from the main areas of the transformation process aimed at shaping a new financial asset market. Cryptocurrencies, in their turn, lay the groundwork for the development of the digital assets segment in modern practice in Russia and abroad.

This is the reason why the purpose of this scientific paper is to define the development potential of digital financial assets (DFA) and central bank digital currencies (CBDC) taking into consideration interests of all participants of financial relationships: government, commercial banks, business and population. It is vital to note that this transformation process is not as simple as it seems and involves solving demanding tasks, including the creation of a regulatory environment for government regulation of digital assets in international and Russian practice, as well as development of digital assets segment in the modern era.

Based on the aims of this academic paper, the following hypotheses are set forth:

1) The Russian digital currency segment is at a stage of rapid development and significantly outperforms the majority of its international counterparts.
2) The demand for and supply of the digital ruble on the financial market may be insignificant unless the Central Bank implements provisional regulatory measures.
3) The supply of and demand for digital financial assets will be ensured mainly by means of short-term (under a year) financing and cost savings in the small and medium-sized entrepreneurship segment.

In order to achieve the purpose in view, the following tasks should be solved:

- consider the economic essence and types of digital assets;
- analyze the characteristics of blockchain technology and the significance of the cryptocurrency market as determinants of digital assets' development in modern practice;
- define the level of digital asset regulation in Russia, which allowed to form the foundation for the emergence of digital financial assets and implementation of the digital ruble concept;
- analyze the institutional framework and fundamental factors in the need in government regulation of digital assets in international practice;
- define the current issues of development of the digital assets segment in modern practice of Russia and foreign countries.

Digital assets are the object of academic research, while the trends and development potential of the digital assets segment, including digital financial assets and digital currencies of central banks, are the subject of the research.

Literature Review

The study of the range of issues related to development of the digital assets segment in modern practice in Russia and abroad is a practical novelty because it has been understudied. Numerous papers by Russian and foreign scholars study the impact of digital technologies on finance and banking, and this is the research object of economic science. However, there are still problem areas that require an answer to the question of how implementation of the national cryptocurrency concept can influence the state of the economy and financial system and that of their subjects. The reason for this is that the digital assets segment started developing just a short while ago and became especially popular in the 2020s.

The best-known papers by such authors as I. Hutton, T. Mosset, T. Shurr, P. Andersen, Y. Guseva, E.V. Rozhkov, A.V. Shchavelev, V.V. Polyakova, L.V. Tokun etc. studied the special features of formation and development of the digital financial asset market from the viewpoint of performance of money functions by these assets and of the need for currency regulation. Numerous experts assume that the emergence of digital financial assets and cryptocurrencies is a new stage in the development of the currency system where conventional monetary units will be replaced with digital tokens and cryptocurrencies. However, the problem with such substitution of the functions performed by money and currencies while the digital assets segment is developing lies in their inability to become a full-fledged payment instrument today. The efficiency of the Bitcoin cryptocurrency network, where it takes over an hour on average to transfer funds confirms this problem. Usually, when there are no targeted regulation attempts to regulate securities or DFA, commodities fail unless there is a government regulator's forced centralized intervention.

Studies by W. Fokri, N. Kshetri, C. Watters, T. Ankenbrand, V.I. Abramov, K.Y. Semenov, A.V. Turbanov etc. are dedicated to development of the digital assets segment in contemporary Russia and across the globe by implementing the digital currency concept. Since 2019 the Bank of Russia had far-reaching plans because their implementation would have taken the country's currency and financial systems to a new level. Besides, the People's Bank of China had been aggressively developing the national cryptocurrency concept and the case of its use during the Winter Olympic Games should have spurred the development of the digital ruble. However, in actual practice the situation is different, and up to this day experts continue serious polemics about the potential effect of the launch of digital currencies. Many people assume that threats and risks outweigh the prospective benefits. Due to legislative restrictions for a series of investor groups the demand for such assets may be below anticipated, and different jurisdictions will impede the instrument's efficient scaling up.

Other researchers such as M. Henderson, E. Trotz, C. Wronka, A.S. Obukhova, N.P. Kazarenkova, V.V. Akinfiev, Yu.K. Tsaregradskaya etc. consider the development of the digital assets segment from the viewpoint of banking. In their opinion, the emergence of digital financial instruments and cryptocurrencies is necessary to improve the operations of banks, which thereby integrate with the fintech sector. This characteristic is correct because commercial banks are the first economic actors that demonstrate interest in the development of digital assets. However, apart from the organizational and financial difficulties related to the need to integrate such instruments and invest in and implement projects, the issues of statutory regulation of digital financial assets are still undeveloped, taking into account the special situation related to money laundering and DFA's potential in terms of minimizing such risks.

Van Adrichem, M. Alshater, Di Matteo, A.V. Dolmatov, E.A. Dolmatov, A.O. Buryakova etc. studied the theoretical and methodological aspects of organizing the system of statutory regulation of the digital financial asset market, where the key role is assigned to the government and activity of such authorities as central banks. They believe that the central bank is the authority that should be responsible for the implementation of legislative projects intended to create the instruments of government regulation of this financial system segment. Some researchers first and foremost consider the turnover of such assets a factor that threatens the sovereignty and information security of countries without proper regulation by the Central Bank.

In spite of the results obtained in the above studies we may conclude that this problem is understudied, thus, it is relevant in modern practice. First of all, they are relevant is due to its novelty. Although the practical relevance of study of the digital assets segment's aspects is high in contemporary Russia, a lot of issues are still undeveloped.

Economic Essence and Types of Digital Assets

In Russian and international practice, various types of digital assets emerge with increasing frequency. They enhance the practical relevance of government regulation of alternative finance. It is an anticipated transformation process characterized by the need to adapt financial relations, instruments, technologies and markets to the digital economy concept [1].

The main form of digital assets in the modern financial markets is cryptocurrency which presents the lion's share of market capitalization and the architecture of global and Russian finance. Digital securities are the most important form of digital assets in financial markets. The following features are related to defining the objects of digital rights are characteristic of such securities [2]:

- monetary claims;
- the right to participate in equity of a private joint-stock company;
- the option to exercise the right of emissive securities.

Digital securities may be divided into several types on the basis of defining their digital rights. There is a range of digital rights that cannot be attributed to digital financial assets. They comprise [3]:

- the right to participate in the equity of a public joint-stock company;
- the right to participate in a limited liability company;
- the right to participate in other business entities.

In classifying digital assets it is necessary to mention the following criteria that distinguish them from each other [4]:

1) issuer criterion (government, collective and private digital assets);
2) centralization status (centralized and decentralized digital assets);
3) backing by tangible assets (secured and unsecured assets);
4) embeddedness in blockchain (embedded and non-embedded digital assets).

By their nature, digital assets can occupy an important place in the real sector of economy, providing opportunities to attract external financing when projects are implemented, to develop innovative solutions or improve infrastructural facilities. It is feasible that digital financial assets will become an important payment instrument optimizing organizations' and individuals' costs for payment transactions [5].

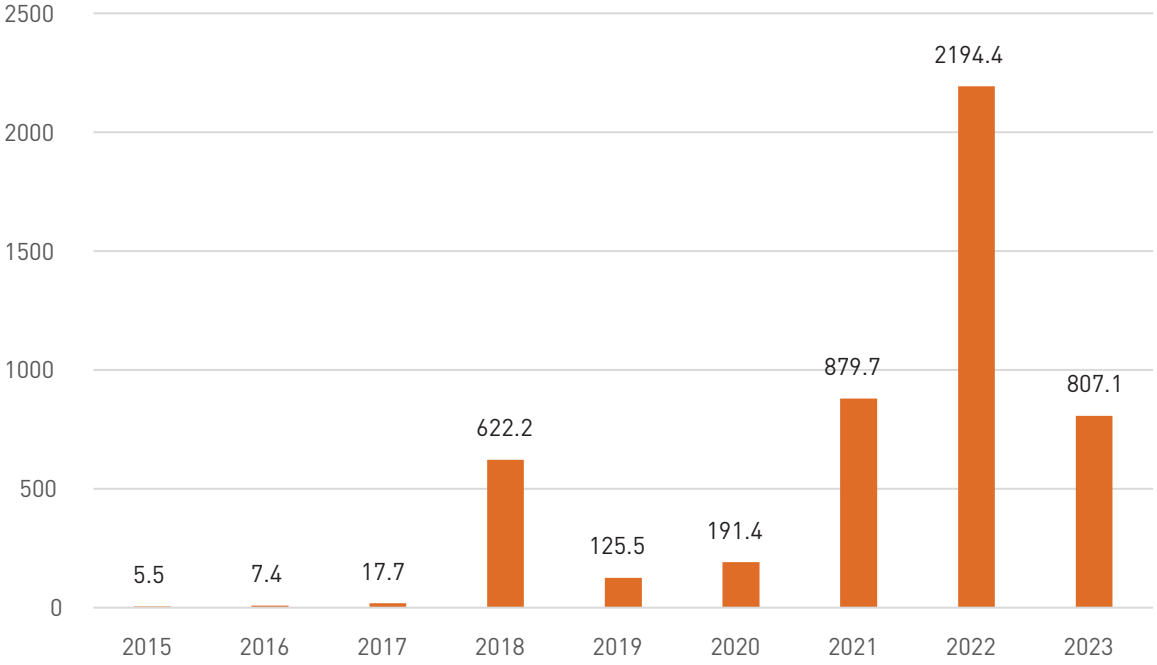
Blockchain Technology and the Cryptocurrency Market as Determinants of Digital Asset Development

Such key factors as changes in the direction of the Central Bank monetary policy and changes in the macroeconomic environment influence the prospects of development of the Russian financial market in present-day conditions. However, we should emphasize the influence of DFA on efficiency of the Russian market and technological development where the emergence of alternative finance, e.g., cryptocurrencies and digital financial instruments provides new prospects for the development of the securities market. Apart from that, new products for private investment and trading are created. They make investment in securities more popular among Russian citizens [6].

Cryptocurrencies are innovative instruments of the digital economy era. They emerged due to modern technologies and the needs of economic entities and parties to financial relations. They have grown enormously in popularity because new industries are evolving, businesses are switching over to platform ecosystems and a new segment of financial markets is being created [7].

The general trend for market capitalization change under conditions of digital asset development confirms the increasing importance of the cryptocurrency market (Figure 1).

Figure 1. Dynamics of changes in market capitalization of the cryptocurrency market, in USD



Source: [8].

Figure 2. Technical analysis of the Bitcoin cryptocurrency

Source: [9].

Thus, from 2015 to 2023 the cryptocurrency market capitalization increased from USD 5.5 billion to USD 807.1 billion. Besides, the maximum market capitalization at the beginning of the year was achieved in 2022. It amounted to the record USD 2.194 trillion. In 2023, a downtrend was observed in the cryptocurrency market, which resulted in return to the values of 2021. This notwithstanding, the forecasts of financial analysts and investment bankers point to the fact that in 2024 the growth of market capitalization of the cryptocurrency market may be revived, and an approval of ETF (exchange-traded funds) holding Bitcoin and Ethereum as their assets would be the main catalyst.

The price for the world's main cryptocurrency – Bitcoin – is the key trigger in navigating changes in the capitalization of the cryptocurrency market. Figure 2 presents a technical analysis of the cryptocurrency taking into consideration its actual price as at September 2023.

The current market price of the Bitcoin cryptocurrency is USD 26 500, while the maximum price by the end of 2021 exceeded USD 69 000. The downtrend of Bitcoin quotes in 2022 was replaced with a sideways trend in 2023 between two horizontal support (USD 15 600) and resistance (USD 31 000) lines.

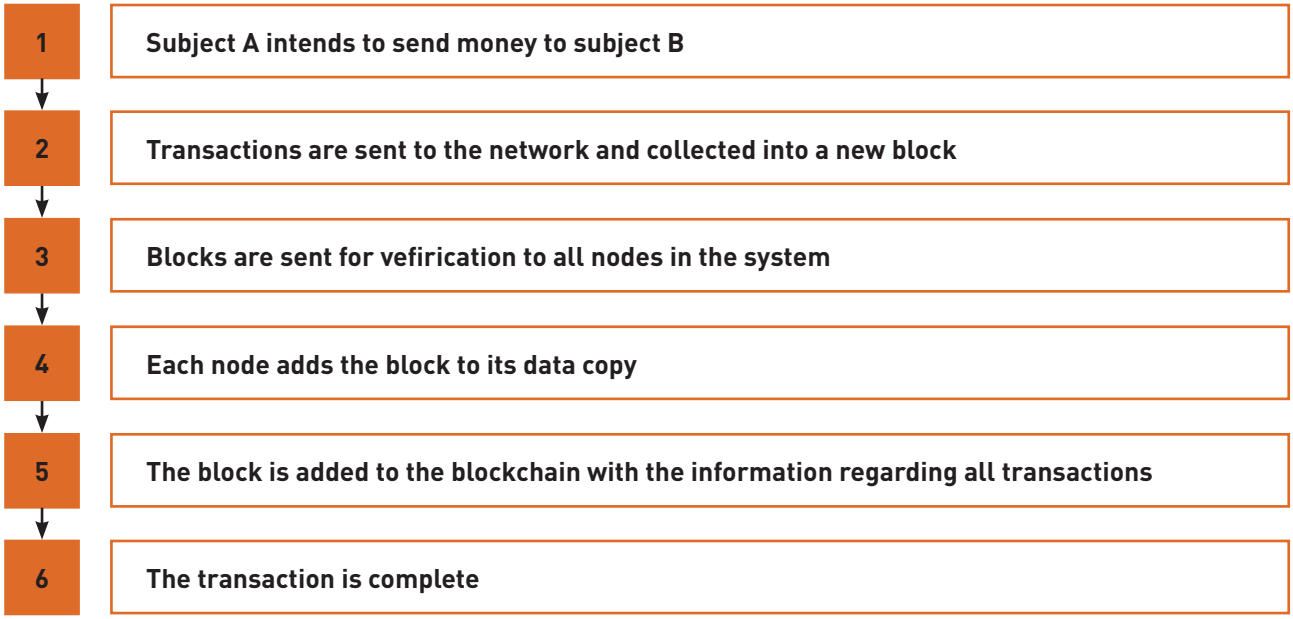
Cryptocurrency is the most important financial asset of the future, however, an expansion of its role in the development of the digital assets segment in modern Russian and foreign practice requires a time-consuming transformation process, which may be divided into the following stages [10]:

- establishing a regulatory framework to regulate and legalize financial and payment transactions using cryptocurrency;
- implementation of the national cryptocurrency concept and introducing digital national monetary units by central banks;
- establishing taxation to make cryptocurrency an object of tax relationships.

In our opinion, the development of alternative financial instruments will exert a positive impact on the efficiency of the Russian financial market because Russia has a competitive edge in the development of digital financial technologies that enhance the investment attractiveness of its markets and financial system, including the securities market. The uptrend of the Russian stock market capitalization and an increase in market quotations for securities in 2023, including the largest issuers' shares, take place because the market is becoming autonomous from global financial markets. First of all, it is possible due to a successful implementation of the import substitution policy in the country's economy.

However, the development of digital assets would have been impossible without emergence, distribution, implementation and development of a financial technology like blockchain. Blockchain is a multifunctional and multilevel information technology generally designed for the reliable accounting of various assets and transactions [11]. The operation diagram of blockchain technology is represented in Figure 3.

Figure 3. Blockchain technology operation diagram



Business entities gain the following advantages from the practical implementation and use of blockchain technology [12]:

- no backend system, thus, costs are optimized and the server operations are decentralized;
- transparency of financial transactions and business operations not subject to change;
- unlimited number of records which may be added to blocks;
- high data reliability – in order to add data one has to get approval of all nodes;
- flexibility of application (from financial transactions and payments to data registration, setting up real estate transactions, etc.).

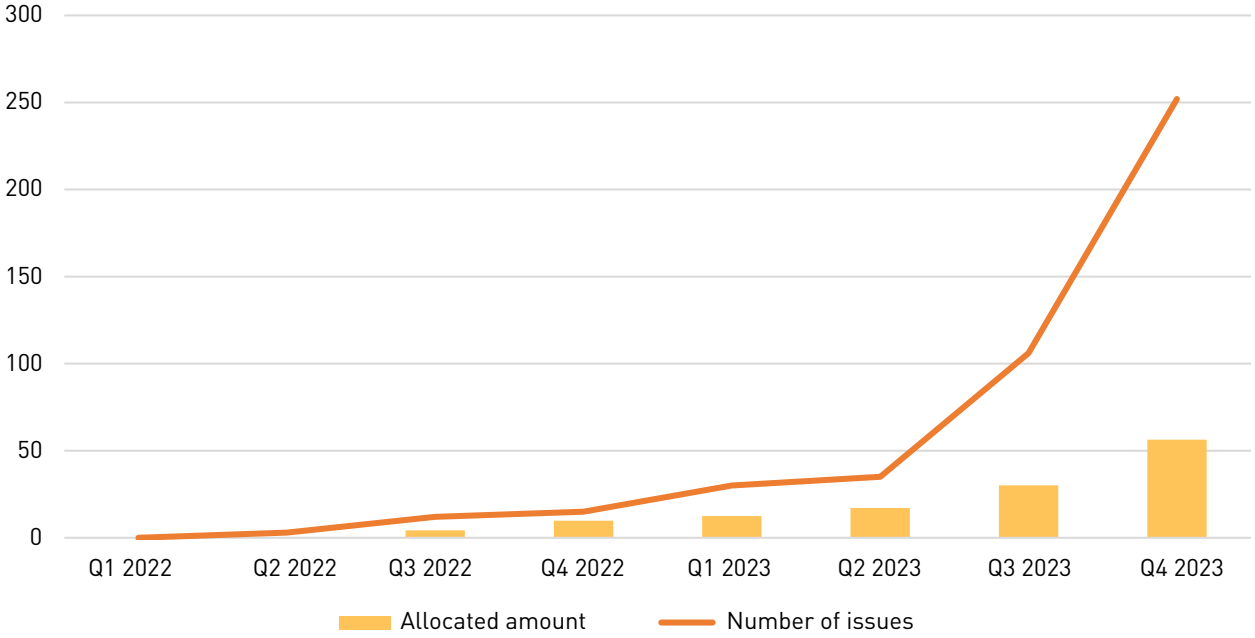
Besides, based on the literature review, the following trends are observed in the cryptocurrency market [13]:

- ongoing transition from monopolization of sectors to competitive development;
- growing predictability of the earning power of cryptocurrency transactions due to a reduction in market liquidity;
- confirmation of the hypothesis that digital currencies are a replacement for fiat money grows less likely;
- increasing role of cryptocurrency as wealth storage instead of just an instrument of financial speculation;
- rapid development of decentralized finance platforms (DeFi);
- growing share of institutional investors in the cryptocurrency market.

A lot of factors confirm that the digital financial asset segment is developing rapidly in Russian and foreign practice. New payment systems are introduced, cryptocurrencies are integrated into financial transactions of large corporations and banks, new services and cryptocurrency storage facilities are offered, the geography of digital assets use is expanding, thus attracting increasing amounts of cash and capital to this industry. Such trends lead us to the conclusion that digital assets play an essential role in the modern system of financial relations [14].

Assessment of offer and demand for DFA provides an additional confirmation of this conclusion. In general, the DFA market, notwithstanding the active growth phase, is at its initial stage of development. The total amount of issued DFA in Russia in 2022–2023 was approximately the equivalent of RUB 3 billion. They mostly represent test transactions involving selected investors (Figure 4).

Figure 4. Number of cumulative DFA issues and the amount of liabilities (RUB, bn.)



The potential for DFA development, as noted above, will depend on the demand for a new type of asset. Based on the present situation in the financing market, opportunities and limitations of the new instrument, one may assume that the prospective medium-term demand will range from RUB 1 trillion to RUB 3 trillion. The lack of interoperability between the platforms and absence of the secondary DFA market will likely impede the increase of this threshold. Table 1 presents the prospective demand of each investor category.

Table 1. Forecasting the DFA demand

Type	Prerequisites	Prospective demand
Banks	It is assumed that the composition of DFA holders will be similar to the existing structure of funding providers. With a deep involvement of platform operators in the financing process (at the moment only five largest banks show such demand), a conservative flow of funds from bonds and loans up to a year may occur	Up to 5% of investments in bonds and credits up to a year
Financial institutions	Insurance companies, non-governmental pension funds and other institutional investors account for approximately one-fourth of the market. However, in accordance with the legislation in force, their DFA investments are restricted, consequently, we do not assess their contribution to the demand. Nevertheless, if the access to the market becomes available, a conservative flow of funds from investments to corporate bonds may occur	Up to 5% of investments in corporate bonds
Retail investors	It is assumed that retail investors will be able to invest in DFA, but with a shift towards short-term instruments. According to surveys a flow of funds from their brokerage accounts is possible	Up to 5% of the brokerage deposits

Source: compiled by the author.

It is thought that the cost of issue of a conventional exchange-traded bond ranges from RUB 11 million to RUB 23 million and is comprised of:

- underwriter's commission and arrangements for placement – 75–90%;
- stock exchange fee – 1–3%;
- depository commission – 1–3%;
- cost of rating – 2–20%;
- cost of marketing and information disclosure – 20%.

In spite of an average 5–7% commission of the DFA platform operator, the cost of raising debt financing will be significantly lower in aggregate, and one may presume that due to high costs of exchange-traded bonds issue, especially up to RUB 1 billion, market participants will respond to the offer of a new instrument with a limited access to the funding market.

Along with the further development of the market, the overall amount of offer may reach RUB 5 trillion. It is important to emphasize that SME will most probably make such an offer to attract this type of financing (Table 2).

Table 2. Projected supply for DFA

Type	Prerequisites	Prospective demand
SME	The DFA market affords entities access to new investors due to the simplicity and rapidness of the issue placement. This access has been previously unavailable, unlike conventional forms of financing. At the same time, the sale of this amount will depend on the level of infrastructure development and regulator's requirement	Based on expert estimates, SME may account for over 80% of the offer
Large companies	In case of the companies with access to the debt financing market, DFA may be a convenient alternative to the conventional short-term financing due to rapid placement and lower expenses for the issue, but only in case of availability of competitive funding costs	Over a long-term horizon up to 5% in the financing structure or approximately 20% of the prospective market

Source: compiled by the author.

As the market develops further, one may assume that DFA will grow primarily due to simple existing types of instruments, but in the future a new complex strategy, securitization products and products for trading in the securities market may emerge.

Defining the Level of Digital Asset Regulation in Russia: Emergence of Digital Financial Assets and Implementation of the Digital Ruble Concept

Russia is one of the countries involved in formation of the statutory and regulatory infrastructure of the digital financial asset market. Thus, new article 141.1 was introduced in the Civil Code of the Russian Federation which entrenches the category of "digital rights" as an object of civil law. They are understood as liability and other rights, the content and terms of execution of which are determined in accordance with the rules of the information system that corresponds to the attributes established by law [15; 16].

Federal Law No. 259-FZ of 31.07.2020 "On Digital Financial Assets, Digital Currency and on Amendments to Certain Legislative Acts of the Russian Federation" entrenched the transactions related to digital financial assets and digital currency at the legislative level. The well-known mining (cryptocurrency mining) and digital transactions may serve as examples of such transactions. This was the exact date when a rapid development of alternative finance and digital financial assets started not just in international practice, but in Russia as well [17].

The law lays down general rules governing the circulation of digital financial assets, including their emission and exchange. A lot of attention is heeded to the issues of organizing the work of operators of information systems where digital financial assets are issued and that of DFA exchange operators [18].

The legislative drafting activities of the Government of the Russian Federation aimed at preparation of the regulatory environment for the regulation of digital financial assets in Russia began on March 20, 2018 when State Duma deputies submitted for consideration a draft legislation that introduced the definition of the concepts related to digital assets, digital finance and rights. In 2020 it was especially necessary because digitalization of the national and international economic and financial systems accelerated, inasmuch as the COVID-19 pandemic caused an increase in the share of financial transactions carried out by means of non-cash payments and digital cash [19].

As of March 2024, only 13 countries, including Russia, are at the stage of piloting and implementation of digital assets, 14 countries are at the stage of discussing the concept, and the rest are only investigating the opportunities. We can make a conclusion that Russia and some other emerging countries are the global leaders in the development of financial sector digitalization.

The level of DFA awareness is growing in society. In 2023 the number of mentions of digital assets increased by 37%,

although in most cases such growth is caused by newsworthy events and is accidental [20].

The main stage in the development of the digital financial asset segment in modern Russian practice is the creation of a national cryptocurrency as a part of implementation of the digital ruble concept.

The digital ruble is money issued by the Bank of Russia in digital form available to a wide range of users. From the economic point of view, the key innovation in the emission of the digital ruble is the expansion of the direct access of economic agents to the liabilities of the Central Bank of the Russian Federation instead of issuing a new form of money [20].

On August 2023, Federal Law of 24.07.2023 No. 340-FZ "On Amendments to Certain Legislative Enactments of the Russian Federation" entered into force. It is the basic law that entrenches the legal rules for introduction of the digital ruble in Russia, which is the third form of national currency. The law outlines the basic concepts of digital currency and related transactions, the relationship between the platform operator, participants and users.

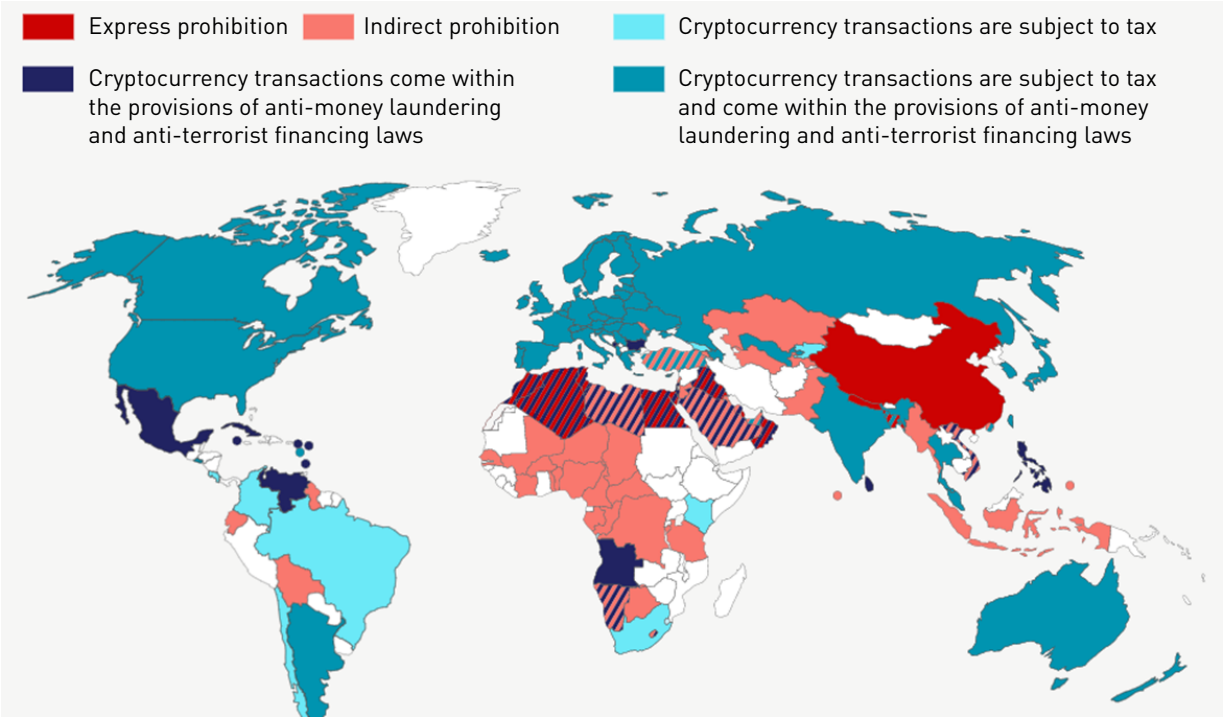
It is important to emphasize that the awareness of the ruble's new form has increased significantly lately. Overall, 70% of Russian citizens are informed in one way or another about the introduction of the digital ruble, but just one in two people understands the purpose of its implementation [20].

From the point of view of attractiveness of digital ruble use, a poor grasp of its purposes is aggravated by the reluctance to attempt to use a cash equivalent. Just 30% of Russian citizens are interested in the new payment instrument and the amount of assets they are ready to transfer to the third form of money on average does not exceed RUB 20 thousand.

Institutional Foundations and Fundamental Factors of the Necessity in Government Regulation of Digital Assets in International Practice

In analyzing the development of government regulation of digital financial assets in contemporary international practice, we should study Figure 5, which presents a map of government regulation of cryptocurrencies.

Figure 5. Map of state regulation of the cryptocurrency market



Source: [21].

Financial and economic relationships between entities in the field of digital financial assets should be regulated.

The following factors facilitate it [1; 22; 23]:

1) Rapid development of the cryptocurrency market, which makes digital tokens and currencies taxable because their turnover causes budget revenue loss. This risk is often noted and emphasized both due to internal competition between various institutions and due to different approaches to regulation in various countries [12; 15; 22].
2) Use of digital tokens and currencies as a collection tool in case of bankruptcy of an individual person or a legal entity which is a debtor. As of now in Russia there is no judicial practice and no approaches to bankruptcy.

3) Use of digital tokens and currencies as a payment instrument of legal entities when they pay for the services of suppliers, contractors, as well as wages to employees, and as a payment method for the population when they pay for goods and services in retail and the hospitality industry. Nevertheless, there is an unresolved issue related to integrating cross-country systems. Some researchers think that digital assets in the world practice should be considered equivalent to conventional forms of money [19; 22; 24].

Prospects for the development of digital financial assets depend on the degree of cryptocurrency market regulation by state authorities. There are several factors explaining the need for government regulation of digital assets and finance [25–27]:

1) The cryptocurrency market holds an ever-growing share in the structure of the global financial market. but some of the above-mentioned advantages may also act as disadvantages. For example, the technological risk is currently mitigated by means of dual accounting both on the operator platform and in blockchain.
2) Private and institutional investors operate in the cryptocurrency market. Nevertheless, at present a restricted number of market participants have access to the digital asset market, while the secondary market is prohibited, thus significantly decreasing the attractiveness and accessibility of the instrument for investors.
3) Regulation of cryptocurrencies will ensure the information and financial security of assets and funds, as well as assist in avoiding mispricing. Due to high information fragmentation and low market liquidity, asset prices may demonstrate more volatility, making it impossible to pledge them.
4) It is necessary to create a foundation for cryptocurrency taxation. The novelty of the instrument and different approaches of regulators to classification lead to additional costs for investors, such as those related to accounting and tax treatment of instruments. Additional legal risks may arise between jurisdictions. For example, the European Central Bank warns investors against conflicts related to digital assets in different jurisdictions.

Current Issues of Development of the Digital Assets Segment in Contemporary Practice in Russia and Abroad

In regulators' opinion, the uncontrolled development of digital financial assets and currencies may cause the following risks and threats:

1) Financial fraud resulting in stealing funds from cryptocurrency market participants. Due to the imperfection of statutory regulation of digital finance by governments, financial swindlers have the opportunity to establish pyramid schemes attracting people's funds, deceiving them and never returning the invested capital. This problem is also complex because these criminals found offshore shell companies, thus complicating domestic investigation by law enforcement authorities and regulators aimed at pursuit of such criminals.
2) Terrorism and extremist activity funding. Taking into consideration that in the 2020s geopolitical and global instability caused an intensification of extremism and terrorist activities, the law enforcement authorities are mainly focused on prevention of financing of illegal organizations by means of transferring funds in the form of cryptocurrency.
3) Illegal tax evasion and evasion of tax liabilities. Digital financial assets may be used for tax evasion by means of performing financial transactions, transfer of funds or payments using cryptocurrency networks instead of conventional banking market instruments. It is difficult to trace the initial and incoming subjects of such transactions because tax administration system bodies have not yet focused on verifying all such transactions.
4) Damage to traditional financial relationships between economic entities. This is the least serious threat posed by the development of digital assets, however, there is a risk that a lot of traditional relationships between financial counterparties will be broken. This may result in a series of liquidations of financial institutions, including commercial banks. The banks that fail to implement these innovations may be potential bankrupts.

Apart from that, there is a range of negative characteristics that emerge when digital financial assets are used in a real case scenario [28]:

- a threat of cyberattacks on crypto wallets, which result in loss of funds by users;
- risk of informal economy growth;
- risk of creating decentralized currency systems not subject to centralized control;
- loss of jobs by the population due to digitalization of financial business processes.

In order to eliminate and offset such risks, it is necessary to introduce systemic preventive measures that are based on strict financial discipline and high qualification of all participants of transactions with digital financial assets. This is possible in case of complete government regulation of the digital financial asset segment [29].

Prospects for Development of Digital Currencies of Central Banks Taking into Consideration the Interests of All Participants of Financial Relations: Government, Commercial Banks, Business and the Population

The present development stage of financial and economic relations is so unique in terms of the characteristics of its transformations that a relevant question arises: what is the future form of money? In our opinion, this enables us to define the prospects for the development of digital currencies by central banks with regard to the interests of all parties to financial relations [30].

There are two most likely development scenarios [31]:

1) The first scenario entails the preservation of the classical form of money. In this case, non-cash funds will dominate over cash (which is due to the rapid development of the e-commerce sector in the global economy).
2) The second scenario implies a transition of numerous forms of money into cryptocurrency. This will be due to people's as well as central banks' desire to use digital tokens, and central banks will issue national monetary units in the form of digital currencies. In Russia, for example, the concept of the digital ruble already exists. Its implementation may lead to dramatic changes in the country's monetary market.

In our opinion, the future of cryptocurrencies depends on the tasks that the countries aim to solve. If they are interested in a system of statutory regulation of the industry, their strategy will ensure a continued integration of digital currencies and cryptocurrencies into economic life of the population, businesses and financial companies; this will be a positive trend in the stimulation of digital transformation of the economy and finance. So, it means that money will progressively shift from the traditional form to cryptocurrency. However, people as well as businesses will have the freedom to choose the most convenient form of money (cash, non-cash, cryptocurrencies, etc.).

The digital ruble has the potential to influence economic transactions and financial payments of such entities as the government, commercial banks, businesses and citizens.

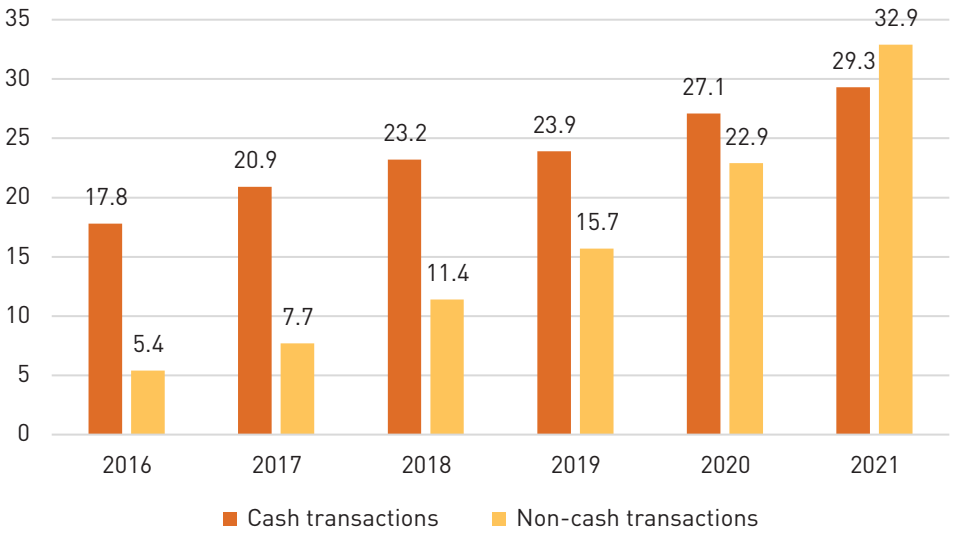
The digital ruble creates opportunities for the population to improve the infrastructure of remote channels and payment service providers, which ensure high speed of financial transactions, low transaction commissions and costs as well as convenient conversion into traditional fiat money for the people [32].

The digital ruble may offer a cheaper and faster way of funds transfer to the population. Unnecessary intermediaries such as banking institutions are excluded from the chain of the payment infrastructure. However, this advantage may raise doubts because conventional financial institutions now provide alternative methods of funds transfer. They are more reliable and cost-effective than the cryptocurrencies we know [33].

For businesses, the emergence of the digital ruble and digital financial assets implies an increase in the share of non-cash payments in the economy, which makes financial transactions and payments cheaper and quicker. Besides, the emission of the digital ruble may result in an increase in liquidity of the Russian monetary market. This is the reason why interest rates will decrease, thus expanding enterprises' access to commercial lending products [6; 34].

Moreover, there is currently a steep increase in the share of non-cash payments in Russia. Thus, according to the data for 2021, it is the first time when non-cash transactions exceeded cash transactions – RUB 32.9 trillion against RUB 29.3 trillion, respectively (Figure 6).

Figure 6. Dynamics of cash and non-cash payment transactions, in trillion rubles



Source: [35].

The digital ruble may make all the difference in the development of innovative forms of entrepreneurship, i.e., startups. In particular, the availability of the digital ruble provides additional opportunities for raising investment capital. This is due to the fact that the digital ruble may be integrated into crowdfunding platforms [36].

The efficiency of the digital ruble technology application in the system of financial transactions for financial corporations of the Russian economy resides in the following [24; 37]:

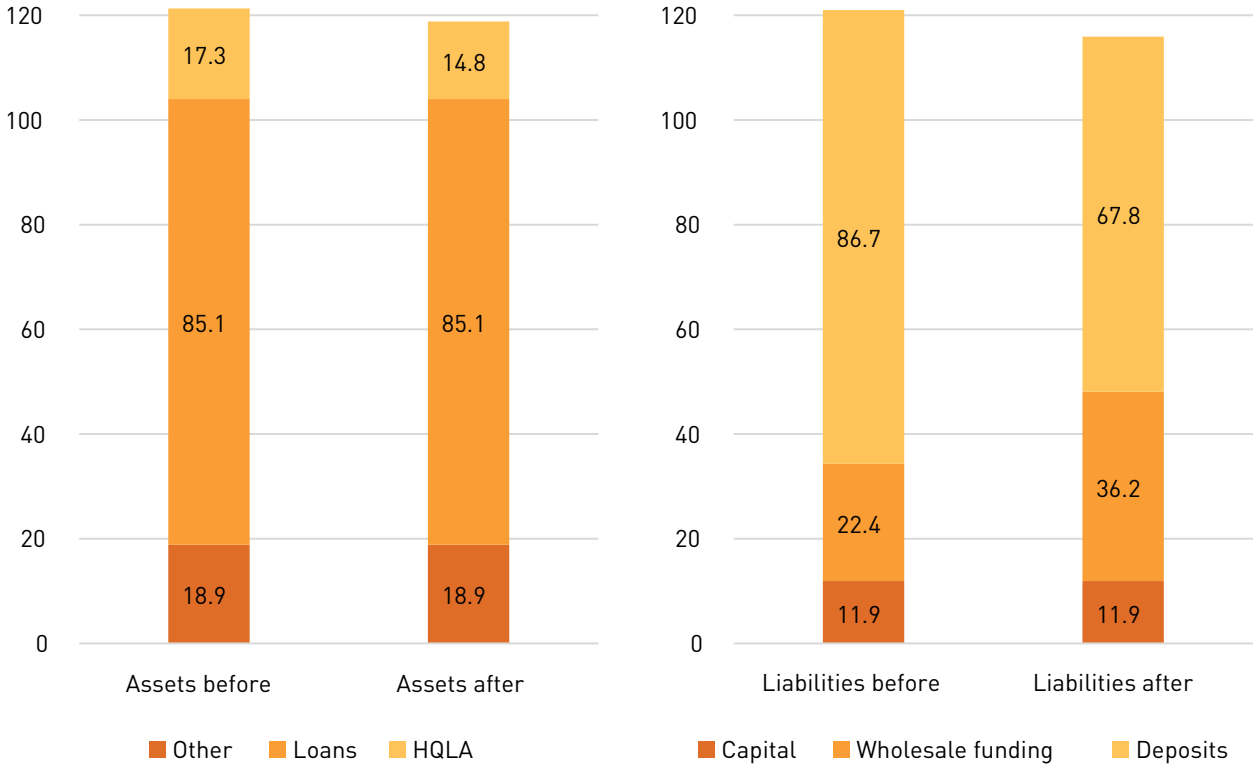
- an increase in the share of non-cash payments;
- ensuring usability, high transaction speed, and settlements without surrogates for the users;
- an increase in cash liquidity of the credit market, thus, a decrease in interest rates

We may also note the following aspects of the digital ruble's influence on digitalization of commercial banks in Russia [38]:

- impact on the procedure of customer service improvement in banks;
- influence on creation of new competitive advantages of a bank;
- facilitating the creation of new banking products, expanding and diversifying the banking business risks, reducing the share of lending, as well as clearing and settlement when earning revenues and profit for organizations.

Analyzing threats posed to business by the development of the digital ruble and financial assets we may note that there aren't any. This is due to the still insufficient use of national cryptocurrencies throughout the world. The highest risks of the digital ruble exist for financial companies – commercial banks, which may face additional competition from the banking regulator when providing funds to economic entities and the population, as well as a liquidity shortage estimated by some researchers as the most significant risk [39]. We made an attempt to assess how exactly the digital ruble will impact the balance sheet of a commercial bank. The transfer of a part of assets to a new form of money causes changes in the funding structure. The share of deposits will decrease, while the share of funding by the government, banks and institutional investors will grow. This type of funding has a higher rate and is more expensive, but a smaller amount of high-quality liquid assets will be necessary to meet the LCR requirements than in case of deposits [36]. Due to an increase in the cost of funding, under otherwise equal conditions, the net interest margin and return on equity decrease, hence, banks raise loan interest rates (Figure 7). In case of the scenario of Russian commercial banks, the deposits outflow may be up to 15%.

Figure 7. Dynamics of commercial banks' balance sheet in the Russian Federation, RUB trillion



Source: [20].

With introduction of digital currency, the rate of return on deposits is believed to grow and the cost of the gains is transferred to the credit market because banks are already unable to draw profit from the deposit market; instead, they hold a monopoly in the credit market, i.e., an exogenous change in the value – profitability of deposits – is also reflected in the price.

On the other hand, we believe that the digital ruble concept may afford golden opportunities to the government due to improvement of financial and tax policy since:

- a legal national cryptocurrency is created, which will be secured by solid assets;
- revenues from digital ruble transactions will replenish the budget;
- it will be easy to impose taxes on transactions with digital financial assets.

At the same time, the emergence of the digital ruble may be considered a significant factor that will influence the terms of the government financial policy. In particular, this is due to the fact that the introduction of the digital ruble will trigger dramatic changes in calculating the money stock in the country's economy.

A growth in money stock in the country's economy will result in an increase in inflation risks. As a result, the Bank of Russia will be forced to make decisions aimed to tighten the monetary policy. As a consequence, a reverse increase in interest rates and deceleration of economic growth will take place (GDP).

Thus, the digital ruble and other digital financial assets provide opportunities and at the same time pose threats for various actors (government, business and citizens) when they pursue their interests. However, positive prospects mainly outweigh risks. Thus, it is necessary to develop a new financial system where Russia occupies an important place in the overall global architecture of digital financial assets and cryptocurrencies. The main threat that the Russian economy may face is the destabilization of the monetary market where an increase in liquidity and money stock will take place.

Conclusion

Thus, in summarizing our academic research, we may speak of the following results: the segment of digital financial assets in contemporary practice in Russia and abroad is at the stage of rapid development caused by the adoption of statutory and regulatory rules that govern the operation of this market. This is an anticipated stage of evolutionary development, which opens the prospects for rapid scaling up and geographic expansion. The emergence of digital financial assets revealed a range of problems and threats related to applying modern technologies in finance. However, due to an active involvement of government authorities and management, they are mitigated, sometimes by way of preventive measures, which contributes to the creation of comfortable conditions for all the participants of the digital financial asset market.

Verification of the hypotheses set forth in the introduction section revealed the following: Russia is one of the leading countries in the development of digital assets; the share of non-cash transactions is increasing; analysis of the prospective market and expressed interest are indicative of the stage of rapid growth in the development of this segment. The demand for and offer of the digital ruble will probably not arouse market interest because there are value-added alternatives. Ultimately, the success of th elaunch of digital currency by the Central Bank will depend the on users' attitude to it. This attitude, in turn, will depend on adoption of digital assets as a payment method with added value which improves the existing alternatives (bank cards and cash). If it turns out that such benefits are smaller than the risks or do not exist, the efforts of implementing the CBDC may not lead to the achievement of the set goals. However, if the initiative expands beyond the pilot stage, the Central Bank will most likely apply all available instruments to attain success. In particular, government transfers under the influence of the government or the Central Bank will be used to provide widespread acceptance, partially phasing out other payment instruments and tools of valuables' safekeeping. Besides, the demand and offer for digital financial assets will be mainly insignificant and secured to a great extent by means of short-term lending within the SME segment. Such assets will not be in demand with the companies that have no need for debt funding. It should be noted that at the present stage of DFA development it is reasonable to issue short-term liabilities by means of cost reduction as compared to conventional instruments. It is assumed that development of the DFA market will additionally reduce the cost of financing by providing access to the market for retail investors and establishing a connection between the end investor and beneficiary, and, ultimately, this will influence the corporate balance sheet.

From this point of view, key avenues for future research may be the risks and influence of digital assets on commercial banks and households, as well as modeling of the demand for these assets on the basis of probable scenarios that may be offered by the Central Bank and calculations of reducing the cost of companies' short-term financing.

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The Impact of Disclosing Digitalization Information on Corporate Financial Performance

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Abstract

The purpose of the present study is to assess the relationship between digitalization disclosure indicators and market capitalization in the Russian market, including during the COVID-19 pandemic. The research methodology includes text analysis to evaluate various components of digital transformation (business model transformation, process transformation, domain transformation, organization transformation) and digitalization. The model was assessed using panel regression and machine learning methods. The empirical basis of the study included financial indicators of 70 Russian companies and annual reports for 2017–2021. The main results are: 1) wider disclosure of information about digitalization in the annual reports of Russian companies increased company market capitalization; 2) the transformation of processes and organizations was highly significant for Russian companies; 3) the COVID-19 pandemic accelerated digitalization and led to a partial catch-up in the level of digitalization among less advanced companies. The results of this study can be used by investors and company management to develop more competent and comprehensive digital policies.

Keywords: companies, digitalization, digital transformation, investment attractiveness, signaling theory, text analysis, random forest

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Introduction

Digitalization has grown into a global phenomenon that impacts the operations of companies across various business sectors. With the implementation of digital technologies and the upgrading of business models, increasing attention is being paid to the disclosure of information on digitalization efforts. Such disclosure provides information about initiatives, strategies, and processes related to the implementation of digital technologies in company reports intended for investors and other stakeholders [1]. Many well-known consulting companies analyze the influence of digital transformation on financial performance. For example, research by McKinsey & Company has revealed that companies implementing digital transformation have the potential to boost their profits by up to 26%[1].

In the Russian domestic market, companies recognize that digitalization is crucial for gaining a competitive advantage, enhancing operating performance, and improving customer service [2; 3]. However, the influence of digitalization disclosure on the financial performance of Russian companies remains an understudied area of research. Additionally, Russia is an emerging market, and the importance of disclosing such information may differ significantly from other markets where similar research has been conducted [4–6]. This makes the topic of our study particularly relevant. Therefore, our research purpose is to evaluate the relationship between the indicators of digitalization disclosure and market capitalization in the Russian market, including during the COVID-19 pandemic.

Several theoretical studies have explored the surge in digital activity during lockdowns and restrictions, including the period of the recent coronavirus pandemic [7–9]. However, no such studies have been conducted for the Russian market. Our study compares the impact of digitalization disclosure before and after the COVID-19 pandemic, a period during which many companies transitioned to remote work and implemented new digital tools. Additionally, this paper contributes to corporate finance theories related to digital transformation within the framework of signaling theory [10]. It applies textual analysis methods using dictionaries to obtain digitalization disclosure indices. Variable significance is calculated using panel regression and random forest models, which represent a nonlinear machine learning approach.

Literature Review

Theoretical Concepts

Digitalization has become an important driver of change across various industries. Companies' declarations about achievements in high technology and digitalization processes demonstrate their development prospects and strategies, thereby reducing uncertainty. Signaling theory helps alleviate information asymmetry between a company and its primary stakeholders, such as investors and customers [10]. Essentially, the company acts as a "signaler," while third parties – such as banks, competitors, and customers – serve as "receivers." A company can send positive signals to third parties by sharing information about new products, improved business practices, or more efficient operating processes [11]. This establishes an effective relationship between economic operators and provides insight into the company's current operations and long-term prospects.

Digitalization is a fundamental stage of corporate development, involving the implementation of various digital technologies in business processes. Today, some companies go further by reorganizing their business processes, which also leads to digital transformation. This major trend extends beyond the mere digitalization of specific processes. Companies undertaking digital transformation are often perceived by investors as promising and forward-looking. These companies can demonstrate their financial soundness by allocating resources to upgrade their operations. By signaling innovations and digital transformation to investors, these companies enhance the likelihood of expanding their market share and increasing future profits [12].

Research Hypotheses

In view of the matters considered above, we raise the following research questions: How does digitalization disclosure influence corporate financial performance in Russia? Additionally, which components of digital transformation have the greatest impact, especially during the COVID-19 pandemic?

The primary motivations for companies undertaking digital transformation include enhancing operating performance, improving service quality, and reducing expenditures. Companies leveraging digital technologies often exhibit significant potential for development, characterized by their ability to expand in existing markets and enter new ones. Management in these companies is equipped to make better and more informed decisions, utilizing scientific advancements, patents, novel technologies, and the expertise of market leaders [13].

Such companies are strongly committed to strategic management, which enhances the attainability of long-term goals. Innovations in artificial intelligence and automation can have a substantial impact on corporate financial performance. Some authors assert that digital technologies can boost productivity, create new business models, and disrupt traditional markets, thereby influencing income growth, profitability, and shareholder value [14].

Moreover, several papers have explored the relationship between a company's digitalization disclosure and its financial performance. Some of them focused on sustainable development methods that can enhance corporate financial performance, particularly for digital companies [5]. Advanced technology-enabled enterprises that dis-

[1] McKinsey&Company. (2018). Digital transformation: Improving the odds of success. URL: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-transformation-improving-the-odds-of-success

close information about their digital resources often serve as catalysts for innovation-driven development within the national economy. Similar results were found by E.R. Baiburina and E.G. Grebtsova [15], who examined the impact of a company's intellectual capital on its value.

This suggests that digital transformation does impact corporate market capitalization, which leads to our first hypothesis:

H1: *A company's digitalization has a positive effect on its market capitalization.*

Business process transformation is essential to fully capitalize on the benefits of digital transformation. Therefore, companies must evaluate the specific opportunities presented by digital technologies to determine their ideal digital transformation strategy. Digital transformation extends beyond mere digitalization by establishing a data-driven organization, leveraging digital platforms and creating new revenue streams through data-driven services[2].

Many companies, comprising over half of the empirical base, dedicate separate chapters in their annual reports to information about their digital transformation efforts. However, annual reports aren't the sole source of information. For instance, D. Libaers et al. [16] employ web page parsing to analyze the business models of small, highly innovative US companies. Some authors also examine innovations and digitalization through the lens of business model disclosure in annual reports [16; 17].

Digital transformation makes a key contribution to the strategic growth of businesses by implementing and integrating advanced technologies. It involves process automation, innovative product development, operation optimization, and the enhancement of digital user interactions. This continuous process allows businesses to implement changes incrementally and evolve consistently over time.

While transitioning business processes online presents opportunities for efficiency enhancements, it also introduces challenges. According to the McKinsey Global Institute, digital transformation encompasses four essential components[3]:

1) Business model transformation.
2) Process transformation.
3) Domain transformation.
4) Organization transformation.

Business model transformation involves reinterpreting and changing fundamental business strategies, models, and operations. Process transformation aims at re-engineering and optimizing current business processes to fully leverage the potential of digital technologies. Domain transformation moves business operations to the cloud. Lastly, Organization transformation focuses on evolving the organization's culture, structure, and opportunities to foster a digital mindset.

Currently, Russia lags behind digital transformation leaders like the USA, China, South Korea, and Germany, but it is rapidly accelerating its development [18]. Each transformation brings significant changes to organizations. Therefore, when investors evaluate the prospects of digital transformations, they can potentially assess both positive and negative consequences while considering uncertainties. For instance, the outcomes of organizational transformation are typically more uncertain compared to those of production process transformation. As a result, different types of transformation may influence investors' evaluations of organizational transformation in varying ways.

H2: *Individual components of digital transformation and digitalization influence the market capitalization of Russian companies in different ways.*

The COVID-19 pandemic significantly accelerated the use of digital platforms worldwide [8]. This ongoing crisis has also provided an opportunity to expedite the digital transformation of financial intermediation, compelling companies and organizations to adapt and potentially overhaul their business models [7]. However, while the pandemic prompted swift digital transformations among many companies, it also brought forth numerous challenges. According to research by V. Klein and J. Todesco [9], medium-sized businesses faced heightened vulnerability due to insufficient financial resources and expertise.

During the COVID-19 pandemic, process and organization transformation, pivotal components of digital transformation, assumed heightened significance. Digital technologies facilitate transformative changes, prompting shifts in economic paradigms. As a consequence of the pandemic, many organizations swiftly adapted to remote work and established corresponding organizational structures, necessitating substantial efforts to transform processes [19]. The conversion of workplaces also gained greater importance post-COVID-19, with increased discussions on the continued utilization of established processes and digital tools. Investors and managers recognized the profound importance of digital transformation and its promising prospects.

H3: *The influence of individual components of digital transformation and digitalization grew during the COVID-19 crisis.*

Data and Research Methodology

Description of the Research Sample

Our study sources data from several official channels, including annual reports, sustainable development reports accessed from corporate websites, and databases such as Smart-Lab[4] and the National Register of Corporate Non-Financial Reporting[5].

[2] The 4 Tiers of Digital Transformation. URL: https://hbr.org/2021/09/the-4-tiers-of-digital-transformation

[3] The 4 Main Areas of Digital Transformation. URL: https://gocardless.com/en-us/guides/posts/what-are-the-4-main-areas-of-digital-transformation/

[4] URL: https://smart-lab.ru

[5] URL: https://rspp.ru/sustainable_development/registr/

To check our hypotheses, we constructed a sample comprising 70 Russian companies selected from the list of the country's 300 largest firms based on market capitalization, covering data from 2017 to 2021. The following criteria guided the compilation of our research dataset:

- Inclusion of public companies listed on the Moscow Exchange.
- Exclusion of financial sector companies from the dataset.
- Selection of companies listed among the top 300 by market capitalization.
- Availability of data from reliable sources.

Textual Analysis

Annual reports serve as crucial sources of non-financial information about companies, essential for external stakeholders such as investors, creditors, and customers [20]. To establish a digitalization disclosure index, the bag-of-words text analysis method is employed. This approach has proven effective in quantifying the coverage of various information disclosures within texts. Specific dictionaries are tailored for assessing characteristics like social and values-based orientations [21], risk level disclosures [22], and digital orientations reflecting innovation and digital transformation strategies [23].

The bag-of-words method is versatile, allowing for the determination of topic coverage levels within texts. This flexibility facilitates the analysis of how the obtained index correlates with other operational characteristics of organizations. Moreover, this method is adept at handling large volumes of information and is frequently utilized to investigate the impacts of various non-numerical factors on organizations.

A dictionary for textual analysis can be developed through the expert analysis of a thematic corpus of texts or compiled from existing dictionaries relevant to the research topic. Currently, there are no specific Russian dictionaries dedicated to digital transformation. Therefore, for this study, a dictionary was compiled based on existing dictionaries focused on digitalization and digital transformation [24–26]. Table 1 outlines the key characteristics of these dictionaries.

Table 1. Characteristics of employed dictionaries

Dictionary source	Total number of words	Digitalization sections
L. Guo, L. Xu, 2021 [24]	53	Seed word, macro policy, paradigm characteristics, influencing scope, technology or equipment
X. Teng et al., 2022 [25]	21	Paradigm characteristics, influencing scope, infrastructure
E. Fedorova et al., 2021 [26]	66	Product innovation, process innovation, marketing innovation, organizational innovation

After analyzing English-language lexicons from research dedicated to related topics and studying annual reports collected from Russian companies, the final lexicon was compiled for this study.

Although the primary focus of this paper is on digital transformation, digitalization is also a crucial accompanying process. It indicates the overall extent to which a company has adopted digital technologies, which are essential for enabling digital transformation. Therefore, we have included a vocabulary related to digitalization, consisting of 196 words divided into five topics: digitalization (41 words), business transformation (50 words), process transformation (35 words), domain transformation (38 words), and organization transformation (27 words).

It's notable that non-technological components of digital transformation, such as organizational aspects, are described with a smaller number of words compared to technological components. This disparity may stem from the strong association between digital transformation and technological advancements, leading to a greater emphasis on describing technological aspects in annual reports. The vocabulary used in this research is detailed in Table 2.

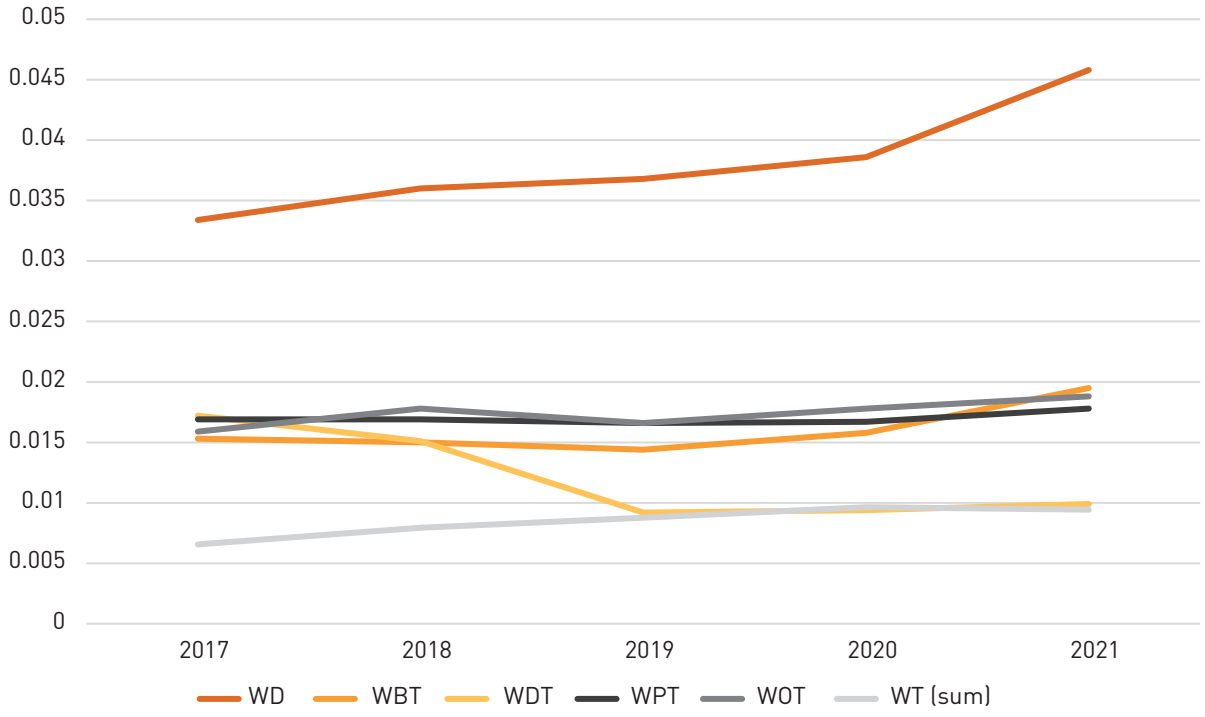
Table 2. Dictionary compiled for this study

Dictionary section (acronym)	Words
Digitalization (WD)	digitalization, technology, digital portal, digital platform, digital business, big data, digital object identifier, account, digital ecosystem, digital channels, services, digital services, user, digital business areas, internet of things, data analytics, data, web, virtual office, digital solutions, optimization, recording, digital devices, data protection

Dictionary section (acronym)	Words
Business transformation (WBT)	business model, ecosystem, digital ecosystem, business transformation, digital, digital economy, digital business, automation, digital business area, automatic control, informatization, informatization management, virtual office, informatized management, informatized application, digitalization, networking, integration, intelligence, virtualization, internet of energy, smart energy, smart city, smart service, smart transport, intelligent transport, e-government, smart medicine, smart community, smart terminal, smart home
Domain transformation (WDT)	internet of things, artificial intelligence, cloud computing, big data, cloud services, internet, 3D printing, mobile internet, biometrics, cloud technologies, data center, data analysis, data mining, interacting, pattern recognition, neuronic network, mass data, data storage, cloud platform, virtual reality, robots, industrial robots, CNC machines, CNC systems, sensors
Process transformation (WPT)	new process, new method, new technology, new equipment, high-technology equipment, improved manufacturing, improved delivery, supply chain, automation, digitalization, robot automation, standardization, manufacturing technology, R&D, waste recycling, asset replacement, lean manufacturing, quality control
Organizational transformation (WOT)	organizational changes, reorganization, workplace arrangement, restructuring, business practice, business transformation, business architecture, business functions, business process reengineering, staff development, design thinking, cooperation, remote work, coworking, import phaseout

Source: compiled by the authors on the basis of existing studies [24–26] and annual reports of studied companies.

Figure 1. Dynamics of indices according to the reports of Russian companies



To calculate the total index for digital transformation components (WT), we aggregate the evaluations from the four parts of the index. For textual analysis, we collected 357 reports spanning from 2017 to 2021, which include ESG (Environmental, Social, and Governance) and sustainable development reports. Subsequently, we conducted text normalization, involving tokenization, removal of stop words, and lemmatization. Differences in word forms were disregarded in the textual analysis. The text indices are computed using the following formula:

$$WD_{it} = \frac{CWD_{it}}{CW_{it}},$$

where WD_{it} is the share of the words related to digitalization, and CWD_{it} is the number of words from the dictionary found in corporate annual report with the total number of words CW_{it}.

The results are presented in Figure 1, which illustrates the dynamics of the indices of digitalization disclosure and digital transformation in annual reports, ESG reports, and sustainable development reports from 2017 to 2021.

It can be observed that the proportion of words related to digitalization and digital transformation components increased, especially during COVID-19 (2020–2021). This may be attributed to the fact that companies had to adapt to the challenges brought about by the pandemic crisis in the context of technological progress.

Model

Based on the analysis of various papers [27–31], we selected a set of variables comprising the following indicators: market capitalization (MCAP), company age (CA), current liquidity (CL), financial leverage (FL), net profit margin (NPM), return on equity (ROE), gross average revenue (GAR), capital expenditures (CAPEX), and asset turnover (ATO).

Panel regression with fixed effects was used to evaluate the model. The disclosure of digitalization components related to process and organization transformation has a greater influence on corporate market capitalization compared to business process and domain transformation, especially during the COVID-19 pandemic. For the periods before and after the pandemic, the same formulas as for H1–H2 were used, but the sample was divided into the periods 2017–2019 and 2020–2021.

Results and Discussion

Descriptive Statistics

Table 3 presents the descriptive statistics of the control variables used in the research, along with the digitalization disclosure variables. These variables assess the share of words related to the digital activities of Russian companies.

Table 3. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
MCAP	581.7	914.12	70.7	4815.7
Financial indicators				
CL	4.03	1.64	2.03	9.58
FL	5	2.67	0.9	8.67
NPM	2.67	1.8	0	10
ROE	28	19.39	7	11
GAR	321.81	116.58	7.95	750.78
CAPEX	802.8	956.67	7.84	1934.78
ATO	2.49	0.27	0.49	2.81
CA	37	35	3	176
Digitalization and digital transformation indices				
WD	0.00406	0.00392	0	0.03129
WBT	0.00156	0.00182	0	0.01207
WDT	0.00518	0.00342	0	0.02675
WPT	0.00073	0.00049	0	0.00390
WOT	0.00073	0.00050	0	0.00391
WT	0.00847	0.00855	0	0.04471

As Table 3 shows, the average digitalization index significantly exceeds the digital transformation indices. This is due to the necessity of digitalization processes for successful digital transformation. The terms related to digitalization are widespread and frequently used in reports. Meanwhile, process transformation and organization transformation indices exhibit the highest average values among all digital transformation components, whereas terms related to business transformation are used less frequently. This difference may be attributed to the specific nature of these terms, which are less commonly employed.

Panel Regression Results

To verify hypotheses H1 and H2, we examined the impact of digitalization disclosure and digital transformation indicators on corporate market capitalization. The results are presented in Table 4.

Table 4. Impact of digital transformation disclosure indicators on the market capitalization of Russian companies (2017–2021)

Variables	(1) *WD MCAP*	(2) *WBT MCAP*	(3) *WDT MCAP*	(4) *WPT MCAP*	(5) *WOT MCAP*	(6) *WT MCAP*
CA	0.51806*** (0.1107)	0.51718*** (0.1122)	0.4928*** (0.11047)	0.4741*** (0.11031)	0.5044*** (0.11144)	0.5044*** (0.11144)
CL	0.0029 (0.0046)	0.00291 (0.00462)	0.00340 (0.00461)	0.00391 (0.0045)	0.003194 (0.00462)	0.00319 (0.00462)
NPM	–0.0022 (0.0043)	–0.00196 (0.00432)	–0.00237 (0.00431)	–0.00233 (0.0042)	–0.002198 (0.00431)	–0.00219 (0.00431)
ROE	–0.02853 (0.070362)	–0.027236 (0.07045)	–0.028706 (0.07054)	–0.0252066 (0.070)	–0.026224 (0.0705)	–0.026224 (0.0705)
FL	–0.00728 (0.00451)	–0.006916 (0.00452)	–0.00732* (0.00453)	–0.0073602 (0.0044)	–0.007084* (0.00452)	–0.007084* (0.00452)
GAR	0.01055** (0.0041)	0.0107*** (0.0041)	0.0107*** (0.0041)	0.01061** (0.0041)	0.01069*** (0.0041)	0.01069*** (0.0041)
CAPEX	–0.00385 (0.00459)	–0.00403 (0.0046)	–0.00392 (0.00459)	–0.00398 (0.00457)	–0.00393 (0.0046)	–0.00393 (0.0046)
ATO	0.0127*** (0.00401)	0.0128*** (0.00401)	0.0128*** (0.00401)	0.01255*** (0.0039)	0.0127*** (0.00401)	0.01276*** (0.00401)
Digitalization disclosure index						
WD	0.0587*** (0.00803)					
WBT		–0.00593 (0.00813)				
WDT			0.00559 (0.00815)			
WPT				0.0088* (0.0048)		
WOT					–0.00137 (0.00647)	
WT						–0.00137 (0.00647)
Model parameters						
R-square	0.285	0.283	0.283	0.290	0.290	0.282

Notes: p-values in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

First, we should point out that WD (digitalization index) has a direct impact and the variable is significant at the 1% level. Therefore, hypothesis H1 regarding the influence of a company's digitalization disclosure on its capitalization is confirmed. The conclusion of a positive impact of digitalization aligns with existing studies [1], which indicate that in recent years, digitalization has gained popularity among Russian companies due to its potential for breakthrough productivity growth and economic efficiency. Many Russian companies are pursuing digitalization initiatives, and the national strategic program "Digital Economy of the Russian Federation" has been launched to promote the implementation of digital technologies and platforms.

Models (2)–(5) check whether various components of digital transformation exert different impacts on the financial performance of Russian companies (hypothesis H2). Among the components considered, process transformation disclosure is the only one that is significant at the 10% level and has a positive effect on market capitalization. This finding confirms hypothesis H2, indicating that one aspect of digital transformation is particularly important. The total index in model (6) is also of low significance over the entire period. It can be assumed that the market and investors are more interested in the process of digital transformation because it involves not only the modernization of strategy but also qualitative improvements in the approach to digitalization.

Then, to test hypothesis H3, we divided the dataset into two parts: the period in Russia before the COVID-19 pandemic (2017–2019) and the period during and after the pandemic (2020–2021). The results are presented in Tables 5 and 6.

Models (7)–(12) examined the impact of digitalization disclosure and digital transformation components for Russian companies before COVID-19. All indices were found to be insignificant. This insignificance may be attributed to the fact that, while digital transformation has been relevant for Russian companies in the past decade, it was not as impactful before the pandemic. The levels of digitalization and digital transformation were less significant across all levels of company and customer interaction during that period.

Table 5. Impact of digital transformation disclosure indicators on the market capitalization of Russian companies before COVID-19 (2017–2019)

Variables	(7) *WD* *MCAP*	(8) *WBT* *MCAP*	(9) *WDT* *MCAP*	(10) *WPT* *MCAP*	(11) *WOT* *MCAP*	(12) *WT* *MCAP*
CA	0.002957 (0.0498)	0.000407 (0.0499)	–0.001806 (0.0474)	0.00651 (0.0480)	0.00092 (0.04913)	0.000923 (0.0491)
CL	–0.00089 (0.0018)	–9.023e-04 (0.00187)	–0.00083 (0.00186)	–0.00098 (0.0018)	–0.00090 (0.0018)	–0.000907 (0.0018)
NPM	0.000102 (0.0016)	1.207e-04 (0.0016)	0.000145 (0.0016)	0.000181 (0.0016)	0.000116 (0.0016)	0.000116 (0.0016)
ROE	0.0979** (0.0444)	0.0970** (0.0442)	0.0950** (0.0447)	0.1001** (0.0443)	0.0974** (0.0446)	0.09744** (0.0446)
FL	–0.0036* (0.00195)	0.0036* (0.00196)	–0.0036* (0.00196)	–0.0035* (0.0019)	–0.0036* (0.00195)	–0.0036* (0.001958)
GAR	–0.006*** (0.00167)	–0.0060*** (0.00165)	–0.0059*** (0.00166)	–0.0060*** (0.0016)	–0.0060*** (0.00166)	–0.00603*** (0.00166)
CAPEX	–0.0058*** (0.00178)	0.0058*** (0.00178)	–0.0058*** (0.00178)	–0.0057*** (0.0017)	–0.0058*** (0.00178)	–0.00586*** (0.00178)
ATO	0.0108*** (0.00249)	0.0107*** (0.00294)	0.0107*** (0.00248)	0.0110*** (0.0025)	0.01082*** (0.0024)	0.01082*** (0.00249)
Digitalization disclosure index						
WD	–0,00049 (0.0027)					
WBT		–8.014e-05 (0.0032)				
WDT			0.00094 (0.0033)			

Variables	(7) WD MCAP	(8) WBT MCAP	(9) WDT MCAP	(10) WPT MCAP	(11) WOT MCAP	(12) WT MCAP
WPT				–0.0013 (0.0021)		
WOT					–0.0002 (0.0031)	
WT						–0.000202 (0.00312)
Model parameters						
R-square	0.4343	0.434	0.434	0.435	0.435	0.434

Note: p-values in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.

Models (13)–(18) from Table 6 examine the significance of digital transformation disclosure after the onset of the COVID-19 pandemic in Russia. Models (16)–(17) clearly demonstrate that process and organization transformation disclosure is significant at the 5% level, positively impacting corporate market capitalization during the pandemic. Consequently, H3 is fully confirmed, indicating that the significance of digitalization increased sharply during and after the pandemic.

Table 6. Impact of digital transformation disclosure indicators on the market capitalization of Russian companies during the COVID-19 period (2020–2021)

Variables	(13) WD MCAP	(14) WBT MCAP	(15) WDT MCAP	(16) WPT MCAP	(17) WOT MCAP	(18) WT MCAP
CA	5.7624*** (0.9226)	5.59526*** (0.9154)	6.1296*** (0.9303)	5.6523*** (0.8714)	5.8821*** (0.926)	5.8821*** (0.9260)
CL	–0.00250 (0.0085)	–0.00208 (0.0084)	–0.006654 (0.0087)	–0.00630 (0.00816)	–0.00410 (0.0086)	–0.0041 (0.00868)
NPM	–0.005769 (0.00823)	–0.00484 (0.008)	–0.00888 (0.00821)	–0.00684 (0.0077)	–0.00714 (0.00826)	–0.00714 (0.0082)
ROE	0.6295*** (0.2165)	0.5967*** (0.2144)	0.7141*** (0.2186)	0.6891*** (0.2054)	0.6590*** (0.2183)	0.65905*** (0.2183)
FL	–0.00362 (0.00864)	–0.00156 (0.00862)	–0.00567 (0.00860)	–0.0036 (0.0081)	–0.0040 (0.0086)	–0.00402 (0.00864)
GAR	0.0359*** (0.0078)	0.0357*** (0.0076)	0.0369*** (0.0075)	0.03713*** (0.0073)	0.03701*** (0.0077)	0.03701*** (0.0077)
CAPEX	5.435e-05 (0.009)	0.00059 (0.0088)	–0.00211 (0.0089)	–0.00087 (0.0084)	–0.00099 (0.009)	–0.00099 (0.009)
ATO	0.0461*** (0.0099)	0.0475*** (0.0097)	0.0471*** (0.0097)	0.0448*** (0.0093)	0.0464*** (0.0098)	0.0464*** (0.0098)
Digitalization disclosure index						
WD	–0.00651 (0.0154)					
WBT		–0.03193 (0.022)				
WDT			0.02628 (0.0174)			
WPT				0.02434** (0.009)		

Variables	(13) WD MCAP	(14) WBT MCAP	(15) WDT MCAP	(16) WPT MCAP	(17) WOT MCAP	(18) WT MCAP
WOT					0.0254** (0.0095)	
WT						0.01048 (0.0157)
Model parameters						
R-square	0.726	0.735	0.73	0.755	0.728	0.723

Note: p-values in parentheses; *** p < 0.01, ** p < 0.05, * p < 0.1.

We expected to obtain equally unambiguous results because the crisis triggered by the pandemic made companies realize the urgent importance of implementing digital technologies. In Russia, the digitalization strategy had been promoted at the national level even before the pandemic, with people, businesses, and governments increasingly applying breakthrough technologies [32]. However, before the pandemic, company digitalization disclosure did not play such an important role and had no significant effect on corporate financial performance.

In fact, the significance of disclosing components of corporate digitalization, such as process and organization transformation, can be attributed to the pandemic's role in redirecting innovation towards new technologies that support video conferencing, remote work, and online learning—technologies that are likely to spread even more widely in the future [32]. Additionally, some studies [33] suggest that the pandemic acted as a catalyst, making the implementation of digital transformation in Russian companies urgent. Before the pandemic, remote work was technically impossible in many Russian companies or not allowed officially. However, the pandemic forced the digitalization of numerous companies [34].

Results of the Random Forest Algorithm

Random forest regression is a supervised learning algorithm that combines ensemble learning methods with a decision tree structure. The predictions or classifications provided by the algorithm are often more reliable than those from many other models [35]. Its nonlinear nature allows it to detect more subtle influences of variables on an indicator. Additionally, it enables the inclusion of all available indices in the same model. Although the nonlinear character of the method makes it impossible to definitively determine the influence area of explanatory variables on the dependent variable (since it may vary depending on the value level), it allows for the assessment of the overall significance of changes in indicator values on the dependent variable. This makes it possible to evaluate the significance of text variables, even if their influence is complex and nonlinear.

Figure 2 shows that the digitalization disclosure indicator ranks seventh in significance. It follows indicators such as asset turnover, return on equity, and capital expenditures. Among other sensitive variables, it is outperformed by both process transformation and organization transformation.

Figure 2. Random forest analysis for hypotheses H1 and H2

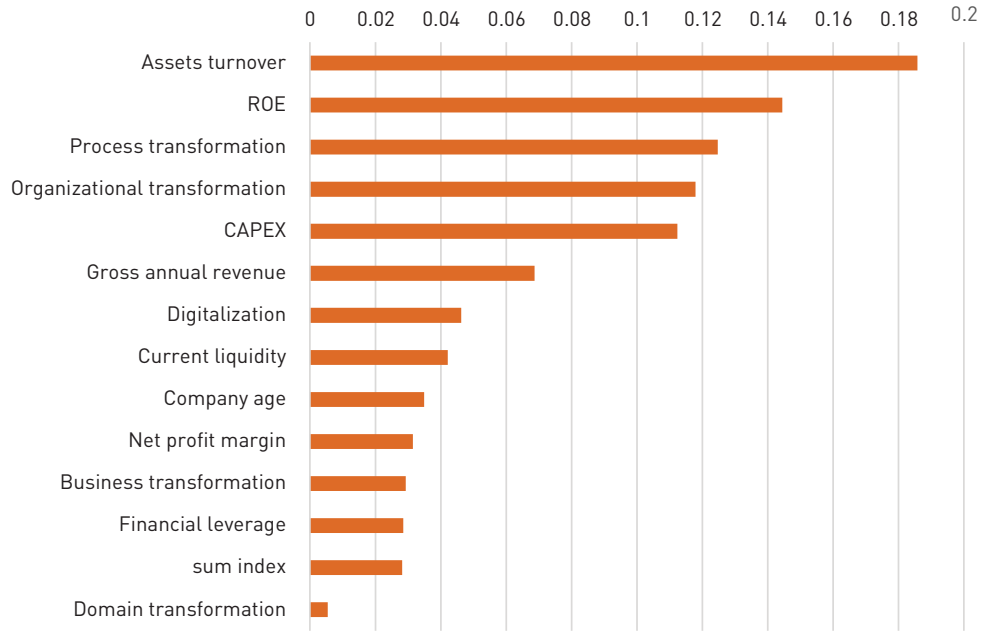
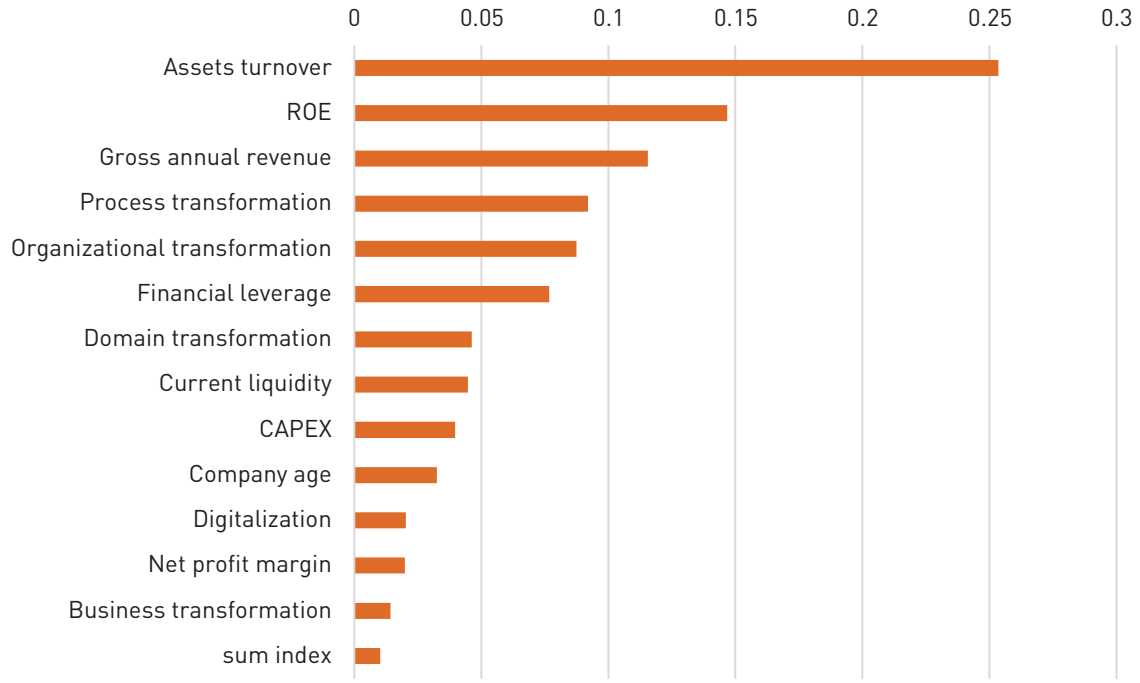


Figure 3. Random forest analysis for H3 hypothesis (during COVID, 2020–2021)



These variables are highly significant. Thus, the results for H1 and H2 are in line with previous research: return on equity has a strong effect on corporate market capitalization [27], while asset turnover [28], CAPEX [29], as well as process and organization transformation disclosure, exert a slightly smaller or equal impact [28]. At the same time, the significance of domain transformation is minimal, and different components exert their impact in varying ways, which explains the decline in significance of the total index. The results of machine learning methods corroborate the regression analysis findings and even extend them, showing that alongside digitalization and process transformation, organizational transformation also proves significant.

Figure 3, in turn, shows that process and organization transformation occupy the fourth and fifth positions on the list, respectively, after asset turnover, return on equity, and gross annual revenue, following the onset of the COVID-19 pandemic in Russia (2020–2021).

Nevertheless, the significance of these components far outweighs that of business transformation and numerous other indicators during COVID-19. Domain transformation, in particular, emerged as highly significant; its importance increased substantially after the pandemic began in Russia. In contrast, the significance of business transformation remains low. These findings are consistent with previous research [36] and are supported by the results of the random forest analysis, confirming hypothesis H3 once more.

Conclusion Based on Modeling Results

Summing up, we present a visual demonstration of all validated hypotheses in Table 7.

Table 7. Summary: Hypothesis Testing

Hypothesis		Result
H1	A company's digitalization has a positive effect on its market capitalization	(+) confirmed
H2	Individual components of digital transformation and digitalization influence market capitalization of Russian companies in different ways	(+) confirmed
H3	The influence of individual components of digital transformation and digitalization components grew during the COVID-19 crisis	(+) confirmed

The confirmation of H1 and H2 correlates with similar papers, suggesting that the disclosed information about company digitalization positively impacts corporate market capitalization. Studies such as [6; 37] indicate that digitalization disclosure influences the cost of capital, stock market valuation, and market-based valuation across various sectors. Such studies underscore the significance of digital technology disclosure as non-financial information crucial to market assessments, highlighting that higher levels of disclosure are directly associated with enhanced stock market valuation [4].

Thus, hypothesis H1 was confirmed through regression analysis and random forest techniques: broader digitalization disclosure in the annual reports of Russian companies correlates with increased corporate market capitalization. This finding aligns with signaling theory, which posits that companies communicate digitalization efforts to signal positive impacts on their value. These results are in line with previous research [38].

The verification of H2 using both methods demonstrates that process transformation disclosure significantly influences financial performance, whereas business transformation shows minimal significance, indicating distinct impacts. Disclosing even individual digital transformation components reduces information asymmetry and facilitates effective communication with stakeholders regarding the company's current operations and long-term strategy. This observation supports the applicability of signaling theory in this context as well.

The results of verifying H3 are consistent with studies confirming that the COVID-19 pandemic accelerated digitalization, prompting less advanced companies to partially catch up with digitalization levels [36]. The changes introduced during the pandemic continue to impact corporate long-term development strategies. Many companies have accelerated digitalization in customer interactions, supply chains, and internal operations and processes. Additionally, there has been an observed increase in the significance of domain transformation during the pandemic. However, components related to process and organizational updates remain the most significant. This finding aligns with similar studies [34].

Conclusion

Currently, digitalization is gaining significant importance in modern business as technological advancements continue to shape companies' operational methods. In today's business environment, transparency and openness are crucial for maintaining a reputable image. Consequently, the disclosure of non-financial information, particularly related to digitalization, has become increasingly important as more companies worldwide, including those in Russia, publish non-financial reports.

This study demonstrates that disclosing information about digitalization and digital transformation has a positive impact on corporate capitalization, with this effect becoming more pronounced after the onset of the pandemic. Stakeholders now place greater reliance on non-financial factors when evaluating the financial and market performance of companies.

The practical relevance of this paper encompasses several key aspects. Firstly, understanding the significance of disclosing non-financial information in reports and thereby enhancing business transparency can inspire businesses to further develop in this realm, potentially attracting more investment and new customers. Secondly, top managers can leverage the findings of this research to formulate a more intelligent and comprehensive digital strategy. Such a strategy has the potential to yield benefits both in terms of reputation and financial performance.

There are several limitations in the present study that also suggest potential avenues for future research. Firstly, conducting a more extensive study with a larger sample of companies, segmented by industry, could provide insights into the consistency of results and the significance of information disclosure across various sectors, drawing parallels with practices in other countries.

Secondly, future studies could consider expanding the list of digital transformation components and employing more sophisticated dictionary processing techniques to develop a more reliable index.

Finally, comparative analyses involving samples of companies from multiple countries could investigate potential differences in the impact of disclosing non-financial information, particularly between Russian practices and those in European contexts.

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Ownership Structure and Corporate Risk Disclosure in Emerging Countries

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Abstract

The study examines the impact of ownership structure on corporate risk disclosure in African emerging countries. The sample includes 42 firms that are listed on the Johannesburg Stock Exchange and the Nigerian Stock Exchange. The data for the independent variables were taken from the Bloomberg data stream, whereas the data for the dependent variable were taken from annual reports retrieved from the website of the sample companies. The study's time period runs from 2014 to 2018. Regression and content analysis were employed as the analytical tools. We perform text analysis on company annual reports to ascertain the risks that companies disclose, and regression analysis was used to establish the extent to which ownership structure influenced corporate risk disclosure. The result shows that strategic and environmental risk disclosures are dominated by operational risk disclosure. It has become a convention for the firms to divulge considerable positive, past, non-monetary information rather than negative, future and monetary risk information. Moreover, it is discovered that the decision to improve risk disclosure is largely influenced by company size and profitability. In contrast, firms are reluctant to unveil risk information provided the shares of the company are not concentrated in the hands of few individuals. Nonetheless, company risk disclosure practice is unaffected by institutional investors, government, foreigners, insider ownership and leverage. It can be concluded that the enterprises operating in emerging African markets have made improvements to their risk disclosure practices. However, there is still room for further improvement. Monetary, future, and negative risk information are the most important risk disclosures that various stakeholder groups, such as investors, demand to see. Hence, there is a need for regulation that can compel corporations to publish the most pertinent risk information. Even though risk disclosure is voluntary in these two African emerging countries, ownership structure is one of significant predictors of corporate risk disclosure.

Keywords: Ownership Structure, Risk and Risk Management Disclosure, Content Analysis, Emerging Countries, Nigeria, South Africa

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Introduction

The increasing number of scandals involving corporate managers and diverse economic uncertainties, such as financial crises across the world, is amongst the pivotal issues that has motivated stakeholders to clamor for business risk disclosure. The lack of sufficient risk disclosure, using which stakeholders could assess a firm's financial strength or weakness was considered the key factor responsible for the 2007/2008 financial crisis [1]. Despite the above contention, the regulators in various jurisdictions have not mandated firms to unveil their risks [2]. However, businesses are encouraged to understand the benefits associated with unveiling risk information as it enhances corporate transparency [3], reduces cost of capital [4]; upholds investor confidence [1], and reduces corporate uncertainties [5], allowing stakeholders to estimate impending cash flows and stock prices [5]. It is also a risk management procedure, as the firms that divulge their risk to the public have to devise an effective risk management strategy [1]. Notwithstanding these risk disclosure incentives, the style and extent of risk information reveal is principally dependent on the corporate manager's decision [6; 7], as the regulators do not offer a comprehensive framework for reporting corporate risks. Meanwhile, corporate governance and organizational characteristics were identified in the research as the elements that affect the quantity and quality of risk disclosure [e.g. 1; 3; 8–15]. Ownership structure is one of the corporate governance factors that lead firms to release risk information [7]. For example, the previous studies [1; 7; 16; 17] explained that ownership structure could shape companies' risk disclosure behavior. These studies have motivated research of this subject matter in the emerging countries and has recently [7] extensively evaluated this phenomenon; nevertheless, it is limited to the Arab community. To the researcher's knowledge, none of the prior studies have focused on emerging African countries. The goal of the study is to evaluate how ownership structure affects risk disclosure in emerging African countries. Due to cultural differences, and diverse business and regulatory environment, the study will contribute immensely to the global literature. The remainder of the paper is organized as follows: second section reviews the literature; third section – research design; fourth section – results and discussion; and fifth section states the conclusions.

Literature review

Research concerning corporate risk disclosure has recently received considerable attention in the world of accounting and finance. The regulators' ineffective risk disclosure response is the major aspect that motivates academic scholars to investigate the different factors that may inspire corporate managers to divulge their firms' risks. In the recent years, many studies have confirmed that firms have been expanding their risk reporting over the years. However, the manner in which information is disclosed remains the topic of discussion. For example, the majority of risk information published in annual reports are historical, positive and non-monetary news [3; 18]. This approach has diminished the usefulness of risk disclosure. Stakeholders are clamoring for future, negative news and monetary risk information to make an informed decision. The firm's decision to disclose its risk information appears to be mostly influenced by regulation. However, in the absence of regulation, ownership structure was found relevant in determining the degree of risk information to be revealed by firms. For example, a study conducted by [6] examines 169 publicly traded South African corporations from 2002 to 2011 and found that firms with substantial institutional investors' ownership or ownership concentration tend to decrease corporate risk disclosure. These findings contradict those reported by [19] who found institutional investors and insider ownership insignificant after examining 118 annual reports of Indonesian firms for the year 2013. This conclusion was reinforced by a study [20] that examined 85 annual reports for listed Pakistani firms from 2011 to 2016. In addition to institutional investors and insiders ownership, ownership concentration and governmental ownership are also insignificant. However, [21] evaluated 365 Indonesian companies' annual reports for the year 2015 and reported a significant inverse linearity between ownership concentration and risk disclosure. In addition, government ownership appears to increase the volume of risk information divulged by firms, while conversely, no significant effect is found in foreign ownership. Meanwhile, the theoretical lenses used in this study are dependent on different ownership variables that we used. These theories are discussed in the development of our hypotheses.

Hypotheses Development

Institutional Investors Ownership

The growth of the number of institutional investors in recent years is highly alarming as they dominate various emerging market activities [22], and the magnitude of their ownership in corporate financial architecture may influence various strategic business decisions. The agency theory is found suitable in explaining the direct association between risk disclosure and institutional investor ownership [6; 16]. Prior studies have established mixed results. The study [17; 23] confirms a positive association between institutional investor ownership and risk disclosure, while others [6; 7] reported an inverse link among the two variables. According to [19], there is no correlation between the two aforementioned parameters. Nonetheless, the following presumption is advanced and is consistent with agency theory:

H1: Firms with greater institutional investor ownership tend to increase risk disclosure.

Government Ownership

The connection between risk disclosure and government ownership can be predicted using the stakeholder theory because the government is one of the authoritative company stakeholders [7]. Hence, companies are anticipated to unveil diverse information that would meet the stakeholders' expectations. Governments, as policymakers, would

encourage enterprises to strengthen their risk reporting processes in order to send signals to market players, and they are dedicated to policies that are in the best interests of owners [21]. It is impossible for the government to collude with corporate executives and conceal sensitive information. Nevertheless, the government is committed to maintaining social order and income distribution rather than promoting stockholders' interest that could create value for the firms, thus, corporate transparency may not be the preference of government stockholdings [7]. Despite theoretical forecasts, prior studies come to mixed conclusions. The studies [6; 7; 21; 24] uncover that the volume of disclosed risks grows if government ownership increases. In contrast, [25] discovered an inverse link between the two variables. Likewise, [26] reported that risk disclosure has no connection with the extent of government ownership. In reference to stakeholder theory, the following hypothesis is coined:

H2: Higher government ownership encourages firms to report more risk information.

Foreign Ownership

Foreigners with substantial ownership tend to influence corporate strategic decisions. They could exert pressure on management in regard to the magnitude of revealed risk information. The coercive isomorphism theory would be applicable in predicting this relationship [27], which suggests positive linearity between risk disclosure and foreign ownership. Nevertheless, the previous empirical studies [21; 27] did not find any connection between the two variables. Meanwhile, since various nations have different policies on the maximum number of shares that can be owned by foreigners, the studies use the coercive isomorphism theory prediction and suggest the following hypothesis:

H3: Foreigners with greater ownership tend to influence higher risk disclosure.

Insider Ownership

Among the most important stakeholders in the corporation are corporate executives, including directors and managers. These groups are regarded as insiders because they comprise the people who make the majority of business strategic decisions. Despite their position, the law does not prevent these insiders from owning a specific proportion of company shares. As a result, they are able to own sizeable shares of the company by receiving them as bonuses or using their own money to buy shares. When these insiders possess a significant amount of the stock, they tend to provide less risk information in company reports. This claim can be supported by a prior study by [19]. A study [19] argues that there is an inverse relationship between managerial ownership and risk disclosure based on agency theory predictions. This indicates that firms with greater managerial ownership tend to divulge less risk information to outsiders [5]. This is consistent with the management entrenchment theory suggested by research [7]. Higher insider ownership could lead managers to exploit their interests at the expense of other stockholders, as well as to abandon their monitoring functions and conceal relevant information that would benefit them without regard for the interests of other stakeholders [7]. The findings [26; 28] have supported the management entrenchment theory prediction by reporting an inverse association between insider ownership and risk disclosure. Nonetheless, other scholars [5; 7] failed to establish linkage between the two variables. Consistent with the entrenchment theory, the following proposition is made:

H4: Insider ownership is inversely associated with corporate risk disclosure.

Diverse Ownership

It is very common for companies to assign a significant portion of their shares to a small number of shareholders. In this case, business managers might collude with the shareholders to provide only limited information to outsiders. Perhaps this is the reason for corporate governance-mandated disclosure of owners with 5% or more of company stock. In contrast, some businesses implement the strategy of distributing their shares to a wide range of people rather than concentrating them in the hands of a small number of people. Diverse ownership is used to describe a situation in which shares are not concentrated in the hands of few individuals. Firms with diverse ownership structure are prone to greater pressure to release risk information since a substantial number of company shares are in possession of many individuals [27]. The coercive isomorphism theory [27] suggested a positive connection between risk disclosure and diverse ownership. According to coercive isomorphism, the behavior of corporate managers is either influenced by regulation or by monitoring activities. The monitoring activities can be influenced by diverse shareholders through voting at annual general meetings. However, the study conducted by [27] does not find diverse ownership to be a determining factor that influences a firm's risk disclosure. Consistent with coercive isomorphism theory, the following hypothesis is postulated:

H5: A corporation's risk disclosure tends to rise when its ownership structure is diverse.

Research design

Sample and Data Collection

The study sampled 42 firms, and a total of 210 annual observations from 2014 to 2018 were considered in the study. The companies were chosen from the financial and non-financial sectors, specifically from those listed on the Johannesburg Stock Exchange and the Nigerian Stock Exchange. Because Nigeria and South Africa are major emerging African economies, companies listed on their exchanges are expected to publish more risk information. As a result, these countries were chosen for this study. The total number of listed banks in both nations is included in the initial sample of the financial sector, but we removed all banks with no pertinent data. On the other hand, non-financial companies are randomly selected from the manufacturing sector. According to [8], financial firms need to be stud-

ied independently because the sector is normally regulated by more than one body. Nevertheless, as the study does not aim to investigate corporate compliance with existing rules and regulations, but rather seeks to examine how risk information is communicated to the users, non-financial firms are incorporated in the sample, which is consistent with the prior study [13]. We investigate five years of annual reports spanning from 2014 to 2018. This time frame was chosen because by 2014, both Nigeria and South Africa had fully implemented the international financial reporting standard (IFRS), which has the advantage of requiring the disclosure of risk associated with financial instruments, leading to a trend of greater risk disclosure practices in companies. In order to gather information related to the dependent variable, we obtained annual reports for five years from 42 companies. Data for the independent variables and control variables was simultaneously received from Bloomberg data stream. Moreover, the research is in line with previous studies; we employ manual content analysis in all narrative sections of the sample firms' annual reports, including notes to the account.

Measurement of variables

Risk Disclosure

Risk disclosure is measured as the number of risk sentences reported in annual reports. Risk disclosure (RD) is our main dependent variable. Environmental RD, Operational RD, and Strategic RD are the risk disclosure categories that are also used as the remaining three dependent variables. The variables and their definitions are listed in Table 1.

Content Analysis

Research of risk disclosure frequently uses content analysis, which examines the narrative sections of annual reports. The application of this method is consistent with earlier research [3; 8; 18]. In several studies, risk information was coded during content analysis by counting the pertinent sentences, words, paragraphs, pages, and percentage of pages. Nevertheless, the words and sentences approach was more popular. In comparison, the number of words may be counted with greater accuracy than the number of sentences. However, only the context of a sentence may be used to interpret the words. In light of this, we decided to use the sentence approach. To code the appropriate sentence, we adopt the risk disclosure framework used by prior studies [8]. It is generally believed that the element of subjectivity often appears in content analysis, especially when the "sentence-based approach" is selected in the coding process. However, we adopted the decision rule technique used in prior studies to minimize the extent of subjectivity in our coding process (see Appendix 2). Moreover, based on the checklist (see Appendix 1), risk disclosure is categorized into strategic, environmental and operational risk disclosure. To gain more insight, the disclosure was analyzed to be past or future information, monetary and non-monetary, positive or negative information, this might help many stakeholders to deduce relevant risk information disclosed for informed decisions. In addition, Table 1 shows how our variables were measured.

Table 1. Variable Description and measurement

Variables	Measurement	Source
Risk Disclosure	Total risk disclosure sentences	Annual reports
Environmental RD	Total environmental risk disclosure sentences	Annual reports
Operational RD	Total operational risk disclosure sentences	Annual reports
Strategic RD	Total strategic risk disclosure sentences	Annual reports
Quantitative	Total monetary risk disclosure sentences	Annual reports
Qualitative	Total non-monetary risk disclosure sentences	Annual reports
Past information	Total number of past risk related sentences	Annual reports
Future information	Total number of future risk related sentences	Annual reports
Non time info	Total risk sentences that is not related to past or future	Annual reports
Good news	Total sentences related to favorable events	Annual reports
Bad news	Total sentences related to unfavorable events	Annual reports
Institutional Investors	The proportion of shares held by institutional investors	Bloomberg
Government	The percentage of shares held by government or its agency	Bloomberg
Foreigners	The proportion of shares held by foreign shareholders	Bloomberg
Insiders	The proportion of shares held by managers and directors	Bloomberg
Diverse	The proportion of ownership held by individuals	Bloomberg

Variables	Measurement	Source
Company Size	Log of total asset	Bloomberg
Profitability	Return on equity	Bloomberg
Leverage	Debt to equity ratio	Bloomberg

Source: compiled by the author, 2023.

Research Model

Apart from the risk disclosure practice, the study investigates how ownership structure influences corporate entities to disclose risk information. As a result, five variables related to ownership structure were created in order to conduct our investigation. These include: government ownership, insider ownership, foreign ownership, institutional ownership, and diverse ownership. Likewise, control variables included in the model are company size, profitability, and leverage. The equations are presented as follows:

$$y_{it} = \beta_1 + \beta_2 \bullet IIO_{it} + \beta_3 \bullet GO_{it} + \beta_4 \bullet FO_{it} + \beta_5 \bullet IO_{it} + \\ + \beta_6 \bullet DO_{it} + \beta_7 \bullet CS_{it} + \beta_8 \bullet CP_{it} + \beta_9 \bullet CL_{it} + \beta_{10} \bullet d_{2015} + \\ + \beta_{11} \bullet d_{2016} + \beta_{12} \bullet d_{2017} + \beta_{13} \bullet d_{2018} + \alpha_i + \varepsilon_{it},$$

where y_{it} is the dependent variable (risk disclosure, environmental risk disclosure, operational risk disclosure and strategic risk disclosure), IIO_{it} stands for Institutional investors' ownership, GO_{it} refers to government ownership, FO_{it} is foreign ownership, IO_{it} means insider ownership, DO_{it} is diverse ownership, CS_{it} stands for company size, CP_{it} means company profitability, CL_{it} is company leverage, i is the index for firm and t is the index for year, $d_{2015} - d_{2018}$ are annual effects, α are the firm's fixed effects, ε_{it} is the random error.

Result and discussion

Results

Table 2 offers descriptive statistics for the variables analyzed in this research. The minimum of the total risk disclosure was 388, maximum – 3585, with a mean of 2061 sentences. Risk disclosure was classified into environmental, operational and strategic, with mean values, respectively, 738; 967 and 361 risk sentences. Further, the result shows an average of 270 sentences and 1792 sentences that are related to quantitative and qualitative risk reporting, respectively and this analysis would offer users of corporate reporting more insight about the monetary and non-monetary implications of the risk evidence released by firms. Moreover, in considering the risks based on the definition suggested by [8] and propagated by risk disclosure researchers, [18] where opportunity, threat and uncertainty are incorporated in the modern definition of risk, our study permits us to identify the average of 672 sentences related to positive news, whereas negative news and neutral information accounted for 235 and 1156 risk sentences respectively. Moreover, the time horizon of the risk reported by firms is also appreciated by the users of corporate reporting; hence Table 2 reveals 361 sentences reporting about future risk evidence, while 794 sentences and 907 sentences were specific to past and non-time risk evidence, respectively.

Table 2. Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Risk Disclosure	210	2061	765	388	3585
Environmental RD	210	738	296	88	1501
Operational RD	210	964	408	142	1860
Strategic RD	210	361	139	74	973
Quantitative	210	270	101	60	710
Qualitative	210	1792	692	253	3201
Past information	210	794	385	99	1778
Future information	210	361	139	74	973
Non time info	210	907	322	124	1667
Good news	210	672	284	81	1389
Bad news	210	235	104	63	467
Institutional investors	210	48.62	38.41	0.00	140.20
Government	210	10.97	9.03	0.02	33.64

Variable	Obs.	Mean	Std. Dev.	Min	Max
Foreigners	210	46.98	30.14	0.45	99.97
Insiders	210	1.510	3.97	0.00	38.35
Diverse	210	32.68	33.56	0.02	99.98

Pearson Correlation

Before conducting multivariate analysis, we examine the potential connection among our variables. Table 3 depicts Pearson correlation coefficients. Risk disclosure is positively related to institutional investor ownership (0.449), government ownership (0.314), company size (0.605), and company leverage (0.140). In addition, risk disclosure is also negatively correlated to diverse ownership structure (–0.490). On the other hand, Table 3 shows that insider ownership, foreign ownership, and profitability do not induce companies to publish more risk information. Meanwhile, in considering the multicollinearity assumption, it appears that the mutual correlation of our explanatory variables is under 0.8. A value beyond that threshold (0.8) signifies that the multicollinearity problem may arise.

Table 3. Pearson Correlation Coefficients

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Risk Disclosure	1.000								
(2) Institutional Investors	0.449*	1.000							
(3) Government	0.314*	–0.016	1.000						
(4) Foreigners	–0.112	–0.180*	0.211	1.000					
(5) Insiders	0.128	–0.105	–0.096	0.089	1.000				
(6) Diverse	–0.490*	–0.683*	0.106	0.313*	0.055	1.000			
(7) Company Size	0.605*	0.569*	0.159	-0.028	0.111	–0.488*	1.000		
(8) Profitability	0.094	0.050	0.023	0.109	0.023	0.010	–0.122	1.000	
(9) Leverage	0.140*	–0.047	0.062	–0.006	0.004	0.003	0.160*	–0.197*	1.000

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4 shows the values of the Variance Inflation Factor (VIF) which were computed to authenticate the results revealed by correlation matrix. The results have confirmed our prior findings as the values demonstrated by all our explanatory factors are below the threshold of 10. Hence, our model is free from any noise that may arise due to multicollinearity. Likewise, we computed Breusch-Pagan and White's tests in order to know the position of our error term. After the computation of the Breusch-Pagan test, the result shows a chi-square value of 3.35 and a p-value of 0.0671. Since the p-value was not significant at 5%, we have assumed that heteroskedasticity does not exist in our model. This result was confirmed after we conducted the White's test for homoscedasticity, on which its chi-square reveals 45.81, and p-value reveals 0.3970. Therefore, our error term is homoscedastic, because the p-value is greater than 5%.

Table 4. Variance Inflation Factors

Risk Disclosure	VIF	1/VIF
Institutional Investors	1.750	0.573
Government	1.670	0.599
Foreigners	2.840	0.353
Insiders	1.250	0.803
Diverse	3.940	0.254
Company size	1.950	0.512
Profitability	1.290	0.777
Leverage	2.480	0.403

Furthermore, the result of the regression has been presented in Table 5. The joint effect of the first model, where risk disclosure is a dependent variable, is statistically significant at 1% (0.0000) and the F-statistic is 8.388. The R-squared is 0.499; while R-squared adjusted is 0.469. This indicates that the explanatory factors included in the model have explained risk disclosure by approximately 47%. Nonetheless, as for the discrete explanatory factors, the company size coefficient is significant at 1%, while diverse ownership and profitability are significant at 10%. Additionally, the second model in Table 5 (where environment stands as dependent variable) has an R-squared of 0.359 and an adjusted R-squared of 0.321. The F-statistics is 5.042 and p-value is 0.000. Therefore, the null hypothesis that the values of all coefficients for the explanatory variables are simultaneously zero cannot be accepted. This means that the joint effect of explanatory variables explains environmental risk disclosure by 32%. Besides, company size is significant at 1%, while profitability is significant at 5%, and the remaining model variables are not statistically significant.

Table 5. Results of Regression Analysis

	Risk Disclosure	Environmental RD	Operational RD	Strategic RD
Institutional investors	−1.019	−0.534	−0.203	−0.277
	(2.716)	(1.216)	(1.300)	(0.387)
Government	8.337	−0.246	4.446	4.973*
	(8.747)	(3.815)	(4.120)	(2.482)
Foreigners	1.381	0.561	0.769	0.099
	(2.711)	(1.110)	(1.329)	(0.409)
Insiders	16.453	−0.857	11.447	5.908***
	(16.823)	(8.051)	(8.233)	(1.755)
Diverse	−6.633*	−2.116	−3.437**	−1.030**
	(3.342)	(1.421)	(1.596)	(0.496)
Company Size	192.858***	69.185***	93.189***	30.194***
	(38.836)	(15.895)**	(19.835)	(5.855)
Profitability	3.194*	1.181	1.537	0.455
	(1.812)	(0.565)	(1.026)	(0.295)
Leverage	8.919	3.959	3.134	2.004
	(10.914)	(4.784)	(4.272)	(2.370)
d_{2015}	80.056	−23.091	83.415**	21.863
	(64.498)	(36.379)	(38.981)	(19.635)
d_{2016}	69.217	−22.882	83.593**	8.218
	(55.199)	(35.235)	(32.206)	(15.577)
d_{2017}	53.025	−28.812	56.632	32.045*
	(73.231)	(36.211)	(42.902)	(16.759)
d_{2018}	154.131*	24.607	92.883*	38.499**
	(90.470)	(45.709)	(53.581)	(18.028)
Constant	374.197	180.518	108.618	79.634
	(381.453)	(154.146)	(194.872)	(57.127)
R-squared	0.499	0.359	0.465	0.498
R-squared Adjusted	0.469	0.321	0.432	0.468
Observations	210	210	210	210
F-statistic	8.388	5.042	8.224	10.974
P-value	0.000	0.000	0.000	0.000

Standard errors are in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results of the third model, which also used operational risk disclosure as a dependent variable, are similarly displayed in Table 5. According to the outcome, R-squared is 0.465, adjusted R-squared 0.432. The calculated F-statistic and the p-value are 8.224 and 0.000, respectively. The joint effect of the model is statistically significant because the p-value (0.000) is less than the 1% level of significance. The factors included in the model have contributed 43.2% to the explanation of operational risk disclosure. When it comes to covariates and control variables, diverse ownership coefficient is significant at 5%; while company size coefficient is significant at 1%. After all, the results of the fourth model, which has strategic risk disclosure as a dependent variable, is also included in Table 5. The R-squared is 0.498, adjusted R-squared is 0.468, the p-value is 0.000 and the F-statistic is 10.974. The joint effect of the model is statistically significant at 5%, and the model's variables described 46.8% of the strategic risk disclosure based on the adjusted R-squared. In terms of covariates and control variables, government, insider and diverse ownership are statistically significant at 10%, while the company size coefficient is significant at 1%.

In the meantime, we conduct a comparison between the firms listed on the Nigerian stock exchange (100 observations out of 210) and those listed on the Johannesburg Stock Exchange (remaining 110 observations out of 210). This comparison will enable us to comprehend how various ownership structures affect risk disclosure practices in the respective countries. Table 6 displays the comparison outcome. The findings for companies listed on the JSE in South Africa reveals the R-squared of 0.324, and the adjusted R-squared of 0.309. The F-statistic is 3.87, while the p-value is 0.000. According to the findings, corporate risk disclosure is described by explanatory factors by 30.9%, and the joint effect of the model is statistically significant at 1%. As for the explanatory variables, foreign ownership and company size are statistically significant at 1%. On the other hand, the results of companies listed on the NSE are also presented in Table 6. According to the result, the R-squared is 0.785, and the adjusted R-squared is 0.756, which shows that the explanatory factors account for 75.6% of the variance in risk disclosure. As for the individual independent variables, institutional investor ownership is significant at 10%, while foreign, insider, diverse ownership, company size, profitability are significant at 1%.

Table 6. Results of Comparative Analysis

Risk Disclosure	South Africa	Nigeria
Institutional investors	1.341	−4.363*
	(2.458)	(2.300)
Government	8.130	−14.367
	(7.268)	(9.813)
Foreigners	−9.906***	5.306***
	(2.858)	(1.132)
Insiders	−4.694	56.803***
	(11.965)	(17.020)
Diverse	−0.158	−4.615***
	(4.309)	(1.476)
Company Size	167.546***	360.394***
	(30.240)	(36.174)
Profitability	2.271	6.386***
	(1.380)	(1.468)
Leverage	5.583	18.700
	(6.358)	(15.565)
d_{2015}	59.588	57.405
	(95.247)	(131.724)
d_{2016}	54.885	80.632
	(77.683)	(131.182)
d_{2017}	109.282	−39.319
	(111.699)	(130.389)
d_{2018}	203.904	85.592
	(152.131)	(131.035)
Constant	838.582**	−1214.341***
	(365.706)	(300.256)
R-squared within	0.324	0.785
R-squared Adjusted	0.309	0.756
No. of observations	110	100
F-statistic	3.869	26.535
P-value	0.000	0.000

Standard errors are in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Discussion

The study evaluated how corporations doing business in emerging African countries disclose their risk-related information. Based on content analysis, the findings imply that the risk disclosure trend has been growing over the years of study. Operational risk disclosure is the most frequently disclosed risk information as its appearance dominates strategic and environmental risk disclosure. This result is anticipated as general statements concerning corporate governance, internal control and employee health and safety, etc. were mandatorily categorized as operational risk disclosure. The results are in line with earlier research [3]. Moreover, it would be in the interests of annual report readers to understand the monetary implication of a business's risk exposure to the extent that can facilitate their forecast and decision-making process. Neverthe-

less, the findings show that quantitative/monetary risks are more rarely disclosed than qualitative/non-monetary risks. Hence, the disclosure's relevance to stakeholders is substantially impaired. This finding supported and solidified the results of prior studies [27; 29].

Besides, many stakeholders attributed risks to the occurrence of negative events. Hence, they expect corporate managers to release any bad news that could help them to make their decision. Limiting the definition of risk to the occurrences of negative incidents is considered a pre-modern perception of risk. However, the inclusion of business prospects and opportunities among risks in the modern era have inspired directors to divulge more positive news rather than negative news. The more frequent appearance of positive news rather than negative news has affected the standard of risk disclosure anticipated by different stakeholders. This assertion is justified by our results, which are similar to the previous findings [18]. Likewise, future risk information is more desirable and relevant as stakeholders can quantify the effect of risk and uncertainty on their future earnings. However, it appears that corporate managers always tend to reveal more past risk information than data regarding the future. This can be proven by the results of our investigation and offers strong support for the findings revealed by earlier empirical evidence [18; 27].

On the other hand, ownership structure is described as the determining factor of corporate risk disclosure. For example, the influence of institutional investors in any business cannot be overemphasized. It appears that corporate managers would find the means of improving risk information disclosure provided that the major shareholders are institutional investors. Our results established a positive association between institutional investor ownership and risk disclosure; nevertheless, it is not statistically significant. Consequently, Hypothesis 1 is rejected. This finding is in line with previous studies [19]. Moreover, when the government is among major stakeholders of a company, its ownership may build up public confidence and trust in the company. Government, as policymakers, would urge firms to improve their risk reporting processes in order to convey signals to market participants, and they are committed to policies that benefit stakeholders. We anticipated a positive relationship between risk disclosure and government ownership. This association has been proven; however, the government coefficient is statistically insignificant. This finding is similar with previous research [26], which found that risk disclosure is unrelated to the degree of government ownership. As a result, Hypothesis 2 is rejected.

Meanwhile, in recent years, foreign direct investment has become very common since globalization has offered foreigner investors a wide range of opportunities to invest on different stock exchanges across the globe. It appears that corporate managers are reluctant to release much risk information provided the foreign stake in a company is substantial. However, our findings corroborate the results of previous research [21; 27], which found no link between the two variables. Hypothesis 3 is rejected since our coefficient is not significant. Moreover, corporate managers are reluctant to release much risk information provided the insider stake in a company is substantial. Our findings failed to establish a connection between insider ownership and corporate risk disclosure, as the coefficient is not statistically significant. The findings are consistent with previous studies [5; 7], thus our Hypothesis 4 is rejected. Likewise, the results suggest a positive linear relationship between risk disclosure and diverse ownership. This indicates that firms with a diverse ownership structure are prone to greater pressure to release risk information since a substantial number of company shares are not concentrated in the hands of few individuals. Diverse ownership has a negatively significant coefficient, indicating that because company shares are not concentrated in the hands of a few persons, the company's directors will disclose little risk information. This conclusion contradicts previous investigations [27], which found no link between the two variables. However, the findings are not consistent with the coercive isomorphism theory and do not support Hypothesis 5, hence it is rejected.

Moreover, the study also looks at how ownership structure affects risk disclosure categories (strategic, operational, and environmental). First, we have started with the effect of ownership structure on environmental risk disclosure. The study found that the combined effect of institutional investor, government, foreigner, insider, and diverse ownership, company size, profitability, and leverage had a considerable impact on environmental risk disclosure. In terms of individual effects, only company size and profitability have significant coefficients. This suggests that only large and profitable corporations can affect environmental risk disclosure. Secondly, the study also examines the effect of ownership structure on operational risk disclosure. According to the findings, the combined effect of institutional investors, government, foreigners, insiders, diverse, company size, profitability, and leverage had a significant influence on operational risk disclosure. As for the individual effect, diverse ownership and company size each have a significant coefficient. This indicates that large companies and companies that have not concentrated their ownership structure in the hands of a few persons affect the operational risk information to be disclosed. Similarly, the findings indicate an inverse relationship between operational risk disclosure and diverse ownership. This suggests that organizations with a diverse ownership structure are more likely to face less pressure to provide operational risk information since a significant portion of the company's shares are not concentrated in the hands of a few individuals. This result is similar to that of prior studies [27].

Thirdly, the study examines the effect of ownership structure on strategic risk disclosure. The research shows that strategic risk disclosure is inversely connected to diverse ownership. This demonstrates that when company shares are not concentrated in the hand of few individuals, corporations tend to disclose strategic risks less frequently. In

addition, the coefficient of government ownership is also significant. This indicates that as the government ownership increases, corporations tend to disclose more strategic risk information. The finding supports the previous studies [6; 7; 21; 24] that reveal that the volume of risk disclosure upsurges if government ownership increases. Furthermore, insider ownership coefficient is also statistically significant. This finding suggests that corporate management tends to disclose more information about strategic risks as insider ownership rises. This tendency exists because the majority of information disclosed under strategic risk disclosure is favorable. This type of information can entice prospective investors. This result is inconsistent with other research [26; 28], which discovered an inverse association between insider ownership and risk disclosure. Additionally, in terms of comparative analysis, key ownership structures that affect corporate risk disclosure in South Africa are foreign. Nevertheless, in Nigeria, institutional investor, government, foreign, insider and diverse ownership are all among the main factors that affect corporate risk disclosure.

Conclusion

Research intends to empirically assess the influence of ownership structure on the corporate risk disclosure practice in emerging African countries from 2014 to 2018. The findings unveil that operational risk disclosure is the most frequent risk disclosure practice. Moreover, positive news, non-monetary and historical risk information are more commonly disclosed than negative news, monetary and forward-looking risk information. Furthermore, empirical findings demonstrate that firms with more diverse ownership are likely to divulge less risk information. In contrast, as company size or profitability of the company increases, corporate risk disclosure tends to increase. However, institutional investor, government, foreign, or insider ownership have no individual effect on corporate risk disclosure. The findings of this study reveal vital implications and seek to inform shareholders, regulators and other stakeholders about the relevant factors that influence the dynamics of risk disclosure practice in the emerging African markets. Potential investors and other interested parties would be in a good position to appraise risk disclosure behavior of the firms operating in these markets and make informed decisions. However, the results could not be generalized to all the existing emerging markets in Africa as the study has a small sample size and is limited to the Nigerian Stock Exchange and the Johannesburg Stock Exchange. The sample size could have been bigger, but the dearth of data in the Bloomberg data stream forced us to limit the scope of our analysis exclusively to companies with pertinent data. Future studies could increase the sample size and include more countries in the African region. There is a unanimous assertion that various theories do not work in the African region, hence there is a need to intensify the studies in the African region that may prove or refute this strong assertion.

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Appendix 1. Risk Disclosure Checklist

1) Operational risk is the likelihood of losses occurring in the core business operations of the company. Operational risk includes things like:
   - Product failure;
   - Internal control and risk management policies;
   - Infrastructure risk;
   - Liquidity and cash flow;
   - Project failure;
   - Operational disruption;
   - Operational problem;
   - Employment practices and workplace safety (H &S);
   - Environment risk (risks arising from the impact of companies' operations on the natural environment);
   - Compliance and reputation;
   - Legal risk.
2) Environmental risk is a result of variables that are fundamentally out of the organization's control and includes disclosure relating to the following:
   - Economic risk (e.g., interest rate, currency risk, price and commodity, inflation, taxation, credit risk);
   - Political risk;
   - Social risk;
   - Regulation and Legislation;
   - Industry sources (e.g., competition, potential entrants, suppliers, substitutes, strategic partners,
   - customers (e.g., changes in demand, changes in clients requirements and customers preferences);
   - Climate and catastrophic.
3) Strategic risks are linked to the company's future business objectives and strategies and result from operating in a specific industry. Among the strategic hazards are
   - Research and Development
   - Product market
   - Intellectual property right
   - Acquisitions, alliances, joint ventures
   - Management of growth
   - Derivatives
   - Investment
   - Technology.

Appendix 2. Decision rules for risk disclosures

1) A new risk definition perfective has been established to help detect risk and classify it as risk disclosures.
2) The definition of risk is, "if the reader is informed of any opportunity or prospect, as well as any risk, danger, harm, threat, or exposure, that has already had an impact on the company or that may have an impact in the future, or of the management of any such opportunity, prospect, risk, harm, threat, or exposure" Linsey and Shrive.
3) The definition of risk that has just been given must be considered to include both good and bad risks as well as uncertainties.
4) Even if risk is broadly defined, disclosures must be made explicitly; they cannot be implied.
5) The risk disclosures must be categorized using the risk categories presented in the Appendix 1
6) General policy statements relating to corporate governance, employee health and safety, and internal control and risk management systems are to be categorized as "non-monetary/neutral/non-time".
7) General statements of risk management policy that do not refer to money or specific dates or times are categorized as non-monetary, neutral, or non-time.
8) Financial risk disclosures are risk disclosures that either directly disclose the financial impact of a risk or provide enough information to allow the reader to determine the financial impact of a risk.
9) Information will be categorized into the category that is most highlighted in the sentence if a sentence has more than one possible categorization.
10) Risk information may occasionally be given in tables. In this case, it should be understood that one line corresponds to one sentence, and the classification should be done as such.
11) It is common for a disclosure to be made more than once. In that case, any repeated disclosures must be recorded as a risk disclosure sentence.
12) A disclosure shall not be recorded as a risk disclosure if it is vague.

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Impact of Board Members' Social Capital on the Resilience of Public Companies to Exogenous Shocks

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Abstract

The objective of this study is to estimate the impact of board members' social capital on firms' market-based metrics of resilience to exogenous shocks. The social capital of directors was measured by their professional, political, and international connections. Firms' resilience was evaluated based on their ability to resist and recover from the impact of shocks, as determined by stock market data. The data covers the period from 2007 to 2020 for over 200 Russian companies whose shares were included in the calculation of the Moscow Exchange Broad Market Index. During this period, three exogenous shocks occurred: the global financial crisis of 2008–2009, commodity price shock and sanctions in 2014–2015, and the COVID-19 pandemic in 2020. The system generalized method of moments is used to estimate the effect of directors' connections on the ability to mitigate shocks, while OLS with robust standard errors is used to reveal the influence of directors' connections on firms' ability to recover from shocks. The results indicate that professional connections moderated the negative impact on firms' resistance to shocks and improved recovery speed during the global financial crisis. However, this type of connection reduced stock recovery speed after the COVID-19 crisis. Political and international connections have different effects on market-based metrics of firm resilience. It is possible that shocks of different nature require firms to leverage various forms of social capital from their directors in order to mitigate the negative effects of such shocks.

Keywords: social capital, firm resilience, exogenous shocks, board of directors, directors' connections, network analysis

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Introduction

Over the past 15 years, Russian financial markets have faced several severe shocks of different natures. In 2008–2009, the subprime mortgage crisis in the USA led to a sharp capital flight from Russia and a decline in oil and commodity prices. In 2014–2015, a commodity price shock occurred, and its negative effects were further amplified by the implementation of sanctions against the Russian economy and companies. In 2020, the COVID-19 pandemic slowed down economic activity, which was reflected in reduced demand for oil and gas, decreased consumer spending, and the disruption of supply chains. In 2022, the Russian economy experienced new sanction packages, the ultimate impact of which will become known in the future. Despite the differences in the nature of these shocks, they all had a negative effect on financial markets and, in particular, on the share prices of companies.

Firms react differently to external shocks, leading to a search for factors that enhance the resilience of corporate market indicators. The concept of resilience can be defined as "the ability of companies to reduce the impact of shocks and recover from them by transforming their structure and means of functioning in the face of long-term pressure, change, and uncertainty" [1]. Research has shown that one of the core factors that can reduce the negative impact of exogenous shocks is corporate governance [2–4], with a significant role played by CEOs [4; 5] and boards of directors [6; 7].

Boards can influence investor expectations during exogenous shocks through several channels. First, they can offer qualified governance, which increases the company's resistance to market turmoil. For example, more independent boards increase the survival probability of firms during crises [8], while more diverse boards may provide better governance, especially during shocks [9]. Additionally, directors can provide essential resources, including valuable knowledge and connections, which are limited during crises. However, existing studies pay little attention to the importance of the resource-providing role of directors during crises, usually focusing only on firm performance [10].

The study of the impact of directors' connections on corporate resilience is particularly relevant for Russian companies. First, the instability of the economic situation in Russia, due to the constant pressure of shocks, leads to high volatility of stock prices, highlighting the need to identify factors that enable companies to withstand and recover from such shocks. Secondly, researchers note that in developing countries, including Russia, the role of top managers' connections is crucial for ensuring access to various resources, such as state support and information, which can affect company performance and investor expectations [11]. Thus, the goal of the current study is to determine the impact of board members' connections on the resilience of Russian traded companies to exogenous shocks.

The empirical part of the study is based on a database of large listed Russian companies included in the Moscow Stock Exchange Broad Market Index (MICEX BMI). The final analyzed sample consists of 1854 firm-year observations between 2007 and 2020. We use two metrics of corporate resilience based on stock prices: the standard deviation of daily stock returns [12; 13] and the speed of stock price recovery to pre-crisis levels [14–16]. Board members' connections are measured based on three types of connections: professional, political, and foreign.

This paper contributes to the literature in three main ways. First, using agency theory, resource dependence theory, and the theory of upper echelons, we argue that firms' market-based resilience to exogenous shocks can be influenced by board members' connections. Second, we propose and empirically test two metrics of market-based firm resilience: one characterizes resistance to shock pressure, and the other measures the speed of recovery. Third, we analyze different crises separately, as they vary in nature. The results confirm that board connections play different roles in firm resilience depending on the crisis. For instance, professional connections enhanced firms' resilience to the market shock of 2008, but their significance decreased during the 2014 crisis and the COVID-19 pandemic. Political and international connections had varying impacts during the crises considered.

Literature Review

Directors' social capital

This research examines the role of the board of directors in a company from the perspective of organizational theories. The most commonly cited theories are agency theory [17; 18] and resource dependence theory [19]. The former focuses on the board's monitoring function, which prevents managers from engaging in opportunistic behavior. The latter emphasizes directors' ability to provide unique resources to a company, such as information and power, which can create a competitive advantage. However, these theories do not directly link the personal characteristics of directors to firm performance. Corporate strategy and actions are proposed through communication and interaction between board members, and this within-group interaction may be influenced by the personal characteristics of the directors.

The upper echelons theory [20] proposes that corporate decisions are based on the cognitive features of decision-makers, which can be observed through different personal characteristics, such as age, experience, education, and others [21]. The influence of directors' personal characteristics on corporate performance [10; 22] and resilience [4; 5] is a highly discussed topic in the literature. One important characteristic that influences corporate performance is social capital [10; 23; 24]. Social capital refers to a director's ability to mobilize resources by using social ties and relations with social structures [25–27]. Based on this definition, empirical studies focus on various directors' connections, such as professional [22; 28], political [29; 30], educational [12], international [31], and others.

A director's social capital comes from connections with social structures. According to the upper echelons theory, these connections are observable characteristics of directors that can influence the decision-making process and firm performance. Following the resource dependence theory, directors' connections are sources of resources that a director can bring to a company. In turn, according to the agency theory, connections can influence a director's incentives to perform duties efficiently (e.g., reduce monitoring efforts) [32; 33]. Therefore, these theories suggest that directors' connections, which form social capital, can affect corporate performance.

Directors' connections as a factor of firm resilience

Although the literature has analyzed the effect of board members' social capital on firm performance and the impact of corporate governance on firm resilience (or adaptation to crises), the effect of different types of board social capital on firm resilience to various exogenous shocks has not been addressed so far. Previous studies usually highlight the importance of the board of directors during exogenous shocks – unexpected external occurrences such as the 2008–2009 financial crisis and the COVID-19 pandemic. Researchers have shown that board independence was an important factor in overcoming the financial crisis in the US [34], Russia [8], China [35], Spain [36], and other European countries [37]. Board size also influenced firm performance during the crisis in Brazil [38] and Spain [36]. The recent paper by E. Croci et al. (2024) estimates the role of board characteristics in stock price changes around disruptive events such as storms, fires, and cyberattacks [39].

Researchers also examine the influence of boards on firms during crises by addressing the notion of resilience. Corporate resilience can be defined as "a firm's ability to recover from disruptive events" [40] or as "the ability of systems to absorb and recover from shocks while transforming their structures and means for functioning in the face of long-term stresses" [1].

Some studies examine the impact of directors' social capital, created through different types of connections, on firm performance in times of crisis, suggesting that higher performance in turbulent times indicates greater firm resilience. For instance, M. Carpenter and J. Westphal [41] provide evidence that directors' connections impact firm resilience. E. Croci et al. (2024) show that directors' busyness, i.e. high number of professional connections, increases cumulative average returns around shocks and even 12 and 36 months after [39].

Directors' professional connections may increase the board's ability to gather information, improving communication within the board and decision-making processes [42]. R. Carney et al. [43] show the positive effect of professional ties on performance around the 2008–2009 crisis. Although there may be no significant impact on firm performance during stable periods [44], the importance of directors' connections can increase in turbulent times, due to greater access to resources [45]. However, several studies show the negative effect of professional connections on firm performance in turbulent times [35; 46], as a high number of connections, termed "busyness," can lead to a lack of time to efficiently fulfill duties. This may reduce the effectiveness of the directors' management monitoring functions and exacerbate agency problems, resulting in poorer financial performance [47; 48] and reduced resilience. Given the increasing importance of social capital in developing capital markets, we align with the first stream of literature and formulate the first hypothesis as follows:

H1: Directors' professional connections reduce the effects of exogenous shocks on firms' market-based metrics of resilience.

Directors' political connections may help firms gain access to financial and informational support from the government [49]. However, empirical evidence presents mixed results on the impact of political connections on firms. On the one hand, such directors may increase a firm's market value [50]. On the other hand, they may underperform in their monitoring and other responsibilities due to a busy schedule, thereby reducing firm value [51; 52]. A. Panibratov et al. [53] show the importance of political connections for the performance of Russian firms. Such connections may therefore be valuable for resilience, leading to the second hypothesis:

H2: Directors' political connections decrease the effects of exogenous shocks on firms' market-based metrics of resilience.

Directors' international connections may positively impact firm value by providing access to the best corporate governance practices [31] and by exercising an effective supervisory function, particularly in controlling investment activities [54]. This can increase the efficiency of companies and make them more resilient in times of increasing turbulence. Thus, the third hypothesis is:

H3: Directors' international connections reduce the effects of exogenous shocks on firms' market-based metrics of resilience.

Data and Methodology

Data sources

The study uses data on Russian non-financial public joint stock companies whose shares were included in the calculation of the Moscow Exchange Broad Market Index (MICEX BMI). This index includes stocks selected based on capitalization, liquidity, and free-float. The capitalization of these companies represents more than 80% of the total market capitalization of companies traded on the Moscow Exchange, making the sample representative of Russian listed companies. The use of data from Russian companies is justified by the significant role that connections play in doing business [11], forming social capital, and acting as a source of limited resources. Additionally, the presence of multiple shocks affecting the Russian economy highlights the relevance of identifying factors of firm resilience.

The data were collected for the period from 2007 to 2020. Consolidated financial statements (IFRS) were obtained from SPARK-Interfax, information on board members from annual reports, market capitalization data from Refinitiv Eikon, and stock prices from the Moscow Exchange.

This paper analyzes the impact of three exogenous shocks on the resilience of Russian companies: the global financial crisis of 2008–2009, the commodity crisis and sanctions of 2014–2015, and the crisis caused by the COVID-19 pandemic in 2020. Although all three crises resulted in economic downturns that affected Russia's GDP growth rate, they were different in nature. The impact of each crisis on the resilience of Russian companies is analyzed separately using a set of dummy variables.

Measurement of resilience

Taking into account the diverse interpretations of resilience provided by numerous papers on this topic, we explore two aspects of firm resilience: the ability to resist and the ability to recover from disruptive events [1]. Following E. Conz and G. Magnani [55], the former measures a dynamic aspect of resilience, while the latter regards resilience as an attribute that allows the firm to return to a stable equilibrium. We measure these using stock market data.

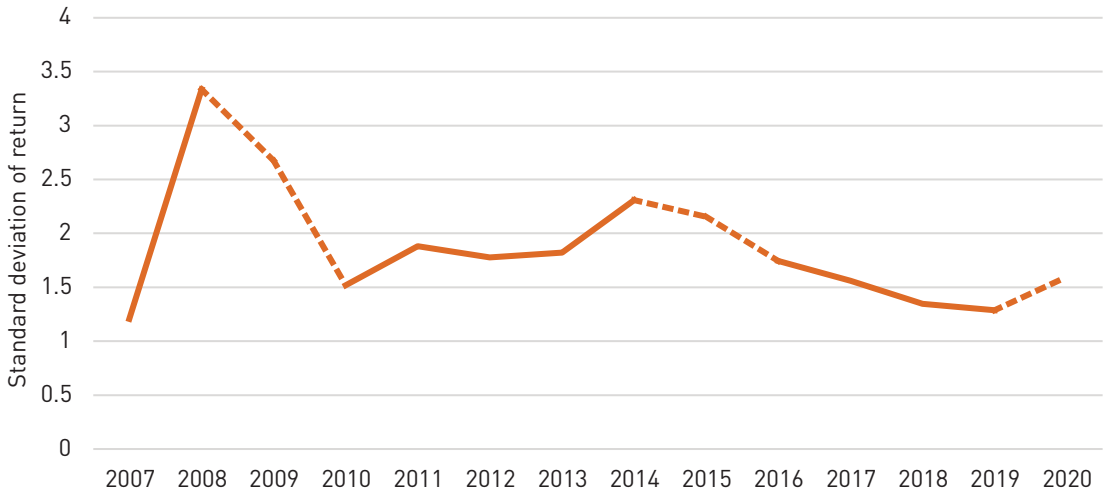
The efficient market hypothesis [56] suggests that stock prices reflect all available information. Therefore, the market reassesses the expected contribution of the board's social capital to the company's recovery from external shocks [57]. If investors anticipate that a company will be significantly affected by a shock – indicating that the firm lacks resilience – they are more likely to sell its shares, leading to a decline in share price and increased volatility.

Researchers employ various market-based indicators to estimate firm performance during crises: abnormal stock returns [34; 58], cumulative returns [37; 40], crash risk [59], Tobin's Q coefficient [60], and corporate risk-taking [12; 13; 61]. In this study, we calculate the metric related to a company's risk-taking – the standard deviation of the company's stock returns for each year – using the following equation:

$$SD\,of\ stock\ returns_{i,t} = \sum_{w=1}^{W}\sqrt{\frac{1}{N-1}\cdot\sum_{d=1}^{N}\left(ret_{i,t,w,d}-\frac{1}{N}\sum_{d=1}^{N}ret_{i,t,w,d}\right)}, \quad (1)$$

where $ret_{i,t,w,d}$ is the rate of return for firm i in year t in week w on day d. N denotes the total number of days in each week, and W represents the total number of weeks (w) in each year (t). We compute the standard deviations of a firm's stock returns for each week and then sum them. Alternatively, researchers also consider the standard deviations of daily, weekly, and monthly stock returns for each year [61], but these measures may smooth the increased volatility during exogenous shocks. Equation (1) allows us to control for this and identify stocks with the highest volatility. We assume that companies with higher standard deviations of returns can be considered less resilient. Figure 1 illustrates that higher values occur during periods of shock, decreasing as the market reassesses the companies' risk.

Figure 1. Dynamics of the average standard deviation of companies' stock returns (the dotted line indicates crisis periods)



The other aspect of resilience that we investigate is the speed with which companies recover. This can be determined by analyzing stock prices and calculating the number of days required to return to pre-crisis levels [14–16]. To define the beginning and end of crises, we track the value of the Moscow Exchange Index (IMOEX, formerly MICEX) and monitor news reports. It is noteworthy that after the Global Financial Crisis (May 19, 2008), the IMOEX did not recover to its pre-crisis level until April 2016. Therefore, we selected the end dates as presented in Table 1, assuming that after these dates, the effects of the crises are either eliminated or minimized. Subsequently, the recovery speed was calculated for each company as the number of days it took for the company's common stock price to return to its pre-crisis level.

Table 1. Dates of crises*

Crisis	Start date	End date
Global financial crisis 2008–2009	19.05.2008	12.04.2011
Commodity price shock and sanctions implementation in 2014–2015	18.02.2014	16.02.2015
COVID-19 pandemic in 2020	20.01.2020	14.12.2020

* The start dates of crises are identified based on the beginning of the decline in IMOEX values. For the 2008–2009 crisis, the end date is determined as the date when the maximum value of the index was observed from the beginning of the crisis until 2014. Similarly, for the 2014–2015 crisis, the end date is considered the maximum value of the index after the signature of the Second Minsk Agreement (February 12, 2015).

Measurement of directors' connections

This paper investigates the social capital of board members formed through different types of connections. Board members establish professional ties through simultaneous service on boards, facilitating the sharing of experience and information. Political ties derive from board members' experience in public administration, while international ties involve connections with foreign companies and institutions [12].

To measure the social capital formed by professional connections, we utilized a social network analysis (SNA) approach, focusing on centrality metrics: degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality [62; 63]. SNA is preferred for measuring professional connections because it captures multiple dimensions such as connection quality and each director's position in the network [64]. Centrality metrics are constructed using graphs where vertices represent board members and edges represent professional connections based on shared board service. Appendix 1 displays the constructed graphs.

- **Degree centrality** quantifies the number of professional ties normalized by the maximum possible number.
- **Betweenness centrality** identifies directors who act as bridges, influencing information flow between other directors [65].
- **Closeness centrality** is calculated as the average length of the shortest paths between directors [65], showing how quickly a director can access information or resources from others in the network.
- **Eigenvector centrality** assesses the degree to which a director's centrality in the network is related to the centrality of their neighbors [66].

The calculation of these variables is described in detail in Appendix 2.

The variables are used separately when testing the impact of professional connections on firm resilience. We do this for several reasons. Firstly, the variables are correlated and so including them simultaneously in the model can lead to the problem of multicollinearity. Secondly, considering them separately allows us to examine the effect of professional ties on firm resilience from different perspectives. However, we can identify the overall effect of professional ties by aggregating the four centrality measures using principal components analysis.

Previous studies have employed diverse methods to identify political connections of board members, including informal ties with politicians formed during education or sports [67]. However, formal ties based on board members' experience in public administration are more commonly used [30; 68]. Information on formal ties is readily available in annual reports and better explains changes in firm performance compared to informal ties [69]. In this study, political ties are measured by board members' experience in public authorities such as the Federation Council, State Duma, Government of the Russian Federation, Supreme Court of the Russian Federation, and regional and municipal authorities.

Board members' international connections are identified based on their birthplace or experience in foreign companies, indicating exposure to international corporate governance practices [31; 53]. Research indicates that a higher proportion of foreign board members in Russian companies positively impacts market value [70], suggesting that international connections can enhance a company's market-based resilience to external shocks.

Control variables that may influence corporate market resilience include firm size, board size, proportion of independent directors, financial leverage, government ownership, and market-to-book ratio [35; 43].

Estimation method and descriptive statistics

The first model investigates how the social capital of directors influences the ability of firms to withstand shocks during crises. The equation is formulated as follows:

$$AS_{it} = \eta_i + \alpha_1 AS_{it-1} + SC_{it-1} \bullet \beta + Crisis_t \bullet \gamma + \\ + SC_{it-1} \bullet Crisis_t \bullet \delta + CV_{it} \bullet \theta + \varepsilon_{it}, \quad (2)$$

where AS_{it} is the ability to resist shocks measured by the standard deviations of stock returns, SC_{it-1} is the social capital vector consisting of directors' professional, political, and international connections, $Crisis_t$ is the vector of crisis dummy variables, CV_{it} is the vector of control variables, η_i is the company fixed effect, and ε_{it} is the model standard error. In this model we focus on the coefficient δ, which indicates the moderating effect of directors' social capital on firm resilience.

We incorporate the past value of the resilience metric as an independent variable into the equation on the basis of two assumptions. First, firm resilience is a dynamic process [56], suggesting that internal resources can accumulate over time, enhancing robustness and adaptability to future shocks. Second, we calculate the resilience metric using company stock prices: stakeholders and investors take all available information into account [55; 57], and so firms' past resilience may be reflected in present-day share prices, affecting current resilience.

The dynamic panel data models are estimated using the system generalized method of moments [71]. This method is chosen to mitigate endogeneity issues commonly encountered in studies examining the impact of corporate governance on firm performance [9; 12]. Lagged values of social capital metrics are included to capture potential delayed effects and further address endogeneity.

Table 2 presents the descriptive statistics of the variables used. All financial variables were winsorized to minimize the influence of outliers. The average board size of 9 aligns with findings from previous research [9; 70; 72]. However, the sample size is reduced due to the use of IFRS consolidated financial statements, which were not published by all companies during the study period.

Table 2. Descriptive statistics of variables

Variable	N	Mean	St. Dev.	Min	Q25	Median	Q75	Max
SD of stock return – ability to resist	1037	1.710	1.465	0.228	0.975	1.293	1.881	18.650
Financial leverage	1037	0.573	0.268	0.161	0.356	0.539	0.752	1.158
Firm size	1037	519 192	1 997 815	17	15 009	74 201	273 624	22 617 267
Logarithm of firm size	1037	11.034	1.884	7.026	9.616	11.215	12.520	13.947
Board size	1037	9.763	2.700	5	7	9	11	23
Share of independent directors	1037	0.217	0.224	0.000	0.000	0.182	0.364	1.000
Market to book value	1037	1.141	0.562	0.432	0.724	0.993	1.389	2.550
ROA	1037	0.187	0.200	0.000	0.000	0.125	0.300	1.200
Government ownership	1037	0.124	0.190	0.000	0.000	0.000	0.200	0.909
Share of directors with political connections	1037	0.008	0.004	0.001	0.006	0.007	0.010	0.031
Share of directors with international connections	1037	0.002	0.003	0.000	0.000	0.001	0.003	0.031
Mean degree centrality	1037	0.079	0.061	0.002	0.008	0.095	0.126	0.223
Mean betweenness centrality	1037	0.055	0.130	0.000	0.000	0.000	0.021	1.000
Mean closeness centrality	1037	0.336	1.690	–1.676	–1.026	–0.055	1.063	8.190
Mean eigenvector centrality	1037	0.057	0.100	–0.160	0.007	0.053	0.118	0.258
PCA professional connections	1037	0.166	0.268	0.000	0.000	0.000	0.340	0.950

Note: see Appendix 2 for a detailed description of variables.

Source: authors' calculations.

The second model estimates the effect of directors' social capital on the speed of firm recovery. The sample is divided into three subsamples corresponding to each exogenous shock. The models are estimated using OLS with White's robust standard errors. The equations for each subsample are specified as follows:

$$RS_{i,2008-2011} = \alpha_0 + SC_{i,2008} \cdot \beta + \\ + FIN\_CV_{i,2007} \cdot \theta + NF\_CV_{i,2008} \cdot \gamma + \varepsilon_i; \quad (3)$$

$$RS_{i,2014-2015} = \alpha_0 + SC_{i,2014} \cdot \beta + FIN\_CV_{i,2013} \cdot \theta + \\ + NF\_CV_{i,2014} \cdot \gamma + \varepsilon_i; \quad (4)$$

$$RS_{i,2020} = \alpha_0 + SC_{i,2019} \cdot \beta + FIN\_CV_{i,2018} \cdot \theta + \\ + NF\_CV_{i,2019} \cdot \gamma + \varepsilon_i, \quad (5)$$

where $RS_{i,2008-2011}$ is the recovery speed after the global financial crisis, $RS_{i,2014-2015}$ is the recovery speed after the commodity price shock and implementation of sanctions, and $RS_{i,2020}$ is the recovery speed after the COVID-19 shock; $SC_{i,t}$ is the vector of lagged values of social capital metrics; $FIN\_CV_{i,t}$ is the vector of control variables: the logarithm of firm size, market-to-book ratio, ROA, and financial leverage; $NF\_CV_{i,t}$ is the vector of non-financial control variables: a dummy variable for government ownership, industry dummy variables controlling for their effects, and board size; and α_0 is the constant.

We examine how firm characteristics at the onset of each shock influence the speed of stock price recovery. By focusing on these periods, we consider the information available

to investors from various sources. For instance, during the onset of COVID-19 in January-February 2020, investors did not have access to 2019 annual reports but could gather non-financial information from other reports and official websites.

Table 3 presents descriptive statistics of the recovery speed of companies after each shock. We see that these shocks had different strengths judging from the number of days it took for stock prices to recover. The minimum and maximum values show the heterogeneity in recovery speeds.

Table 3. Descriptive statistics of recovery speed

Crisis	N	Mean	St. Dev.	Min	Q25	Median	Q75	Max
Recovery speed after the global financial crisis in 2008–2009	45	614.2	147.7	66	581	676	706	717
Recovery speed after the commodity price shock and sanctions implementation in 2014–2015	96	153.7	83	3	73.5	165.5	236.5	250
Recovery speed after the COVID-19 shock	127	141.9	82.4	0	67	173	218	227

Note: the recovery speed is calculated as the number of days required for company stock prices to reach their pre-crisis levels (closing price at the crisis starting date, presented in Table 1).

Source: authors' calculations.

Results

Ability to absorb the negative effects of shocks

Tables 4 and 5 includes two panels. Panel A presents the estimated results for degree centrality (columns 1–3), closeness centrality (columns 4-6), and betweenness centrality (columns 7–9) regarding their influence on firms' ability to absorb the negative effects of the considered shocks. Panel B displays the results for eigenvector centrality (columns 1–3) and the aggregated metric of professional connections (columns 4–6), derived from centrality metrics using principal component analysis (PCA).

Table 4. Panel A. Relation between directors' social capital and firms' ability to absorb negative effects of shocks

	SD of stock returns (ability to absorb shocks)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SD of daily stock returns$_{t-1}$	0.365**	0.543**	0.550**	0.369**	0.542**	0.550**	0.367**	0.540**	0.549**
	(0.058)	(0.056)	(0.056)	(0.058)	(0.057)	(0.056)	(0.059)	(0.057)	(0.056)
Share of directors with political connections$_{t-1}$	−0.506**	−0.080	−0.323*	−0.518**	−0.082	−0.316*	−0.507**	−0.100	−0.311*
	(0.176)	(0.154)	(0.176)	(0.176)	(0.154)	(0.179)	(0.176)	(0.153)	(0.178)
Share of directors with international connections$_{t-1}$	−0.795**	−0.401**	−0.528**	−0.780**	−0.415**	−0.551**	−0.800**	−0.418**	−0.559**
	(0.157)	(0.113)	(0.125)	(0.154)	(0.111)	(0.127)	(0.155)	(0.110)	(0.131)
Degree centrality$_{t-1}$	5.584	5.072	6.533						
	(17.438)	(10.173)	(12.074)						
Closeness centrality$_{t-1}$				0.399	−0.133	−0.047			
				(1.024)	(0.777)	(0.800)			

	SD of stock returns (ability to absorb shocks)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Betweenness centrality$_{t-1}$							−9.489	−10.499	−12.258*
							(9.164)	(7.300)	(7.274)
Crisis 2008–2009	0.469*	0.544**	0.545**	0.617**	0.565**	0.572**	0.456*	0.568**	0.574**
	(0.270)	(0.116)	(0.117)	(0.230)	(0.126)	(0.128)	(0.212)	(0.125)	(0.127)
Crisis 2014–2015	0.584**	0.773**	0.514**	0.577**	0.798**	0.510**	0.574**	0.847**	0.507**
	(0.125)	(0.212)	(0.119)	(0.117)	(0.239)	(0.114)	(0.117)	(0.255)	(0.114)
Crisis 2020	0.252**	0.321**	0.459*	0.265**	0.311**	0.249*	0.235**	0.300**	0.199
	(0.091)	(0.075)	(0.206)	(0.101)	(0.081)	(0.150)	(0.091)	(0.076)	(0.127)
Share of directors with political connections$_{t-1}$ • Crisis 2008–2009	1.199**			1.253**			1.135**		
	(0.375)			(0.370)			(0.382)		
Share of directors with political connections$_{t-1}$ • Crisis 2014–2015		−1.321*			−1.311*			−1.151*	
		(0.736)			(0.699)			(0.599)	
Share of directors with political connections$_{t-1}$ • Crisis 2020			0.721*			0.671*			0.629*
			(0.284)			(0.296)			(0.296)
Share of directors with international connections$_{t-1}$• Crisis 2008–2009	1.392**			1.237**			1.301**		
	(0.418)			(0.466)			(0.478)		
Share of directors with international connections$_{t-1}$• Crisis 2014–2015		−0.871*			−0.885*			−0.927*	
		(0.426)			(0.447)			(0.469)	
Share of directors with international connections$_{t-11}$• Crisis 2020			−0.157			−0.085			−0.084
			(0.292)			(0.291)			(0.294)

	SD of stock returns (ability to absorb shocks)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Degree centrality$_{t-11}$• Crisis 2008–2009	–16.283								
	(18.368)								
Degree centrality$_{t-11}$• Crisis 2014–2015		8.207							
		(28.919)							
Degree centrality$_{t-11}$• Crisis 2020			–34.988*						
			(19.631)						
Closeness centrality$_{t-11}$• Crisis 2008–2009				–3.690**					
				(1.185)					
Closeness centrality$_{t-11}$• Crisis 2014–2015					0.440				
					(1.543)				
Closeness centrality$_{t-11}$• Crisis 2020						–1.248			
						(1.641)			
Betweenness centrality$_{t-11}$• Crisis 2008–2009							–58.917*		
							(23.223)		
Betweenness centrality$_{t-11}$• Crisis 2014–2020								–17.586	
								(18.314)	
Betweenness centrality$_{t-11}$• Crisis 2020									–19.930
									(46.123)
Financial leverage	0.403*	0.238	0.250	0.398*	0.236	0.247	0.413*	0.240	0.249
	(0.235)	(0.224)	(0.228)	(0.235)	(0.226)	(0.229)	(0.232)	(0.225)	(0.227)
ROA	0.263	0.084	0.173	0.249	0.087	0.164	0.256	0.077	0.159
	(0.795)	(0.636)	(0.663)	(0.791)	(0.643)	(0.664)	(0.793)	(0.644)	(0.665)

	SD of stock returns (ability to absorb shocks)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Logarithm of board size	0.616**	0.372**	0.388**	0.644**	0.407**	0.422**	0.647**	0.400**	0.423**
	(0.195)	(0.131)	(0.130)	(0.174)	(0.126)	(0.125)	(0.167)	(0.121)	(0.123)
Government ownership	–0.579**	–0.496**	–0.487**	–0.548**	–0.453**	–0.458**	–0.493**	–0.405**	–0.420**
	(0.157)	(0.121)	(0.123)	(0.142)	(0.110)	(0.113)	(0.134)	(0.103)	(0.104)
Logarithm of firm size	–0.056*	–0.037	–0.038	–0.061*	–0.039	–0.039	–0.057*	–0.036	–0.038
	(0.031)	(0.024)	(0.025)	(0.032)	(0.026)	(0.026)	(0.032)	(0.026)	(0.026)
Share of independent directors	–0.316*	–0.230*	–0.250*	–0.308*	–0.211	–0.230*	–0.280*	–0.199	–0.214
	(0.147)	(0.134)	(0.133)	(0.139)	(0.129)	(0.126)	(0.147)	(0.133)	(0.131)
Market-to-book value	0.099	0.102	0.103	0.091	0.095	0.098	0.080	0.089	0.093
	(0.080)	(0.065)	(0.066)	(0.081)	(0.067)	(0.067)	(0.081)	(0.067)	(0.067)
J-test	115.8	116.2	116	115.9	114.5	116.2	115.7	116.4	116.1
AR(2)	–0.39	–0.28	–0.27	–0.38	–0.28	–0.28	–0.39	–0.28	–0.29
Wald test	3091.1**	4858.7**	4815**	3010.8**	4612.5**	4858.7**	2995.1**	4524.9**	4659.3**

Note: *p < 0.1, *p < 0.05, **p < 0.01. See Appendix 2 for variables descriptions and calculations. J-test measures the validity of the instrument. AR(2) checks for the absence of the second-order correlation. Wald test shows the joint significance of the independent variables.

Source: authors' calculations.

Table 5. Panel B. Relation between directors' social capital and firms' ability to absorb negative effects of shocks

	SD of stock returns (ability to absorb shocks)					
	(1)	(2)	(3)	(4)	(5)	(6)
SD of daily stock returns$_{t-1}$	0.372**	0.537**	0.548**	0.370**	0.538**	0.547**
	(0.057)	(0.057)	(0.056)	(0.058)	(0.056)	(0.055)
Share of directors with political connections$_{t-1}$	–0.514**	–0.106	–0.329*	–0.497**	–0.092	–0.320*
	(0.175)	(0.150)	(0.178)	(0.172)	(0.154)	(0.178)
Share of directors with international connections$_{t-1}$	–0.808**	–0.410**	–0.566**	–0.820**	–0.431**	–0.574**
	(0.153)	(0.108)	(0.130)	(0.154)	(0.110)	(0.129)
Eigenvector centrality$_{t-1}$	–0.414*	–0.184	–0.320*			
	(0.249)	(0.184)	(0.180)			

	SD of stock returns (ability to absorb shocks)					
	(1)	(2)	(3)	(4)	(5)	(6)
PCA professional connections$_{t-1}$				−0.037	−0.028	−0.029
				(0.030)	(0.020)	(0.021)
Crisis 2008–2009	0.493*	0.577**	0.583**	0.416*	0.586**	0.593**
	(0.192)	(0.125)	(0.127)	(0.199)	(0.122)	(0.124)
Crisis 2014–2015	0.566**	0.871**	0.504**	0.567**	0.819**	0.503**
	(0.116)	(0.262)	(0.113)	(0.119)	(0.253)	(0.116)
Crisis 2020	0.247**	0.313**	0.234*	0.223*	0.295**	0.152
	(0.086)	(0.074)	(0.126)	(0.095)	(0.077)	(0.114)
Share of directors with political connections$_{t-1}$ • Crisis 2008–2009	1.109**			1.151**		
	(0.364)			(0.373)		
Share of directors with political connections$_{t-1}$ • Crisis 2014–2015		−1.095*			−1.194*	
		(0.544)			(0.660)	
Share of directors with political connections$_{t-1}$ • Crisis 2020			0.647*			0.694*
			(0.280)			(0.283)
Share of directors with international connections$_{t-1}$ • Crisis 2008–2009	1.130**			1.250**		
	(0.416)			(0.437)		
Share of directors with international connections$_{t-1}$ • Crisis 2014–2015		−1.017*			−0.932*	
		(0.499)			(0.457)	
Share of directors with international connections$_{t-1}$ • Crisis 2020			−0.147			−0.107
			(0.300)			(0.301)
Eigenvector centrality$_{t-1}$ • Crisis 2008–2009	−1.763*					
	(0.738)					
Eigenvector centrality$_{t-1}$ • Crisis 2014–2015		−1.303*				
		(0.542)				
Eigenvector centrality$_{t-1}$ • Crisis 2020			−0.660			
			(0.520)			

	SD of stock returns (ability to absorb shocks)					
	(1)	(2)	(3)	(4)	(5)	(6)
PCA professional connections$_{t-1}$ • Crisis 2008–2009				–0.072*		
				(0.042)		
PCA professional connections$_{t-1}$ • Crisis 2014–2015					–0.014	
					(0.048)	
PCA professional connections$_{t-1}$ • Crisis 2020						–0.060
						(0.052)
Financial leverage	0.405*	0.246	0.248	0.392*	0.235	0.244
	(0.232)	(0.227)	(0.227)	(0.233)	(0.226)	(0.228)
ROA	0.198	0.044	0.127	0.227	0.065	0.148
	(0.789)	(0.643)	(0.663)	(0.796)	(0.648)	(0.669)
Logarithm of board size	0.688**	0.440**	0.461**	0.676**	0.429**	0.450**
	(0.172)	(0.121)	(0.123)	(0.172)	(0.122)	(0.123)
Government ownership	–0.463**	–0.402**	–0.408**	–0.430**	–0.376**	–0.376**
	(0.137)	(0.105)	(0.109)	(0.137)	(0.106)	(0.110)
Logarithm of firm size	–0.065*	–0.045*	–0.045*	–0.063*	–0.043*	–0.044*
	(0.032)	(0.025)	(0.026)	(0.031)	(0.025)	(0.025)
Share of independent directors	–0.248*	–0.196	–0.198	–0.239*	–0.177	–0.188
	(0.143)	(0.134)	(0.131)	(0.137)	(0.130)	(0.126)
Market-to-book value	0.072	0.085	0.089	0.071	0.081	0.084
	(0.081)	(0.068)	(0.067)	(0.081)	(0.068)	(0.068)
J-test	114.8	115.7	115.6	115.6	116.2	117
AR(2)	–0.4	–0.25	–0.29	–0.4	–0.29	–0.29
Wald test	3243.6**	4605.3**	5025.1**	3160.8**	4654.1**	4998.6**

Note: *p < 0.1, *p < 0.05, **p < 0.01. See Appendix 2 for variables descriptions and calculations. J-test measures the validity of the instrument. AR(2) checks for the absence of the second-order correlation. Wald test shows the joint significance of the independent variables.

Source: authors' calculations.

In this part of the research, we focus on the coefficients of interaction between social capital measures and crisis dummy variables. A negative sign implies that a specific type of director connection mitigates the negative impact of a given shock on the standard deviation of daily stock returns. This indicates an enhanced ability to resist the adverse effects of the shock, thereby reflecting higher resilience from the market's perspective.

Table 5 supports the positive influence of directors' professional connections on firm resilience during the global financial crisis. While the aggregate metric of professional connections is insignificant for the other two periods, some

components demonstrate importance. Eigenvector centrality, indicating connections to highly central directors, positively impacted firms' resilience in 2014–2015. Degree centrality, which counts the number of connections, was significant for resilience during the COVID-19 pandemic. Thus, the first hypothesis is supported.

Directors' political connections affect firms' ability to resist shocks differently. These connections had a negative influence during the commodity price shock and sanctions in 2014–2015, implying a positive effect on resilience. However, in the other two periods, the opposite effect was observed. Therefore, the second hypothesis is partially supported for the 2014–2015 crisis, but not for the other two periods.

Similarly, directors' international connections affect firms' resistance in varying ways. During the global financial crisis, these connections increased the standard deviation of firms' returns, thereby reducing resilience. However, in 2014–2015, international connections were beneficial and mitigated the shock's effects. This partly supports the third hypothesis.

Recovery speed from the negative effects of shocks

The second part of the research investigates the influence of directors' social capital on the speed of firms' recovery after shocks. Tables 6 and 7 includes two panels. Panel A presents results for the global financial crisis, and Panel B for the COVID-19 pandemic. Models for the commodity price shock in 2014–2015 were found to be insignificant, therefore results for this period are not reported.

Table 6. Panel A. Relation between directors' social capital and firms' ability to recover from the negative effects of the global financial crisis

	Number of days (recovery speed)				
	(1)	(2)	(3)	(4)	(5)
Share of directors with political connections	–53.788	–21.361	–39.023	–47.935	–38.783
	(49.037)	(45.661)	(59.802)	(44.518)	(51.442)
Share of directors with international connections	–40.943	–23.075	–11.096	–66.453	–35.047
	(48.870)	(37.630)	(41.937)	(45.109)	(41.909)
Degree centrality	–5,324.572*				
	(3,162.320)				
Betweenness centrality		–8,851.719**			
		(2,825.372)			
Closeness centrality			–109.581		
			(118.950)		
Eigenvector centrality				–282.543**	
				(90.263)	
PCA professional connections					–11.586*
					(5.206)
Logarithm of firm size	26.557*	14.973	28.302*	32.314*	24.590*
	(13.261)	(11.894)	(14.064)	(12.914)	(12.955)
Market-to-book value	–29.937*	–37.063*	–30.806*	–32.943*	–31.452*
	(14.939)	(17.480)	(16.226)	(14.419)	(16.255)
ROA	117.851	47.077	24.800	136.436	73.644
	(140.933)	(126.166)	(141.182)	(141.877)	(137.430)

	Number of days (recovery speed)				
	(1)	(2)	(3)	(4)	(5)
Financial leverage	0.560**	0.497**	0.576**	0.595**	0.554**
	(0.088)	(0.078)	(0.096)	(0.088)	(0.087)
Logarithm of board size	–13.669	–39.573	–57.743	–50.748	–35.034
	(83.266)	(60.386)	(73.780)	(65.279)	(67.217)
Industry dummy	Included				
Constant	505.522*	678.491**	550.249*	484.153*	534.240*
	(218.399)	(223.573)	(223.241)	(219.398)	(225.764)
Observations	30	30	30	30	30
R^2	0.849	0.878	0.838	0.870	0.857
Adjusted R^2	0.663	0.728	0.640	0.709	0.680
Residual Std. Error (df = 13)	51.148	46.003	52.913	47.539	49.851
F Statistic (df = 16; 13)	4.572**	5.843**	4.218**	5.420**	4.855**

Note: *p < 0.1, *p < 0.05, **p < 0.01. White's robust standard errors are given in parentheses. The dummy variable for government ownership is excluded as observations for this period are lacking.

Table 7. Panel B. Relation between directors' social capital and firms' ability to recover from the negative effects of COVID-19

	Number of days (recovery speed)				
	(1)	(2)	(3)	(4)	(5)
Share of directors with political connections	33.240	29.882	30.455	30.759	30.211
	(39.375)	(39.770)	(39.335)	(39.516)	(39.714)
Share of directors with international connections	106.383**	98.976**	89.209*	95.807**	99.992**
	(37.104)	(37.584)	(34.636)	(34.783)	(36.668)
Degree centrality	5549.354*				
	(3063.073)				
Betweenness centrality		3208.731			
		(4897.073)			
Closeness centrality			–67.230		
			(217.939)		
Eigenvector centrality				72.325	
				(63.861)	
PCA professional connections					7.383
					(7.168)

	Number of days (recovery speed)				
	(1)	(2)	(3)	(4)	(5)
Logarithm of firm size	–4.284	–3.666	–1.306	–1.894	–3.521
	(6.821)	(7.493)	(6.849)	(6.708)	(6.798)
Market-to-book value	10.853	11.929	11.848	11.583	11.697
	(18.494)	(18.322)	(18.514)	(18.265)	(18.363)
ROA	–79.168	–101.182	–112.013	–87.524	–92.392
	(103.857)	(104.707)	(106.969)	(103.087)	(103.419)
Financial leverage	–29.359	–33.943	–37.894	–33.381	–32.450
	(33.918)	(34.108)	(34.847)	(34.203)	(33.922)
Government ownership (dummy)	19.964	22.989	28.931	23.777	21.512
	(16.802)	(17.999)	(18.396)	(17.035)	(17.817)
Logarithm of board size	28.405	61.059*	64.584*	45.591	46.914
	(34.073)	(31.513)	(33.103)	(37.403)	(35.332)
Industry dummy	Included				
Constant	505.522*	678.491**	550.249*	484.153*	534.240*
	(218.399)	(223.573)	(223.241)	(219.398)	(225.764)
Observations	97	97	97	97	97
R^2	0.324	0.307	0.305	0.313	0.312
Adjusted R^2	0.123	0.101	0.099	0.109	0.107
Residual Std. Error (df = 74)	73.926	74.851	74.962	74.546	74.607
F Statistic (df = 22; 74)	1.614*	1.492	1.477	1.532*	1.524*

Note: *p < 0.1, *p < 0.05, **p < 0.01. White's robust standard errors are given in parentheses.

The positive coefficients indicate a longer period required for stock prices to return to pre-crisis levels, suggesting a slower recovery and thus lower resilience of firms from the market's perspective. Panel A of Table 6 demonstrates the positive impact of directors' professional connections on the recovery period. This suggests that directors with greater professional connections can expedite the recovery speed of stock prices. However, similar results are not observed for the other periods.

Panel B of Table 7 presents the results for the COVID-19 period. It shows that directors with international connections prolong the recovery period. Conversely, there is no robust evidence for professional connections, yet we do find a negative impact of degree centrality on stock price recovery. These findings do not support the third hypothesis and only partially support the first one, specifically in relation to the 2008–2009 crisis.

Discussion of results

We find mixed evidence regarding the influence of directors' social capital on firms' resilience to exogenous shocks. Further empirical research should investigate the mechanisms underlying these effects. One possible explanation for these results is that different shocks vary in nature and have distinct mechanisms of influence on firms. As a result, directors' social capital may be beneficial in some periods yet not impactful or even detrimental in others.

During the global financial crisis, which initially impacted banks and subsequently other industries [73], directors' professional connections, indicating access to information and resources, enhanced firms' market-based resilience. However, international and political connections did not show similar effects. It is plausible that companies with such board compositions may not have had sufficient time

to adapt their strategies, or investors may not have perceived these connections as valuable at the time.

The commodity price shock, along with sanctions against Russian banks and companies, and the subsequent slowdown in economic growth and investment activity in 2014–2015 [74], saw directors' social capital mitigate the shock's negative impact on firms' resilience. Social capital likely enabled firms to identify new opportunities for development and explore alternative resource pathways.

During the 2020 crisis, initially triggered by non-economic factors such as declining global economic growth rates affecting export prices [75] coupled with lockdown measures reducing household consumption and real income [76], investors may have perceived boards with a high proportion of politically connected directors as less effective in managing the crisis. Government priorities focused more on financing social policies than supporting corporate efficiency. Additionally, directors with international connections, often appointed in companies within global value chains disrupted by restrictions [77], may have experienced difficulties in helping their firms to recover from the shock.

Conclusion

In this study, we employed resource dependency theory and agency theory to explore how board members' social capital, comprising professional, political, and international connections, influences firm resilience to exogenous shocks in terms of market performance. Market-based resilience was initially measured using the sum of daily standard deviations of stock returns, revealing that directors' professional connections mitigated the negative impact of crises studied. Meanwhile, international and political ties lessened the effects of the 2014–2015 crisis yet exacerbated impacts during the COVID-19 pandemic.

Examining resilience through the speed of stock price recovery post-shock, the study demonstrated the positive effects of professional ties during the global financial crisis, no significant effects during the 2014–2015 crisis, and a negative impact of directors' international connections during the COVID-19 crisis on recovery speed.

The implications of our findings are both theoretical and practical. Our results can be used to design boards that are more resilient to exogenous shocks. By distinguishing between different types of director connections and crises, we gain a detailed understanding of the potential consequences of hiring directors with high social capital of a particular type. Moreover, we suggest that board diversity in terms of connections can serve as a form of insurance, enabling firms to handle various types of shocks. Since the nature of future shocks is unknown, including directors with diverse types of connections can enhance firms' resilience.

The government can use the developed resilience metrics to monitor firms' recovery during crises and to develop targeted stimulus programs. Investors may benefit from paying closer attention to the connections of a board of directors when selecting companies during economic turbulence. Researchers can utilize the developed system of social capital and resilience metrics in studies of firms' responses to exogenous changes and the role of board connections in firm performance.

Our research can be extended in several directions. While we focus solely on market-based metrics of resilience, future studies could explore other indicators, such as book-based performance metrics, or develop more complex metrics, such as those measuring the acceleration of recovery. Differences in firms' responses to various types of shocks may prompt further research on the characteristics of crises and the specific types of linkages needed for recovery. Additionally, expanding the sample to include all Russian listed firms could enhance accuracy, given that centrality metrics are highly sensitive to the chosen sample.

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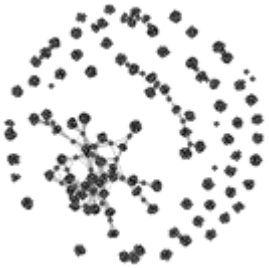
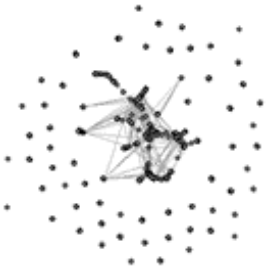
Appendix 1

Graphs show the connections between board members, with N being the number of unique directors in a given year, nodes representing directors, and edges representing professional connections (directors serving on one board).

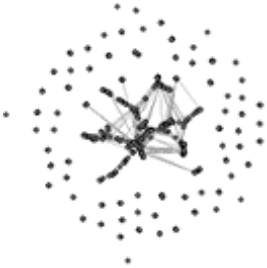
2007, N = 845



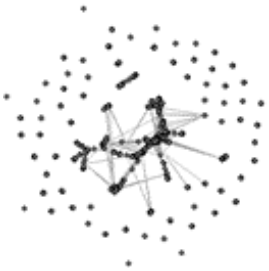
2008, N = 1133



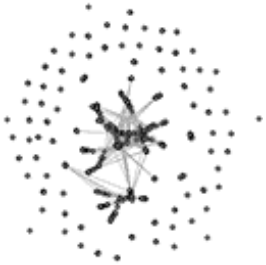
2009, N = 1426



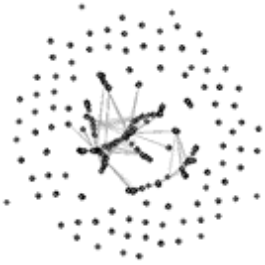
2010, N = 1458



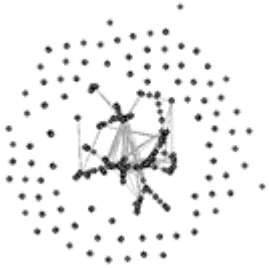
2011, N = 1512



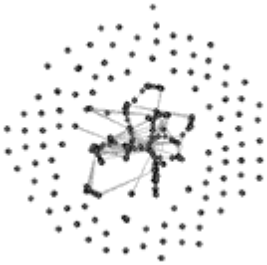
2012, N = 1626



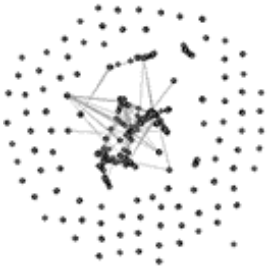
2013, N = 1680



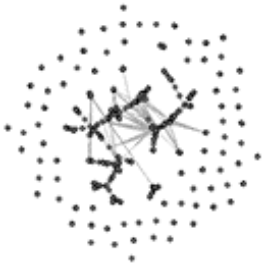
2014, N = 1693



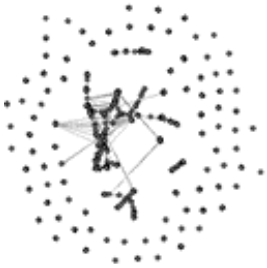
2015, N = 1653



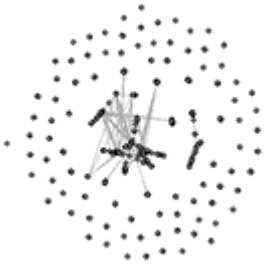
2016, N = 1652



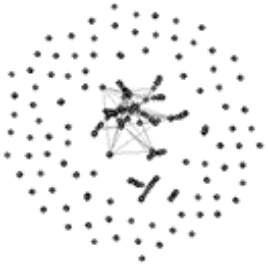
2017, N = 1613



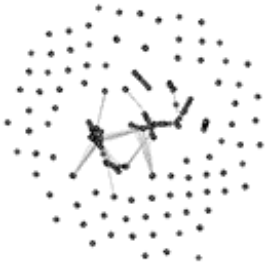
2018, N = 1525



2019, N = 1540



2020, N = 1458



Source: authors' calculations.

Appendix 2.

Explanatory variables used in the study

Explanatory variable	Definition and calculation	Expected influence on resilience
Degree centrality	The number of ties that a given director has, normalized by the maximum possible number of connections: $Degree\_Centrality = \frac{\sum_{i \neq j}^{n} b_{ij}}{n-1}$, where $b_{ij} = 1$ if director *i* is connected with a director *j*, and n is the number of directors in the network.	+
Closeness centrality	The average length of the shortest paths between a node and all other nodes in the network [65]: $Closeness = \frac{}{\sum_{i \neq j}^{n} dist\left(b_i, b_j\right)}$, where $\frac{1}{dist\left(b_i, b_j\right)} = 0$ if directors *i* and *j* are not connected, $dist\left(b_i, b_j\right)$ is the distance between directors *i* and *j*, and n is the number of directors in the network.	+
Betweenness centrality	The degree to which the same node reduces the path distance between all pairs of other nodes [65]: $Betweenness_i = \frac{\sum_{j<k} g_{jk(ni)} / g_{jk}}{(g-1)(g-2)}$, where $g_{jk(ni)}$ is the number of geodesics in which director *j* communicates with director *k* through director *i*, g_{jk} is the number of geodesics in which director *j* communicates with director *k*, and *g* is the number of directors in the board network.	+
Eigenvector centrality	The extent to which a node's network centrality is related to that of its neighbors [66]: $Eigenvector\_Centrality = \frac{1}{\lambda}\sum_{j=1} b_{ij} E_j$, where b_{ij} is an adjacency matrix that takes a value of 1 if directors *i* and *j* are on the same board and 0 otherwise, λ is the largest eigenvalue, and E_j is the eigenvalue of director *j*'s centrality.	+
PCA professional connections	A variable used to aggregate indicators of professional connections, obtained by applying Principal Component Analysis (PCA) to degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality. The first component accounts for about 75% of the variation in the variable.	+
Political connections	Share of directors with a political background	+

Explanatory variable	Definition and calculation	Expected influence on resilience
Foreign connections	Share of directors who were born outside of Russia (USSR) or have work experience in foreign companies	+
Financial leverage	Total debt to total assets	
Market-to-book value	Market value of equity plus book value of debt divided by book value of total assets	
ROA	EBIT to average total assets	
Firm size	Natural logarithm of total assets	
Board size	Natural logarithm of the number of board members	
Government ownership	Share of equity held by the government	
Dummy government ownership	Dummy for government ownership	

Note: The table describes the explanatory variables, their calculation and the expected signs.

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Study of the Reaction of Stock Markets to the Cancel Culture Phenomenon in Relation to Russia

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Abstract

Suspension of business in Russia by most foreign corporations after the events of 24 February 2022 led to the fact that the social phenomenon of "cancel culture" is now also considered within the framework of global economy and finance. In recent years, the IT industry is appraised as one of the fastest-growing, and the study of its reaction to global events is highly relevant. Using the Event Study method, this study proves that there is no significant impact of the declaration of the Russia-Ukraine conflict on US stock market dynamics of IT companies with branches in Russia. The analysis of individual cases from the sample of companies shows that the companies' decision to suspend or continue business in Russia depended only on the presence of a significant share of revenues in Russia, the degree of reputational and sanctions risks, and the specifics of corporate ESG policies. The model is limited by the sample and period of analysis. In order to verify model reliability, we applied the t-test that determined the significance of the results. The research is of practical relevance because internationally operating companies may use its data to evaluate risks and make strategic decisions.

Keywords: cancel culture phenomenon, event study, case study, cumulative abnormal return, reputational risks

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Introduction

The declaration of the special military operation (SMO) on 24 February was one of the milestone global events of 2022. The ongoing international conflict entailed wide-ranging consequences in geopolitics, military sphere and economics. Economic sanctions were imposed on the Russian Federation, including restrictions on import and export of goods and services. In this context, many international companies operating in the Russian market decided to sell their Russian branches or cut investments in the Russian economy. According to the Yale CELI List of Companies, as of today over 1000 companies have publicly announced they are voluntarily curtailing operations in Russia in compliance with international sanctions and for other reasons [1]. Nevertheless, some companies opted to continue their business in our country.

In view of the current events the term "cancel culture" began to gain traction in relation to Russia. It has been studied as a social phenomenon before, and only since 2022 it has been considered in terms of the global economy. In spite of multiple studies from this angle, this topic is still significantly understudied. In particular, in the majority of relevant papers the main markets affected by sanctions are manufacturing and energy. The novelty of the present paper consists in the analysis of the influence of the global event of the SMO declaration on the IT industry, which is considered one of the most rapid-growing and insufficiently explored ones. Besides, as long as there is a lack of corresponding research, we have analyzed the relationship between global events and companies' financial and non-financial factors that may influence their decision to withdraw from the domestic market or continue their business in Russia.

The purpose of the paper is to study the reaction of the American stock market to the cancel culture phenomenon in relation to Russia using the example of the IT industry.

In order to achieve the purpose in hand, we have to accomplish the following objectives:

1) study the existing hypotheses about the market reaction to global events (SMO, sanctions, etc.), the cancel culture phenomenon, the influence of financial and non-financial factors on a company's value generation;
2) develop a methodology to study the influence of the declaration of the SMO on international companies' behavior and justify the choice of the IT industry for the research;
3) study the reaction of the stock market of American IT companies to the declaration of the SMO on 24 February 2022 applying event study or cumulative abnormal return (CAR) analysis;
4) subsequently perform a case study of representative IT companies from the studied sample for financial and non-financial factors;
5) analyze the influence of the selected financial and non-financial factors on the companies' decision to suspend or continue their business in Russia.

The research object is the price dynamics of public American IT companies' stock.

The research subject is the factors that influence the IT companies' decision concerning continuation or suspension of their business in the Russian market.

The research methodology implies event study, which will allow to determine the stock market reaction to the event of 24 February 2022 using IT companies as an example. Besides, during case analysis we will perform a review of companies from the viewpoint of the influence of financial and non-financial factors on the decisions to continue or wind down their IT business in the Russian Federation.

Review of Current Economic Research of the Cancel Culture Phenomenon

Event Study

Event study is considered to be the most effective scientific tool for study of the impact of specific events on the dynamics of the price of public companies' shares. However, presently there is a lack of relevant studies that apply this method because in 2020–2023 there were only two key events that triggered a strong reaction of the global market: the COVID-19 pandemic at the end of 2019 – beginning of 2020 and the declaration of the special military operation on 24 February 2022 [2].

For the event study we chose the dates of the official announcement stating COVID-19 was a global pandemic, and the declaration of successful vaccine testing in the USA as the event dates for calculation of expected returns. We analyzed 59 aviation companies from the sample (over 30% are from the USA and China) with high liquidity in stock markets. As a result, we revealed a negative reaction of stock prices to the declaration of the pandemic and a positive impact on the stock market of the announcement of COVID-19 vaccine efficacy in the USA. However, due to limitations of the sample of companies these conclusions cannot be applied to the industries other than the aviation industry.

Some research gaps were filled in by later papers related to analysis of the event that is similar in terms of its global impact – the declaration of the SMO in Ukraine on 24 February 2022. This event launched a strong instantaneous response of stock markets in various countries. The majority of studies established that the main markets which have "suffered" were the manufacturing industry and energy, as well as financial institutions.

Thus, some papers [3; 4] study the influence of the Russia-Ukraine conflict on energy markets. Analysis of *CAR* before and after the beginning of the SMO shows a strong positive impact of this event, especially on the energy market. However, on a global scale the event had a negative impact on the economy of many countries engaged with Russia to a greater or lesser degree. For instance, I. Yousaf et al. [5] studied the impact of the beginning of the Russia-Ukraine

conflict on the economic situation in the Group of Twenty (G20) and other individual financial markets in the first days of the SMO. Pooled analysis showed a significant negative impact of the Russia-Ukraine conflict on these countries' stock markets on the day of the event on 24 February 2022 and after the event. Country analysis found out that stock markets of Hungary, Russia, Poland and Slovakia were the first to respond to the expectation of military activities in Ukraine, showing negative return in the days immediately preceding the declaration, while other countries' markets deteriorated in the days after 24 February. However, up to the present time the particular factors which could cause a positive or negative market reaction have not been revealed.

Influence of the Cancel Culture Phenomenon on Corporate Decisions of Foreign Companies

Social research defines cancel culture as behavior in a society or group, especially in social networks, when it becomes conventional to reject completely or withdraw support for someone in response to unacceptable actions or statements. After the declaration of the SMO, the cancel culture phenomenon manifested itself on a global scale. Since the beginning of the SMO, over 1200 companies publicly declared the end of their operations in the Russian market, thus, supporting the cancel culture trend towards Russia [1]. Consequently, in this paper we have considered scientific research of the cancel culture phenomenon within an economic context.

Thus, O. Tosun and A. Eshraghi in their paper studied the reaction of the financial market to the announcement that companies had decided to stay in two weeks after the SMO had begun [6]. As a result, they found out that foreign companies that continued operations in Russia in spite of sanctions and public disapproval undermined their market performance. The portfolio of the companies that stayed is inferior to the portfolio of the companies that left. Besides, investors impose significant market penalties on the remaining companies.

In addition, a lot of American corporations limited their business operations in Russia after the SMO had begun. The exit announcement is preceded by a negative trend of accumulated returns which changes its vector the next day after the announcement [7]. These results are in line with the idea that companies prefer to limit their presence in Russia in response to operational and reputational consequences, while stock return stops decreasing immediately after the exit announcement.

In general, there is currently a lack of papers which that offer a breakdown by industry, more up-to-date information, or an analysis of the consequences for the global economy. In addition, these papers do not assess the influence of financial and non-financial factors on companies' decision to withdraw from the Russian market, as well as on the corporate market value.

Influence of Non-Financial Factors on Company Value

The study of the impact of non-financial factors, in particular, corporate governance factors on creation of company value has become a separate topic. Some authors revealed a positive relation between corporate governance and financial performance both in India and Persian Gulf countries [8]. In particular, it was demonstrated that efficient corporate governance practice is related to higher return on assets and return on equity in these regions. However, we should mention a lack of studies dedicated to the impact of reputational and sanctions risks as well as other non-financial factors on strategic decisions of the company.

Table 1. Classification of hypotheses on the basis of literature analysis

Topic	Research gap	Hypotheses
Event study	Insufficiency of studies dedicated to the IT sector	H1: Declaration of the SMO produced a significant impact on the American stock market of IT companies
Cancel culture	No analysis of the impact of financial factors on companies' decision of exiting the market and corresponding influence on the company's market value	H2: American IT companies are governed by financial aspects when making corporate decisions on continuing business in Russia
Impact of non-financial factors on the company value	Insufficiency of studies of the impact of reputational and sanctions risks as well as other non-financial factors on corporate strategic decisions	H3: Such non-financial factors as reputational and sanctions risks have a significant impact on decision-making concerning continuing operations or withdrawal from Russia

Source: compiled by the authors.

The factor of corporate decision-making guided by behavioural finance is one of such non-financial factors. Some studies produce evidence that public companies in stock markets often act irrationally and in conflict with market forecasts, which ultimately yields higher returns [9]. These anomalies are especially frequent at times of economic uncertainty and crises conditions, when corporate management is more prone to risk which, as is commonly known, increases return on investment. Thus, the theoretical basis of behavioural finance contradicts the well-known market

efficiency hypothesis, which presumes that fluctuations in the securities market are caused only by new events related to companies and investors' response to them [10; 11].

On the basis of analysis of academic literature and revealed research gaps in regard to the three chosen topics we defined the main hypotheses of the present research (Table 1).

We decided to apply the following methodology to study the postulated hypotheses:

H1: event study using the sample of American IT companies from the Yale CELI List of Companies;

H2: case study, i.e., building predictive financial models of the selected companies to define the impact of revenue share in Russia on the company value;

H3: case study, i.e. a qualitative evaluation of the impact of individual factors of corporate governance and behavioral finance on decision-making concerning curtailing or continuing business in Russia.

Study of the Stock Market Reaction to the Declaration of the SMO

Description of the Sample of Companies

Event study aimed to verify the first hypothesis (H1) in this paper was based on the highly publicised research as it played a significant role in the study of international companies' exodus from the Russian market. A team of experts from the Yale School of Management experienced in financial analysis, economics, accounting, strategy, management, geopolitics and Eurasian relations created a unique dataset that comprises a list of international companies that have made various decisions concerning their operations in Russia [1]. The list was originally published on 28 February 2022 when just a few dozens of companies declared their exit from the Russian market. Since then, it has been continuously updated.

Initially, the classification of companies according to their decision consisted of two groups: "withdraw" or "remain". However, at present there are five categories of companies assessed on the basis of grades from *A* to *F* depending on the completeness of their exit from the Russian market (Table 2).

Table 2. Categories of companies on the Yale CELI List

Company category	Description
A	Withdrawal
B	Suspension (curtailing the majority of operations, leaving a loophole for a comeback)
C	Scaling back
D	Buying time (postponing new investments/developments)
F	Digging in

Source: Yale CELI List of Companies.

At the date of selecting the companies for analysis (December 2022), the Yale CELI List consisted of over 1300 foreign companies from various industries (manufacture, consumer goods, energy, marketing etc.) and countries. US companies had the biggest share among them. The category revealed that the majority of foreign companies retained the opportunity to return to Russia (*B* category). 96 of these companies pertained to the IT sector, and the share of American companies among them was 56%.

The second place is occupied by IT companies that have completely withdrawn from Russia (45 firms in category *A*), with the majority incorporated in the USA (53%). Such companies (Cisco, Canva, Accenture, Slack etc.) run the highest reputational risks if they continue their business in Russia and may be deprived of their business assets through nationalization. Companies assigned the *C* and *D* categories (18 and 11, respectively), for example, Asus, Paypal, Amadeus IT Group, Adobe, Lenovo, etc., are exposed to other risks, such as loss of profitability, supply chain disruption, end of manufacturing and sales of some products. 12 IT companies from the *F* category of the list: AnyDesk Software, Honor, Cloudflare, Check Point Software Technologies Ltd. etc. disobeyed the request to exit or curtail operations.

Thus, US IT companies are forced to pull out of the Russian market, first of all, because they have to sustain their brand image and maintain their reputation. However, when making such a decision, companies often leave open the possibility of return which is indicative of an indirect influence of certain external factors.

In the present paper the sample consists of 60 companies that have exited the market. They are divided into categories A and B with 25 and 35 companies, respectively; and 22 companies that have stayed in the Russian market and pertain to categories *C*, *D* and *F*. It is important to note that in order to expand the sample of the remaining companies (*C*, *D*, and *F* categories) we decided to consider the industries related to the IT sector, such as telecommunications and IT-oriented industrial companies (as a rule, they pertain to the manufacturing industry).

In the present research we have used the corporations directly related to development of advanced IT solutions for oil and gas, aviation and other similar sectors: Schlumberger Limited, Aspen Technology, L3Harris Technologies, General Electric. Telecommunications are the second additional category. This industry is represented by Iridium Communications Inc. (telecommunications equipment), Match Group Inc. (dating application), Seagate Technology Holdings pic and Western Digital Corporation (development and manufacture of data storage solutions), E2open Parent Holdings Inc. (provider of cloud solutions for network supply chains). All of the above companies are engaged directly or indirectly in information technology.

After we have selected the sample of IT companies, an event study methodology was created.

Event Study Methodology

Event study is a way to assess the impact of a certain corporate or macroeconomic event on the stock price [12]. Multiple studies confirm the efficiency of this method.

However, the following basic prerequisites should be observed to perform it:

1) capital market efficiency, i.e., any news concerning the events should get to the market quickly and in their entirety, and have an effect on companies' stock prices [11];
2) unpredictability of the studied event from the market participants' viewpoint;
3) isolation from other effects, i.e., the presumption that within the considered time interval the event is the only one that could influence the stock price.

Event study is carried out in several stages. In the first instance, events are selected; in our case it is a single event: the declaration of the SMO on 24 February 2022. The research object is the daily dynamics of stocks in the sample compiled of American IT companies that have remained in the Russian market or pulled out of it.

Choosing the estimation period length and the event window is an important factor that influences the results of event study. We have chosen the optimal estimation period interval of 120 days, although there is no consensus among researchers concerning the length of this period.

The researchers are also divided on the issue of the event window length; the following versions are offered in the papers: (–1; +1), (–5; +5), (–10; +10), (–20; +20) etc. However, the following windows of (–10; +10), (–5; +5), (–3; +3) are the most frequently used ones. They guarantee trustworthy results.

At the second stage, real return within the event window is calculated by the natural logarithm formula:

$$y_t = ln\frac{P_t}{P_{t-1}},$$

where y_t – real stock return; P_t – closing share price on day t; P_{t-1} – closing share price on the day before t–1.

We also calculate normal stock return on the basis of the window preceding the event window which does not include the considered event.

In order to calculate normal (expected) stock return, we applied three statistical methods found in the literature sources that we have studied earlier:

Mean return method, which implies calculation of return as the arithmetic mean for the previous period (120 days in our case), where the same return is used for all event windows:

$$\widehat{y_t} = \frac{1}{120}\sum_{t=-21}^{t=-141} y_t,$$

where $\hat{y}_t$ – expected company stock return on day t; $\sum y_t$ – sum of real stock returns on day t.

Market model that defines stock return on the basis of market portfolio sensitivity, beta is used as the sensitivity factor. The advantage of this method over the previous one lies in the fact that a change of normal return is implied within the event window:

$$\widehat{y_t} = \hat{a} + \hat{\beta} \cdot x_t,$$

where $\hat{y}_t$ – expected company stock return on day t; $\hat{a}$ – constant; $\hat{\beta}$ – factor of sensitivity of company shares to index profitability; x_t – index profitability.

Capital asset pricing model (*CAPM*). It is a one-factor model as well as the market model. It is applied to evaluate shares or assets by means of analysis of the risk and expected return ratio. *CAPM* is based on the idea that investors gain additional expected return (risk premium) if they take additional risk. Just as in the market method, beta is used as the sensitivity factor. It was found for each company in publicly available sources. The equation is as follows:

$$\widehat{y_t} = \underline{r_f} + \beta \cdot (r_m - \underline{r_f}),$$

where $\hat{y}_t$ – expected company stock return on day t; $\underline{r_f}$ – risk-free rate of return (return of annual American government bonds); β – factor of the asset's sensitivity to change of market return; $(r_m - \underline{r_f})$ – risk premium.

At the third stage, according to each method, we calculated abnormal return (*AR*) as the difference between normal and real return:

$$AR_t = y_t - \widehat{y_t},$$

where AR_t – abnormal company stock return on day t; y_t – real return of a share; $\hat{y}_t$ – expected stock return of the company on day t.

The resultant stage of analysis is the calculation of *CAR* and test of statistical significance of the obtained indicators. *CAR* is calculated as the sum of abnormal returns within the event window period:

$$CAR = \sum_{t=T_1}^{t=T_2} AR_t,$$

where *CAR* – cumulative abnormal company share return; AR_t – abnormal return of company's stock price on day t.

T-test is applied to verify the zero hypothesis: whether mean abnormal return equals zero:

$$T - value = \frac{CAR}{\sqrt{VAR(\sum AR)\bullet n}},$$

where *CAR* – cumulative abnormal return of company share; $\acute{o}^2$ (*VAR*) – variance of the sum of abnormal returns of company stock price on day t; n – window length.

Consequently, at a certain significance level of 1.96 the hypothesis is confirmed or rejected, i.e. we may assert that the event produces or does not produce influence on stock return within the considered window.

Analysis of the Event Study Results

After uploading the necessary sample data, we performed the primary analysis of the shares' dynamics, in particular, we compared the mean closing prices for the entire researched period, periods before and after the event. Analysis revealed that after the event the price of 49 companies that have withdrawn from the Russian market (*A* and *B* categories) came down. As for the rest of the companies (*C*, *F*, *D* categories) in percentage terms, similar to the previously mentioned categories, indicators of 82% of companies decreased after the event (18 out of 22 companies).

Nevertheless, stock price dynamics yield no significant results, therefore this study is not meaningful because, first, it does not take into consideration any other factors, second, it is too primitive. For this reason, at the next stage we conducted event study. Its results are interpreted below.

In the first instance, we may conclude that there is no single trend for all companies: the impact on each one is individual. *CAR* shows the cumulative effect of the event which has taken place within the event window. As a result of the analysis, we determined that *CAR* for the whole sample of companies is distinct from zero, hence, the event has influenced the stock price.

In our case, depending on the event window span and the method of normal return calculation, we have obtained different results not just for the whole sample, but for the same company as well. *CAR* also changes conspicuously depending on the chosen size of the event window: the bigger it is, the higher the probability of influence of other external and internal factors on stock returns.

However, it is important to establish not just the existing influence, but its significance as well. To that end we carried out a *t*-test: if the obtained *t-value* exceeds in modulus a threshold of 1.96, the influence is significant, if the value is lower – it is insignificant. On the basis of analysis of the test results, we may assert that only 37% of the entire sample of the companies that have withdrawn from Russia (22 companies out of 60) showed significant values in the *t*-test. Among the remaining companies, only 27% showed significant results (6 companies out of 22).

One of the reasons for such results may be the specific nature of the considered event, which led to the structural crisis. Consequently, a small number of significant results of the event study in this case may also be indicative of the specific character of the IT industry, which has not been affected as much as many others (for example, banking).

Besides, the majority of significant results are based on returns calculated by means of the market method with the event window (–3; +3) and using *CAPM* with the event window of (–10; +10). The market model differs from *CAPM* by the additional limitations imposed by *CAPM* on the model: $\hat{\alpha}$ (constant, the point of intersection of the optimal regression line drawn through stock returns and NASDAQ return, which is set equal to the risk-free rate. Variance of a random value will exceed that of the market model, hence, the *t*-test performed will theoretically yield "weaker" results than the market model. At the same time, in the majority of academic research studies the market model, which implies no such limitations, and *CAPM* most often yield almost the same final result. In our case, the market model is less effective than *CAPM*, therefore we choose *CAPM* for further analysis of the event.

In order to determine the nature of the event impact on stock dynamics, the *CAR* of the sample of companies with a significant influence according to the *t*-test is compared to zero: a positive *CAR* suggests a positive influence of the event on the market, while a negative value implies a negative impact.

We see that according to *CAR,* 13% of the companies that have left demonstrate a negative impact of the event on the market, while 17% of the companies that have pulled out of the market show a positive influence of the event.

Taking into consideration the small number of tested companies that have left Russia and showed a negative or positive impact of the event, we cannot assert with confidence that the event really produces the indicated effect on companies included in categories *A* and *B*. Consequently, the first research hypothesis (H1) is rejected for the sample of the companies that have withdrawn from the market.

The analysis results indicate that according to *CAR,* 9% of the remaining companies show a negative influence of the event on the market. At the same time, 17% of the remaining companies indicate a positive impact of the event.

We also cannot state for sure that there is a certain impact of the event on companies from categories *C*, *D* and *F*. Consequently, the first research hypothesis (H1) is rejected for the sample of remaining companies.

The performed event study suggests the following conclusions:

CAR distinct from zero is indicative of a general accumulated effect of the event within all event windows;

1) most often significant results of the *t*-test were obtained in the case of *CAPM* use, but the share of significant results that correspond to the hypothesis is very small;
2) if we choose another event date, for example, announcement of sanctions in the IT industry on 08.05.2022, we will not get a larger share of significant results because stock dynamics in this period remained within the same limits as in the study as at 24.02.2022;
3) no crash in the American market of IT companies' stocks as a result of the SMO declaration is observed.

Based on the event study results, we reject hypothesis H1 of the present research. Thus, the event of 24 February 2022 produced no significant influence on the American stock market of IT companies. Factors other than market shocks were behind the companies' decision to curtail or continue their business in Russia. These factors are analyzed in the next section.

Analysis of Influence of Financial and Non-Financial Factors on the Decision of Foreign Companies to Close down or Continue their Business in Russia

Case Study Methodology

On the basis of the event study results, at the present stage of the research we decided to consider financial and non-financial factors of companies by means of case study. The companies for this study are selected premised on the following criteria:

1) focus on the results of event study, in particular, significance of the *t*-test results, however, the company should pertain to one of the categories (departed or remaining companies), as well as differ in terms of the nature of the event impact (positive or negative);
2) pertain to the same IT industry, but differ in the lines of business, so that we could assess the reasons behind the decisions of the companies from different sub-industries;
3) information transparency, high openness of companies will allow for efficient data analysis.

The group of companies that have pulled out of Russia consists of the largest IT companies from a variety of sub-industries: Visa – the largest financial corporation in the bank card industry, Nvidia – a technology company, graphic processor and system-on-a-chip designer. The group of remaining companies comprises: Activision Blizzard – one of the largest computer gaming and entertainment corporations, Schlumberger – global supplier of technology, information solutions and integrated project management in the oil and gas industry.

For the case study we chose the factors influencing corporate decisions that are most frequently used in academic literature and mentioned in news and reports as reasons substantiating company decisions.

In the first instance, we considered the financial aspects of the selected sample: one of the most important indicators is the share of revenue earned in Russia. So, the smaller the share of Russia in the consolidated revenue, the easier it is for a company to exit the market.

Another financial factor, the significant amount of company's assets in the Russian Federation, also plays a large part. In this case, the risk is posed by the threat of their loss as a result of probable nationalization. Therefore, companies make a decision to pull out of the Russian market or sell their assets to another organization, which is bound to maintain operations for a year.

In order to verify the significance of the RF revenue share factor, we developed two financial models for each company: the first one mirrors the current situation (i.e., in 2022 the basic model for the companies that have left was built exclusive of the Russian revenue share, and for the remaining companies – inclusive of the RF revenue), while the second model presents a hypothetical reverse situation. In order to evaluate the factor's influence, we accepted a benchmark of the 10% difference in the appraisal value of company stocks between the basic and hypothetical scenarios of the models.

Qualitative evaluation was applied to consider the following non-financial factors: corporate brand; influence of risks, institutional investors, terms of ESG policies (environmental, social and corporate governance); additionally, we verified the behavioural finance theory as a decision-making factor.

From the viewpoint of the impact of possible risks, we considered the sanctions and reputational risks.

With regard to stakeholders, we studied the company's largest institutional investors and their relations with political groups (government). The larger the number of politically charged stakeholders, the stronger the direct influence on the board of directors and the decision to exit Russia.

As the last criterion, we verified the behavioural finance theory according to which the initial expectations of a company related to further operations with regard to the event are compared to the actual decision of the company over time. Consequently, if immediately after the event there are forecasts with positive expectations in corporate reports or press releases, but several months later new information is published indicating the company's withdrawal from the market, the behavioral finance factor in the theoretical framework is confirmed (an irrational decision inconsistent with the expectations has been made). A reverse situation of confirming the hypothesis of the behavioral finance impact: immediately after the event the company made negative forecasts, but finally opted to stay in the market. At the same time, the agent's rational behavior, when negative or positive expectations are in line with actual negative and positive decisions, tacitly rejects the hypothesis of the influence of the behavioral finance factor on the decision.

In conclusion of the quantitative and qualitative analysis we revealed the factors that most significantly influence corporate decisions.

Results of Case Study

The first considered company from the category of the firms that have exited the market with the negative impact of the event is Visa. The company was incorporated in 1958 and has become a dominant player in the global payment industry. As at 2021, Visa operated in 200 countries and processed billions of transactions annually.

The basic prerequisites to develop forecast financial models for Visa to verify the significance of the revenue share factor are:

- assumption of the 5% annual revenue growth rate since 2024;
- the current assets' and short-term liabilities' growth rate corresponds to the revenue growth rate;

- use of discounting parameters from publicly available sources [13–15].

In order to develop the second model for a hypothetical situation of continuing business as usual in Russia for Visa, we added the RF revenue share (4%) to the reporting value of revenue for 2022; besides, the operating expenditures for the same year were reduced due to the absence of deconsolidation expenses ($60 mln.) [16]. After comparing the results of evaluation of the two models for Visa, we obtained the difference of 2% in the stock prices in these cases (below the benchmark), i.e., we may assert that withdrawal from Russia had no impact on the company's stock price.

One of the key factors that define the Visa brand awareness is its universal presence. Over the years the company has been investing significant amounts in marketing and advertising and has also gained a reputation of an innovative corporation. Staying ahead of the times and offering advanced payment solutions, Visa managed to retain its position as the leading brand in payment technologies.

In its income statement for 2022 the company disclosed 20 risk factors and indicated that the largest number of risks was present in the category of Legal and Regulatory risks (35%) [16]. Given that Visa is engaged in payment technologies, it is subject to a wide range of laws and regulations, including data protection legislation, financial norms and antimonopoly law. In order to reduce regulatory risks, Visa applies a set of measures, including compliance assurance programs, lobbying and interaction with regulatory authorities.

Reputational risks arise due to the perception of Visa by stakeholders including customers, sellers, investors and regulatory authorities. Any public actions which harm the Visa brand image may significantly influence its reputation and public confidence in the company. To manage reputational risks, Visa employed a set of measures, including reputation management programs, crisis communication plans and transparency initiatives.

Speaking of the influence exerted by stakeholders, it may be noted that the share of independent institutional investors in Visa is rather large (98.68%) and includes such funds as The Vanguard Group, BlackRock, Inc., FMR etc.

The factor of the company's ESG policy impact on decision-making is also significant. Visa launched programs to issue cards for Ukrainian users, Visa Foundation provided a grant of $2 million to the U.S. Fund for UNICEF for humanitarian assistance and helps refugees to obtain employment, actively broadcasting its position in integrated reporting.

The behavioral finance theory is rejected in this case because the company declared its withdrawal in March 2022, and then wound down its business completely, cutting off its services for Russian customers abroad. Visa exited the Russian market at its own business initiative, but under the threat of secondary sanctions. Thus, the company acted rationally: the expectations after the event were negative, so it announced its withdrawal from the market.

We also analyzed NVIDIA, which is among the companies that have pulled out of Russia, and considered the principal financial aspects. The first aspect is assets in the territory of the Russian Federation. Since 2003 the company had a business unit in the Russian Federation, but in October 2022 it wound down all operations and closed down the Russian office. The second important financial indicator is revenue. The company's direct sales in the Russian Federation were insignificant. In the 2022 financial year it amounted to approximately 2% of total sales and 4% of sales of games [17]. Then we performed quantitative analysis.

For NVIDIA we applied the same approach as for Visa, developing two financial models inclusive of and exclusive of revenue in Russia.

The key prerequisites for the NVIDIA model forecast were as follows:

- assumption of the annual growth rate of revenue of 20% in 2023–2027 on the basis of analysts' predicted values taken from publicly available sources [18];
- the current assets' and short-term liabilities' growth rate is defined on the basis of data on revenue;
- use of discounting parameters from publicly available sources [13; 19; 20].

In order to develop the second model for the hypothetical situation of continuing business in Russia for NVIDIA we added the RF revenue share (2%) to the reporting value of revenue for 2022, besides, the operating expenditures for the same year decreased by $16 mln (deconsolidation expenses), according to the report for the 3rd quarter [21] .

After comparing the two models, we obtained the difference of 3% in stock prices of these cases (below the 10% benchmark), i.e., we may assert that the end of operations in Russia has no impact on the stock price.

Speaking of non-financial aspects, for example, NVIDIA business model, we may say that this is more of a business-to-business model (*B2B*). NVIDIA's products are in strong demand among client companies. Technologies in the spheres of video gaming industry, professional imaging, high performance computing and automobile industry, where NVIDIA's on-board computers are used as the foundation for self-driving cars, gained widespread use.

One of important criteria that have influenced the company's decision to exit the Russian market was the reputational and sanctions risks. The reputational risk is interrelated with the corporate brand. Since NVIDIA is a technological leader, it is rational for the company to avoid the risk of loss of stakeholders' confidence. It also runs a high sanctions risk, making it impossible for NVIDIA to effect direct sales in Russia.

The share of institutional investors is 68.04% [22]. An analysis of the list of investment funds generally demonstrates that there is no political pressure on them or their management.

The ESG factor impact on the company is strong. In its annual reports NVIDIA emphasizes that it has supported Ukraine after the beginning of the conflict, it is involved in volunteering and has donated over $22 mln for these purposes.

The behavioral finance theory is rejected in this case because the company opted to exit the market having initially negative expectations of the impact of the event that took place on 24 February. Thus, NVIDIA acted rationally, which ultimately led to no adverse effect on its operations.

Another company we examined is Activision Blizzard, which is known for its video games and was founded in 2008 as a result of a merger of Activision and Vivendi Games. We chose Activision Blizzard because it represents a rather large and prospective IT sub-industry – the gaming industry – and is distinguished by the specific character of its business operations.

The major part of company's revenue (approximately 82%) is generated by the content distributed by digital on-line channels, while retail channels gain about 6% and other sources account for 12% [23].

In March 2022, the company announced the suspension of new sales in Russia as a response to the news of the launch of the SMO. At the same time, the company de facto continues its operations in Russia because the games released before 24 February 2022 are available to Russian users.

In the quantitative analysis, i.e., a financial model of financial factors in decision-making, the main assumption is the annual revenue growth rate of 5% since 2024. The current assets' and short-term liabilities' growth rate also corresponds to the revenue growth rate; discounting parameters are taken from publicly available sources [13; 24; 25].

In order to develop the second model for a hypothetical situation of business suspension in Russia we deducted the RF revenue share of 5% from the reporting value of revenue for 2022. After comparing the two models, we revealed that the difference in stock prices in these cases amounted to 31%. It exceeds the control benchmark of 10%, i.e., the factor of the Russian revenue share has a significant impact on the dynamics of Activision Blizzard stock and the company's corporate decisions related to business in Russia.

It is one of the largest computer games producers, whose products are highly recognizable. Also, last year Activision Blizzard was often mentioned in mass media because Microsoft declared its intent to purchase the company for $68.7 bn [26]. The future value of the company depends directly on the success of this deal, therefore at the moment reputational risks exert a serious influence on corporate decisions.

Activision Blizzard has a large share of institutional investors independent from the government (84.76%) and the management is not exposed to political pressure [27]. None of the board members has occupied positions in government bodies or was engaged in politics.

The impact of the ESG policy factor on corporate decisions is considered average because the company increases all donations made by its employees to charities that help Ukraine. However, the company does not declare its position directly in the integrated reports because it plans to resume sales in Russia after the end of the SMO.

Theory of the impact of behavioral finance in this case is partially confirmed:

- company management expressed its negative expectations of the impact of the SMO launch on the business in Russia;
- the company made the decision to suspend sales of new developments in March 2022, while continuing to support Russian users of the existing products, preserving the share of Russian revenue and maintaining its presence in the Russian market.

Thus, in spite of suspension of some operations, in actual fact the company stayed in the Russian market. The impact of the negative expectations from the current events on the company's decision was not strong enough to make it withdraw from the market completely. So, the company made a partially irrational decision to stay in the market despite the risks and benefited from the market abandoned by competitors.

The last company used in the case study is Schlumberger Limited – an American oil and gas giant represented in over 120 countries, including Russia. This company has been selected for the study for several reasons:

- the company represents a specific IT sub-industry: creation of IT infrastructure for oil extraction;
- the company presents one of the most interesting cases in the study of the impact of the event of the SMO launch: in March 2022 the company declared a complete suspension of all operations in Russia, however, in about 6 months it fully reactivated its Russian business operations under its brand after it had re-registered legal entities as owned by the local management.

Similarly to previous cases, we performed a quantitative analysis of the impact of the revenue share factor in the form of a financial model. The model's main forecast prerequisites are the accepted assumption of the annual revenue growth rate of 5% since 2024. The current assets' and short-term liabilities' growth rate also corresponds to the revenue growth rate, discounting parameters are taken from publicly available sources [13; 28; 29].

In order to develop the second model for a hypothetical situation of business suspension in Russia for Schlumberger, we deducted the RF revenue share (6% taking into account the 23% growth in 2022) from the reporting value of consolidated revenue for 2022. Also, operating expenditures for the same year were increased due to the addition of deconsolidation expenses (assumption of sale of the company's Russian assets at a 50% discount from the fair value).

After comparing the results of the evaluation of the two models, we discovered a difference of 11% in stock prices in these cases (exceeding the 10% benchmark), i.e., in this case we also observe the impact of the RF revenue share factor on the Schlumberger's stock dynamics and, hence, on corporate decision-making concerning the business in Russia.

The significant factor of Schlumberger's Russian assets should also be noted. The company's fixed assets in Russia amount to approximately $0.3 billion (5% of the total

amount of the entire group of companies). First of all, these assets comprise factories and plants [30]. This factor along with revenue is evaluated as one of the principal ones for the company because Schlumberger technologies and the demand for them were the main reason for the company's return and business reactivation.

The aspect of Schlumberger recognizability is ambiguous, although the company has enormous weight in the oil and gas industry, renders over 20% of all oilfield services in Russia and is the industry leader in the country.

Political and reputational risks and risks of country instability are the main business risks in Schlumberger's risk management system. In spite of the fact that at the date of the event study performed in this research Schlumberger belonged to category *F* of remaining companies (i.e., the ones continuing business in the Russian Federation without limitations) on 10 May 2023 the company declared a set of measures that should have ensured a normal course of operations in Russia. The main reason behind the decision was industry sanctions prohibiting to provide to Russia certain technologies of similar western companies. The company will also restrict the access of the Russian office to certain products and internal documents of the group of companies. Thus, Schlumberger management complies with the international sanctions requirements, but at the same time preserves its position in the Russian market and continues to provide services to Russian companies. Thus, the impact of political risks is considered low, while the impact of reputational and sanctions risks is assessed as high in regard to the decision on continuing or winding down business operations in Russia.

The factor of government participation in several investment funds (Deutsche Bank AG (2%), JP Morgan Chase & Co., S&P Global Inc. (<5%)) produces no significant impact on the company management when corporate decisions are made.

In this case, there is no ESG policy impact on the decisions of the Schlumberger management because the company does not take a clear political stand in its integrated reports or publish data on other humanitarian initiatives concerning the Russia-Ukraine conflict.

The hypothesis of the behavioral finance impact on the decisions of the Schlumberger management is true for this case because the company made an irrational decision to stay in the market with negative expectations concerning the impact of the event of 24 February. As at March 2022, the company expressed its concerns about continuing its business in Russia because the management had negative expectations and declared openly that they are closing down their business in the Russian Federation. At the same time, in fact the company has continued rendering services in Russia and still operates with minimal restrictions. This is an action that contradicts the management's expectations and is anomalous with this background. The company benefited from the decision to stay in the Russian market: at the end of 2022 the company recorded a 23% increase in revenue because its competitors had left the market.

The conclusions of analysis of the Visa, NVIDIA, Activision Blizzard and Schlumberger cases are presented in Table 3. An analysis of the degree of the impact of the selected factors showed that in their decision-making companies are guided by the RF revenue share in the total consolidated amount, rather than other financial factors. This factor turned out to be significant for Activision Blizzard and Schlumberger.

After an analysis of corporate governance factors, we found out that sanctions and reputational risks are of importance in decision-making of all considered companies. Terms of ESG policies turned out to be important for two of the four companies: Visa and NVIDIA. The recognizability factor also produced a high impact on making corporate decisions for Visa, NVIDIA and Activision Blizzard.

Table 3. Evaluation of the degree of influence of financial and non-financial factors on companies' corporate decisions

Company	Degree of influence of the considered factors						
	Financial factors		Non-financial factors				
	Revenue share	Assets share	Recognizability	Risks	Institutional investors	ESG policy	Behavioral finance
Visa	Low	Low	High	High	Average	High	Low
NVIDIA	Low	Low	High	High	Low	High	Low
Activision Blizzard	High	Low	High	High	Low	Average	Average
Schlumberger	High	High	Average	High	Low	Low	High

Source: compiled by the authors.

In the present paper we performed two types of research: an event analysis of dynamics of American IT companies' stocks before and after the declaration of the SMO on 24 February 2022, as well as a case study by way of quantitative and qualitative analysis of financial and non-financial factors of the sample of the companies which have exited the market and the remaining companies.

On the basis of the results of event study, hypothesis H1 was rejected: the SMO declaration did not exert a significant impact on the American IT companies' stock. Hypotheses H2 and H3 were confirmed. The remaining companies selected for the cases are governed by financial aspects, in particular, the RF revenue share when they make corporate decisions on whether to continue business in Russia. From the point of view of non-financial factors, reputational and sanctions risks have the greatest impact on companies' decisions.

Thus, the cancel culture phenomenon in relation to Russia did not influence the dynamics of the American IT industry stock, and the companies' decision to exit the market or continue business in Russia depends on whether a company has a significant share of revenue in the RF, on the degree of reputational and sanctions risks, the recognizability factor and specific features of ESG policy.

Conclusion

After the beginning of the SMO, foreign companies revised their strategy of presence in the Russian market. After the abovementioned events the cancel culture phenomenon in relation to Russia took on a global economic meaning.

We reviewed literature sources in three key areas: study of the stock markets' reaction by means of event study, consideration of the cancel culture phenomenon in its new interpretation, defining the factors that influence corporate decision-making. We also examined the reaction of the American stock market to the cancel culture phenomenon in relation to Russia using the rapid-growing IT industry as an example, established a methodology and applied it to study the impact of the event of 24 February 2022 on the dynamics of company stocks, and substantiated the choice of the technology industry for the research. Then, on the basis of the event study, both positive and negative results of the event impact were revealed for certain categories of companies. Hypothesis H1 was rejected, i.e., the declaration of the SMO exerted no significant impact on the American IT companies' stock.

Then, as a part of the case study, qualitative and quantitative evaluation of four IT companies was carried out. The companies were selected on the basis of the event study results. As a result, hypothesis H2 was confirmed: the RF revenue share is of great importance for companies when they make a decision whether to continue business in Russia or wind it down. The smaller the revenue share in the RF, the higher the probability of a foreign company's exit from the market without serious losses.

Hypothesis H3 was partially confirmed: the most significant decision-making factors are the degree of reputational and sanctions risks, the company recognizability factor and the specific features of ESG policies. At the same time, the behavioral finance theory which implies a comparison of the company's initial expectations to its actual decision was completely confirmed only for one company among the ones used as an example.

In conclusion, some limitations detected during the research should be noted, and the possible ways to expand and make the present paper more profound should be suggested.

First, taking into consideration the specific character of the industry and constantly updating the data, the company sample for the event study is insufficient in size. In addition, in this research we have not considered the multifactor event study models that are necessary for the expanded analysis and additionally take into consideration such indicators as, for example, the size of the analyzed company.

In the future, the researchers performing a case study may also consider the impact of other non-financial factors, for example, CEO's and board of directors' characteristics. The impact of financial aspects on corporate decisions may be analyzed in a more comprehensive way. For example, the factor of reputational and other relevant risks may be taken into consideration from the quantitative point of view for the purpose of forecasting in the financial model.

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