Vol. 18 | № 1 | 2024 cfjournal.hse.ru ISSN 2073-0438

JOURNAL OF CORPORATE FINANCE RESEARCH

New Research | Corporate Financial Analytics | Applied Financial Analytics | Methods | Reviews | Discussions

Journal of Corporate Finance Research

Vol. 18 | № 1 | 2024
e-journal
www.cfjournal.hse.ru
ISSN 2073-0438

Contacts:
Higher School
of Economics (HSE),
11 Pokrovsky Boulevard, Building S
Tel.: +7 (495) 621 9192*27188
E-mail: cf@hse.ru

Journal of Corporate Finance Research (JCFR) was established in 2007. It is founded by the National Research University Higher School of Economics (NRU HSE) and **Irina Ivashkovskaya** (chief editor). The journal is included in Web of Science Russian Science Citation Index (RSCI).

Journal of Corporate Finance Research aims to publish high quality and well-written papers that develop theoretical concepts, empirical tests and research by case studies in corporate finance.

The scope of topics that are most interesting to JCFR includes but is not limited to: corporate financial architecture, payout policies, corporate restructuring, mergers and takeovers, corporate governance, international financial management, behavioral finance, implications of asset pricing and microstructure analysis for corporate finance, private equity, venture capital, corporate risk-management, real options, applications of corporate finance concepts to family-owned business, financial intermediation and financial institutions.

JCFR targets scholars from both academia and business community all over the world.

Frequency: 4 times per year

The Journal of Corporate Finance Research is committed to upholding the standards of publication ethics and takes all possible measures against any publication malpractices. Editors of the journal reserve the right to reject the work from publication in case of revealing any such malpractices.

Guidelines for authors:
https://cfjournal.hse.ru/en/for%20authors.html.

Editorial Staff

Editorial board

Contents

Journal of Corporate Finance Research
Vol. 18 | № 1 | 2024
www.cfjournal.hse.ru

New Research

Reviews

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.5-19
JEL classification: G11, G20

The Impact of ESG Ratings on Exchange-Traded Fund Flows

Yury Dranev ✉
PhD, Leading Research Fellow, National Research University Higher School of Economics, Moscow, Russia, ydranev@hse.ru, ORCID

Mikhail Miriakov
PhD, leading expert, National Research University Higher School of Economics, Moscow, Russia, mmiryakov@hse.ru, ORCID

Elena Ochirova
PhD, Research Fellow, National Research University Higher School of Economics, Moscow, Russia, eochirova@hse.ru, ORCID

Gennadii Baranovskii
Leading expert, ESG Consulting Agency, Moscow, Russia, G.baranovsky83@gmail.com, ORCID

Abstract

The aim of our paper is to examine the impact of environmental, social, and governance (ESG) ratings on investment decisions in the pre-pandemic US bond and equity exchange-traded fund (ETF) markets. We measure the attractiveness of investments in the ETF as net fund flows and estimate whether the attractiveness varies with the ESG score. For empirical estimations, we employ the regression analysis methodology; specifically, we use linear mixed-effect model to analyze time-series dataset and ordinary least squares to analyze the cross-section data. On the one hand, we found that, on average, ETFs which comply with ESG criteria attracted additional net assets per month as compared to conventional ETFs. Thus, the results of our study indicate that investors demonstrate collective preference towards ESG investments and pay attention to the information on whether the ETF complies with the ESG criteria. On the other hand, we found mixed evidence that higher ESG score always leads to larger investments: differences in scores could not explain the variation in net fund flows. Overall, our study shows that ETF market investments are not directed by the risk-return profile only, and investors also have non-pecuniary motives for their decisions. The results have several practical implications. First, our findings offer business entities useful insight into the fact that incorporation of ESG policy can increase the attractiveness of their business for potential investors. Second, it shows that the market participants would benefit from increasing transparency and unification of rating methodology.

Keywords: exchange-traded funds, sustainable finance innovation, ESG score, ESG compliance

For citation: Dranev Y., Miriakov M., Ochirova E., Baranovskii G. (2024) The Impact of ESG Ratings on Exchange-Traded Fund Flows. *Journal of Corporate Finance Research.* 18(1): 5-19. https://doi.org/10.17323/j. jcfr.2073-0438.18.1.2024.5-19

Introduction

Since firms significantly increase expenses for environmental, social, and governance (ESG hereafter) activities, the financial market's assessment of the shift toward sustainability and social responsibility gains importance. The reallocation of fund flows to ESG assets has major implications for investment decisions [1], and several studies suggested the introduction of investor's personal tastes into the asset pricing model [2] – particularly, the inclusion of preferences for sustainable investment [3]. However, while some investors may have strong inclinations towards highly rated ESG assets because of non-pecuniary motives, others may consider the information on risk-return profiles as a framework for their decisions [4]. The overall reaction of market participants to ESG-related information remains a debatable issue and requires additional theoretical and empirical examination [e.g. 3; 5].

In this study, we attempt to assess the ESG preferences of investors and the impact of the ESG rating on the attractiveness of exchange-traded funds (ETF hereafter). ETFs are investment entities that track an index or a basket of assets [6]. For the past decade, the ETF industry has become a primary competitor for actively managed funds [7]. Since the shift of conventional wisdom in favor of passive investment strategies, the total net assets of ETFs have been growing rapidly [8]. The rise of the ETF market has been studied by numerous researchers, but relatively little attention has been heeded to the relationship between ESG policies and investments in the ETF market. Recently, several financial scholars examined the impact of the ESG rating on the financial performance and riskiness of ETF investments [1; 9–11]. The primary focus of our study is on fund flows as an indicator of ETF attractiveness for investors [e.g. 5]. We use two measures to capture the ESG-related information. First, the fact for an ETF of being compliant with ESG criteria is obtained from the MSCI ESG Score and the Morningstar's list of socially conscious funds. Second, the difference in MSCI ESG Score of ETFs measures the ability of underlying assets to manage risks and opportunities arising from ESG factors. These metrics are used to assess (1) whether ESG ETFs attract more investments as compared with the conventional ETFs, and (2) whether a higher level of ESG score is associated with the higher level of investments.

The main contribution of this paper is twofold. Firstly, the results indicate that ETFs that comply with ESG criteria attracted more investments in US bond and equity ETF markets from 2018 to 2020. Thus, our study provides evidence of nonfinancial incentives of investors in ETF: overall, the financial market rewards ESG ETFs with additional investment flows. Secondly, we could not find evidence that market participants consider the differences in the ESG score. The ESG score of ETFs does not explain the variation in the fund flows. Such investment behavior is consistent with previous findings that investors tend to react to basic sustainability metrics [e.g. 5] and often ignore complicated information in their decision-making process [e.g. 12].

The rest of the paper proceeds as follows. Second section offers a review of academic literature concerning ESG information in financial decision-making. In this section, we state the main hypotheses concerning the non-pecuniary motives of ETF investors and the role of the ESG score in decision-making. Sections three and four describe the methodology and data. Section five outlines the empirical results of the econometric analysis. Finally, Section six concludes with the discussion of results and its theoretical and practical implications as well as the limitations of our study and avenues for further research.

Development of hypotheses

Do investors in ETFs have non-pecuniary motives?

While ESG-compliant assets attract more funding, the important question concerns the reasons behind this tendency: whether it is a reflection of the attractiveness of related segments of the financial market, or a shift from conventional instruments to ESG-motivated investments. As the share of sustainable investments increases [13], a growing number of studies have examined the factors influencing the attractiveness of such financial instruments [14]. Several studies analyzed the market performance of ESG-compliant financial instruments. However, the evidence is mixed [e.g. 14]. Some empirical studies discovered that the ESG investing may reduce risk and provide superior returns. The attractiveness of investments in ESG assets was confirmed by T. Kanamura, A. Borgers et al., and T. Barko et al. [1; 15–16]. A. Amel-Zadeh and G. Serafeim showed that for investors the key motivation to use ESG information is its relevance to investment performance [17]. Other studies found evidence of low returns on socially responsible investments [18–23]: these authors suggest that ESG-motivated investors underperform in the market due to the non-pecuniary utility, which means sacrificing returns in order to invest responsibly.

To reconcile these contradictory empirical results, several studies explicitly incorporated non-financial incentives into modern portfolio theory. A prominent example of such theoretical research is E. Fama and K. French, who studied how the personal preferences of investors may affect asset prices in a real-world economy [2]. In a recent study L. Pedersen et al. developed an asset pricing model by including the ESG attitude of investors and proposed an ESG-adjusted asset pricing model [3]. Their model predicts that the proportion of different types of investors affect both the returns and resource allocation in the financial market.

Recent literature treats the attitude of investors toward ESG as an important factor that affects market resource allocation [e.g., 5]. In our study, we assume that ETF market investors are aware of ESG policy and pay attention to the general ESG-related information. The fact that an ETF complies with ESG criteria is important information in making investment decisions. Hence the first hypothesis states:

H1a: The compliance of a bond ETF with ESG criteria positively affects ETF flows.

H1b: The compliance of an equity ETF with ESG criteria positively affects ETF flows.

Do investors pay attention to the ESG Score?

Despite the progress that companies have made in disclosing their ESG performance during the last decade, the assessment of ESG factors usually entails high costs [24–26]. Therefore, rating agencies play an important mediatory role between firms and investors, provide information influencing investors' decisions and may thus direct fund flows in the financial market [27–28].

Several studies emphasized various challenges that ranking agencies had to deal with [11; 29]. First, investors often do not behave as rational agents, and look for simpler signals while making a decision [e.g., 12]. For ESG performance, the literature suggests that investors tend to respond to the highly ranked assets and ignore the others [e.g., 5; 30]. Some researchers warn that naive use of primary information on ESG ranking may be misleading [31], since non-expert investors face difficulties in linking numerous sustainability concepts in a coherent way [32].

Second, the uncertainty of ESG-related information constitutes an additional obstacle in decision-making. There are no uniform standards in ESG information disclosure, and rating agencies provide various ESG scores using opaque methods; the variability of approaches to the ESG ratings of firms may lead to biased investors' decisions in cases of information abundance [33]. The lack of unified methodology for assigning company-specific ratings increases the gap between the ESG scores of different ESG rating providers [31; 34].

Thus, to test whether a high ESG score increases the attractiveness of ETFs for investors, we developed the second hypothesis as follows:

H2a: A ESG score positively affects flows to bond ETFs.

H2b: A ESG score positively affects flows to equity ETFs.

Methodology

Modeling the ESG compliance effect

We tested hypotheses H1a and H1b using linear mixed-effect model [e.g., 35]. In order to estimate the impact of ESG compliance on fund flows, we use the following model specification for ETF i and month t:

$$FlowTNA_{i,t} = \beta_0 + \beta_1 ESG\,Compliance_{i,t} + \beta_2 ER_{i,t} + \\ + \beta_3 Return_{i,t} + \beta_4 Log\,Holding_{i,t} + \beta_5 Price\,NAV_{i,t} + \\ + \beta_6 Log\,Age_{i,t} + \beta_7 Spread\,Price_{i,t} + \\ + \beta_8 Log\,Turnover_{i,t}. \quad (1)$$

Table 1 provides the definition of variables. The dependent variable is the one-year fund flow to net total assets ratio ($Flow\ TNA_{i,t}$), which is a proxy for the attractiveness of the ETF. Since one of the major advantages of passive investments is low managerial fees, we control the model for expense ratio ($ER_{i,t}$) and assume that even a small increase is associated with a fall of fund flows [36]. High returns ($Return_{i,t}$) for the previous period, as one of the major motives to invest, positively affects the attractiveness of an ETF [1]. The number of underlying securities ($Log\ Holding_{i,t}$) is assumed to have a positive effect, since investors may have concerns about small numbers of holdings [37]. The ratio of the fund's market price to its book value ($Price\ NAV_{i,t}$) may represent the inflows to ETFs. The assets of the newly launched ETF are expected to grow faster in percentage terms, indicating the larger inflows. Thus, the age of the fund ($Log\ Age_{i,t}$) is expected to have a negative impact on asset-weighted fund flows [36]. The turnover ($Log\ Turnover_{i,t}$) controls for fund liquidity, which should have a positive effect [36]. Likewise, the bid-ask spread ($Spread\ Price_{i,t}$) shows the fund's liquidity.

Table 1. List of variables (ESG compliance effect modelling)

Variable	Description
Dependent variable	
Flow TNA	The ratio of monthly fund flow divided by total net assets (TNA), %
Independent variable	
ESG compliance	Dummy variable, 1 – the fund complies with the ESG criteria, 0 – otherwise
Control variables	
ER	Expense ratio set by the fund, %
Return	Aggregated monthly return lagged for one month, %
Log Holdings	Natural logarithm of the number of securities owned by the fund
Price NAV	Price of the ETF to the fund's Net Asset Value, %
Log Age	Natural logarithm of the age of the fund, months
Spread Price	Ratio of the ETF's price spread to its price, %
Log Turnover	Natural logarithm of turnover divided by the total amount traded

We structure the panel data set of ESG-compliant ETFs and conventional ETFs using data provided by MSCI for March 2020 (available at ETF Database – ETFdb.com). Only ETFs included in both MSCI data and Morningstar's list were considered to be ESG compliant. To construct a

comparison subsample of conventional ETFs, we followed the procedure described below. First, we identified the list of issuers of ESG-compliant ETFs. Therefore, all conventional ETFs were combined in the pool of potential matches for ESG ETFs. In the second step, we conducted further matching based on asset-adjusted fund flows, exploited age, expense ratio, and the number of holdings, following [38–39]:

$$Match_{i,j} = \frac{\left(FlowTNA_i - FlowTNA_j\right)^2}{\sigma^2_{TNA}} + \frac{\left(Age_i - Age_j\right)^2}{\sigma^2_{Age}} + \frac{\left(ER_i - ER_j\right)^2}{\sigma^2_{ER}} + \frac{\left(Holdings_i - Holdings_j\right)^2}{\sigma^2_{Holdings}}, \quad (2)$$

where, σ is the cross-sectional deviation.

Following L. Renneboog et al., we restricted potential matches among conventional ETFs to be no more than 2 years older or younger than the ESG-compliant ETF [39]. This prevents an estimation bias of life-cycle effects and macroeconomic time-series effects. To construct panel A, for each ESG compliant ETF, we added one conventional ETF using the matching measure. Similarly, we constructed panel B by matching one ESG-compliant ETF to two conventional ETFs. Since several ESG-compliant ETF providers had less than two conventional ETFs, some matches have different issuers. The final subsamples of ESG compliant bond ETFs and ESG compliant equity ETFs covers 15 and 42 funds respectively. The lists of conventional and ESG compliant funds are provided in Appendix A.

Modeling the ESG score effect

In order to test the effect of ESG score, we estimate the following regression model using the ordinary least squares (OLS hereafter) method:

$$FlowTNA_i = \beta_0 + \beta_1 ESG\,Score_i + \beta_2 ER_i + \\ + \beta_3 Return_i + \beta_4 Log\,Volume_i + \beta_5 SD_i + \\ + \beta_6 Log\,Age_i + \beta_7 Volatility_i. \quad (3)$$

In the case of heteroscedasticity, we applied OLS with Huber-White robust standard errors (the results of heteroscedasticity testing are in the Appendix). Table 2 provides the definition of variables of the regression equation. As in the case of the time-series model, the dependent variable is the one-year fund flow to net total assets ratio ($Flow\,TNA_i$). We considered five proxies of ESG measures for different model specifications. In Model 1, ETFs' ESG scores are provided by MSCI for March 2020 (available at ETF Database – ETFdb.com). The MSCI Inc. dominates the market of ESG ranking data providers, covering about 40% of the entire market [40]. In Model 2, the ESG score peer percentile ($ESG\,Peer_i$) normalizes the ESG score to other ETFs in the same peer group. In model 3, the ESG score global percentile ($ESG\,Global_i$) normalizes the ESG score to all funds in the MSCI ESG Fund Metrics coverage. In Model 4, SRI exclusion criteria ($ESG\,Exclusion_i$) allows us to identify the level of funds' exposure to companies involving at least one SRI exclusion factor (e.g., alcohol, gambling, weapons, etc.). In Model 5, sustainable impact solutions ($Sustainable\,Impact_i$) is the portfolio weighted average of each company's percentage of revenue generated by Sustainable Impact Solutions goods and services. In the cross-section model, we additionally control for a standard deviation of return (SD_i) which is a measure of investment riskiness that is expected to have a negative impact on fund flows [9]. The average traded volume of a fund ($Log\,Volume_i$) demonstrates the overall activity [41]. It is expected to have a positive effect. Finally, we expect the positive relationship between adjusted fund flows and fund volatility ($Volatility_i$) for the last 200 days, compared to its peer group in ETFdb.com [39].

Table 2. List of variables (ESG score effect modelling)

Variable	Description
Dependent variable	
Flow TNA	The ratio of one-year fund flow divided by total net assets (TNA), %
Independent variable	
ESG Score	MSCI ESG score, 1 to 10
ESG Score Peer Percentile	Measure of how the ESG score of ETF ranks relative to other funds in the same peer group, %
ESG Score Global Percentile	Measure of how the ESG score of ETF ranks relative to all funds in MSCI ESG Fund Metrics coverage, %
SRI Exclusion	ETF's exposure to companies flagged for at least one SRI exclusion factors (e.g., alcohol, gambling, weapons), %
Sustainable impact	Portfolio weighted average of each company's percent of revenue generated by Sustainable Impact Solutions goods and services, %
Control variables	
ER	Expense ratio set by the fund, %
Return	Aggregated annual return for the previous year, %
Log Volume	Logarithm of a fund's average traded volume, $
SD	Standard deviation of a fund's returns, %
Log Age	Logarithm of Age of fund, months
Volatility	Volatility of the fund for last 200 days, compared to its peer group in ETFdb.com, %

Data

For the purposes of empirical testing, we collected 2 data samples for each model. The first sample covers the period from March 2018 to March 2020. A significant part of ESG-compliant ETFs were founded in 2015 and later, thus, it is impossible to collect earlier data appropriate for empirical study in the case of ESG ETFs [42]. According to Statista, the value of Global ESG ETF assets started growing rapidly in 2017–2018 [43]. Besides, the sample is limited to the beginning of 2020, due to the Covid-19 pandemic's harsh impact on the economy and financial markets [11].

We use balanced panel data with financial information from the Bloomberg database. We employ the fund flow to the net total assets ratio as a dependent variable. Return of the funds, age and expense ratio are also included as independent variables. Additionally, we control for the number of securities owned by the ETFs, the ratios of the ETF's price to net assets, the ETF's price spread to its price, and the turnover ratio of the funds. Table 3 presents the descriptive statistics for bond ETFs based on panel data. For the majority of variables, both panels have similar results.

Table 3. Descriptive statistics of bond ETFs based on panel data

Panel A: Bond ETFs 1-1												
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	Flow TNA	0.017	0.128	1								
(2)	ESG compliance	0.500	0.500	0.180***	1							
(3)	ER	0.003	0.002	–0.014	–0.038	1						
(4)	Return	0.369	1.269	0.049	0.063*	–0.047	1					
(5)	Log Holdings	5.347	1.837	0.057	0.230***	–0.230***	0.005	1				
(6)	Price NAV	1.000	0.003	0.120***	0.200***	0.080**	0.078**	–0.049	1			
(7)	Log Age	3.541	0.903	–0.130***	–0.130***	0.021	0.070*	–0.180***	–0.170***	1		
(8)	Spread Price	0.304	8.140	–0.005	–0.037	0.014	–0.012	–0.085**	–0.013	0.020	1	
(9)	Log Turnover	15.597	2.428	0.150***	0.280***	0.080**	0.073**	0.270***	0.059	0.090**	–0.036	1
No of obs: 750. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.												
Panel B: Bond ETFs 1-2												
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	Flow TNA	0.019	0.110	1								
(2)	ESG compliance	0.333	0.472	0.140***	1							
(3)	ER	0.002	0.003	–0.013	0.110***	1						
(4)	Return	0.337	1.243	0.083***	0.064**	–0.043	1					
(5)	Log Holdings	5.339	1.612	0.062**	0.190***	–0.140***	–0.0003	1				
(6)	Price NAV	1.000	0.003	0.140***	0.110***	0.009	0.078***	–0.045	1			
(7)	Log Age	3.708	0.852	–0.077***	–0.230***	–0.084***	0.075**	–0.097***	–0.086***	1		
(8)	Spread Price	0.203	6.646	–0.005	–0.021	0.017	–0.009	–0.079***	–0.013	0.012	1	
(9)	Log Turnover	16.594	2.645	0.100***	–0.085***	–0.180***	0.041	0.180***	0.033	0.260***	–0.039	1
No of obs: 1125. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.												

Table 4 shows the descriptive statistics for equity ETFs. In comparison, bond ETFs demonstrated a higher average return than equity ETFs. The spread price difference was also higher for bond ETFs.

Table 4. Descriptive statistics of equity ETFs based on panel data

Panel A: Equity ETFs 1-1												
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	Flow TNA	0.003	0.164	1								
(2)	ESG compliance	0.500	0.500	0.074***	1							
(3)	ER	0.004	0.002	-0.150***	0.085***	1						
(4)	Return	–0.308	5.908	0.058***	0.021	0.007	1					
(5)	Log Holdings	4.460	1.410	0.160***	0.020	–0.480***	–0.008	1				
(6)	Price NAV	1.000	0.003	0.067***	0.053**	–0.097***	0.160***	0.064***	1			
(7)	Log Age	4.259	0.701	–0.081***	–0.240***	0.420***	–0.001	–0.330***	–0.140***	1		
(8)	Spread Price	0.054	1.044	0.045**	0.031	–0.006	0.027	–0.012	0.025	–0.030	1	
(9)	Log Turnover	16.766	1.861	0.030	–0.310***	–0.210***	-0.110***	0.140***	-0.055**	0.350***	–0.066***	1

No of obs: 2100. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.

Panel B: Equity ETFs 1-2												
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	Flow TNA	0.002	0.149	1								
(2)	ESG compliance	0.333	0.471	0.062***	1							
(3)	ER	0.005	0.002	–0.150***	0.052***	1						
(4)	Return	–0.333	6.059	0.086***	0.017	0.006	1					
(5)	Log Holdings	4.566	1.363	0.130***	–0.041**	–0.480***	–0.013	1				
(6)	Price NAV	1.000	0.003	0.075***	0.067***	–0.095***	0.160***	0.044**	1			
(7)	Log Age	4.400	0.681	–0.081***	–0.320***	0.380***	–0.010	–0.220***	–0.120***	1		
(8)	Spread Price	0.049	1.098	0.039**	0.024	0.019	0.016	–0.010	0.019	–0.017	1	
(9)	Log Turnover	17.283	1.905	0.015	–0.410***	–0.210***	–0.110***	0.160***	–0.053***	0.420***	–0.051***	1

No of obs: 3150. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.

The second data sample is obtained from ETFdb.com on the US ETF market. The sample does not cover inverse and leveraged ETFs because of the differences in investment strategies. The overall sample consists of 206 bonds and 1,095 equity ESG ETFs. Table 5 presents the descriptive statistics for cross-sectional data. The average ESG score for bond ETFs is 4.914, while for equity ETFs this score is 5.185. ESG Score Peer Percentile and ESG Score Global Percentile variables do not differentiate substantially between bond and equity funds.

Table 5. Descriptive statistics of ESG ETFs based on cross-sectional data

ESG Bond ETFs														
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(1)	Flow TNA	0.186	0.340	1											
(2)	ER	0.002	0.002	–0.180**	1										
(3)	Return	0.044	0.087	0.052	–0.570***	1									
(4)	Log Volume	11.862	2.409	–0.031	–0.330***	0.180***	1								
(5)	SD	0.016	0.017	–0.160**	–0.030	0.530***	0.180***	1							
(6)	Log Age	4.201	0.701	–0.440***	–0.140**	0.220***	0.620***	0.330***	1						
(7)	Volatility	0.161	0.090	–0.052	0.290***	0.015	–0.002	0.490***	0.056	1					
(8)	ESG_Score	4.914	1.265	–0.026	–0.550***	0.600***	0.180***	0.024	0.260***	–0.450***	1				
(9)	ESG–Peer	0.557	0.302	0.0002	–0.230***	0.340***	0.075	0.130*	0.200***	–0.170**	0.640***	1			
(10)	ESG–Global	0.419	0.252	–0.030	–0.520***	0.580***	0.190***	0.055	0.270***	–0.440***	0.980***	0.680***	1		
(11)	ESG–Exclusion	0.049	0.040	0.150**	–0.100	0.062	–0.190***	–0.069	–0.240***	0.210***	–0.200***	–0.370***	–0.280***	1	
(12)	Sustainable–Impact	0.022	0.020	0.092	0.072	–0.066	–0.180**	–0.083	–0.260***	0.250***	–0.260***	–0.320***	–0.320***	0.640***	1

No of obs: 206. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.

ESG Equity ETFs														
	Variables	**Mean**	**St.Dev**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(1)	Flow TNA	–0.025	0.550	1											
(2)	ER	0.004	0.002	–0.160***	1										
(3)	Return	–0.145	0.136	0.180***	–0.110***	1									
(4)	Volume	10.959	2.440	0.088***	–0.260***	0.038	1								
(5)	SD	0.043	0.036	–0.046	–0.310***	0.023	0.260***	1							
(6)	Log Age	4.348	0.805	–0.260***	–0.035	–0.095***	0.540***	0.460***	1						
(7)	Volatility	0.485	0.099	–0.019	–0.011	–0.460***	0.220***	0.210***	0.210***	1					
(8)	ESG_Score	5.185	1.408	0.094***	–0.190***	0.290***	0.075**	–0.064**	0.001	–0.230***	1				
(9)	ESG-Peer	0.428	0.287	0.066**	–0.170***	0.220***	0.079***	0.032	0.013	–0.150***	0.670***	1			
(10)	ESG-Global	0.466	0.269	0.100***	–0.180***	0.300***	0.068**	–0.087***	–0.007	–0.250***	0.980***	0.670***	1		
(11)	ESG-Exclusion	0.076	0.096	0.019	–0.082***	0.088***	0.031	0.026	0.046	–0.094***	0.330***	0.160***	0.330***	1	
(12)	Sustainable-Impact	0.062	0.067	0.064**	0.059**	0.270***	–0.066**	–0.054*	–0.001	–0.180***	0.200***	0.170***	0.200***	–0.074**	1

No of obs: 1095. * indicates significance at 10%, ** indicates significance at 5%, *** indicates significance at 1%.

Empirical results

ESG compliance and fund flows.

The time-series model addresses the hypothesis that the ESG compliance criteria affect the flows of the ETF positively and significantly. Tables 6 and 7 show the results of econometric analysis. To check whether the results are robust, we estimated two panels (A and B) with pooled OLS models.

Table 6 shows that the bond ESG ETFs attracted more investments than conventional ETFs: the dummy variable for ESG is statistically significant. Thus, H1a (compliance of a bond ETF with ESG criteria significantly and positively affects ETF flows) cannot be rejected at a 1% level of significance. This result is consistent: both panels confirmed a positive and significant relationship between ESG compliance and fund flows. Moreover, the robustness test also confirms the positive effect of ESG compliance on fund flows.

Table 6. ESG compliance and fund flows of bond ETFs: econometric analysis results

	Panel A: Bond ETF 1-1		Panel B: Bond ETF 1-2	
Dependent Variable	**Fund flow to TNA**			
Independent Variables	**Pooled OLS**	**Mixed model**	**Pooled OLS**	**Mixed model**
Intercept	−2.347*	−2.331	−3.983***	−3.028***
ESG Compliance	0.031***	0.029**	0.028***	0.029***
ER	−2.149	−2.206	−0.453	0.167
Return	0.003	0.008**	0.006**	0.009***
Log Holdings	−0.002	−0.002	0.001	0.0005
Price NAV	2.320	2.274	3.936***	2.960***
Log Age	−0.017***	−0.013*	−0.010**	−0.008
Spread Price	0.00008	0.00006	0.0001	0.00003
Log Turnover	0.007***	0.008***	0.005***	0.007***
ETF effects	No	Yes	No	Yes
Time effects	No	Yes	No	Yes
No of obs.	750	750	1 125	1 125
R^2	0.063	0.129	0.058	0.133
F-test	6.232***		8.535***	

Note: The table shows the results of panel regression models created to identify the impact of ESG compliance on US bond ETFs. The dependent variable is the fund flows to total net assets ratio. R^2 for mixed linear models are conditional.

* Indicates significance at 10%.

** Indicates significance at 5%.

*** Indicates significance at 1%.

Table 7 reports the results of the H1b hypothesis' tests. According to the regression analysis, equity ESG ETFs, on average, attracted more investments than conventional ETFs. Both A and B panels confirmed a positive and significant relationship between ESG compliance and equity ETF flows.

Additional analysis using pooled OLS methodology indicates that the results are robust. As in the case of the bond ETF market, tests confirm that H1b (compliance of an equity ETF with ESG criteria significantly and positively affects ETF flows) cannot be rejected at a 1% level of significance.

Table 7. ESG compliance and fund flows of equity ETFs: econometric analysis results

	Panel A: Equity ETF 1-1		Panel B: Equity ETF 1-2	
Dependent Variable	**Flow to TNA**			
Independent Variables	**Pooled OLS**	**Mixed model**	**Pooled OLS**	**Mixed model**
Intercept	−2.023*	−2.005*	−2.033**	−1.926**
ESG Compliance	0.029***	0.031***	0.023***	0.025***
ER	−7.831***	−7.966***	−6.76***	−6.904***
Return	0.001**	−0.002*	0.002***	0.0004
Log Holdings	0.013***	0.013***	0.009***	0.009***
Price NAV	1.933*	1.904*	1.988**	1.881**
Log Age	0.005	0.007	−0.002	−0.00005
Spread Price	0.007**	0.007**	0.005**	0.005**
Log Turnover	0.002	0.002	0.002	0.002
ETF effects	No	Yes	No	Yes
Time effects	No	Yes	No	Yes
No of obs.	2100	2100	3150	3150
R2	0.048	0.084	0.042	0.078
F-test	13.11***		17.40***	

Note: The table shows the results of panel regression models created to identify the impact of ESG compliance on US equity funds. The dependent variable is the fund flows to total net assets ratio. R2 for mixed linear models are conditional.

* Indicates significance at 10%.

** Indicates significance at 5%.

*** Indicates significance at 1%.

The overall evidence strongly confirms the positive link between the ETFs flows and the compliance with ESG criteria.

ESG score and fund flows

Tables 8 and 9 present the results for bond and equity ETF markets, respectively. We used five proxies of ESG performance to estimate the impact on fund flows. The overall MSCI ESG score has no significant impact on fund flows on equity and bond markets. Moreover, two additional measures of ESG performance – ESG score peer percentile and ESG exclusion criteria – also have no influence on ETF flows.

Table 8. ESG score and bond ETFs' flows: econometric analysis results

Dependent Variable	**Flow_Assets**				
Independent Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Intercept	1.042***	0.955***	1.000***	0.974***	1.022***
ER	−22.108	−20.988	−21.588	−20.330	−21.575
Return	0.600	0.409	0.541	0.489	0.515
Log Volume	0.048***	0.050***	0.048***	0.049***	0.0048***
SD	−2.334	−2.217	−2.219	−2.045	−2.380

Dependent Variable	Flow_Assets				
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Log Age	−0.319***	−0.332***	−0.322***	−0.322***	−0.328***
Volatility	0.200	0.316	0.230	0.221	0.317
ESG_Score	−0.011				
ESG-Peer		0.092			
ESG-Global			−0.025		
ESG-Exclusion				0.185	
Sustainable-Impact					−0.678
No of obs.	206	206	206	206	206
R2	0.325	0.330	0.324	0.325	0.326
Robust st.error	No	No	No	No	Yes
F-test	13.60***	13.90***	13.57***	13.59***	15.95***
Ramsey RESET	0.078	0.035	0.092	0.100	0.074
p-value	0.780	0.853	0.761	0.752	0.785

Note: This table reports the regression analysis of the ESG score on the fund flow of US bond ETFs. The dependent variable is the ratio of one-year fund flow divided by total net assets.

* Indicates significance at 10%.

** Indicates significance at 5%.

*** Indicates significance at 1%.

On the equity ETF market, sustainable impact solutions and ESG-Global Percentile have a significant and positive effect on fund flows. We additionally tested our regression models for specification errors, and the Ramsey test indicated the absence of omitted variables. Moreover, robust standard errors are used when the assumption of homoscedasticity is violated. The results for heteroscedasticity are provided in Appendix B.

Table 9. ESG score and equity ETFs' flows: econometric analysis results

Dependent Variable	Flow_Assets				
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.426***	0.508***	0.450***	0.515***	0.480***
ER	−16.190*	−17.686**	−15.695**	−17.880**	−18.917**
Return	0.589***	0.615***	0.577***	0.622***	0.553***
Log Volume	0.060***	0.059***	0.059***	0.059***	0.061***
SD	0.652	0.559	0.698*	0.559	0.619
Log Age	−0.289***	−0.287***	−0.290***	−0.288***	−0.292***
Volatility	0.425**	0.404**	0.439**	0.405**	0.413**
ESG_Score	0.016				
ESG-Peer		0.028			

Dependent Variable	Flow_Assets				
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5
ESG-Global			0.108*		
ESG-Exclusion				0.092	
Sustainable-Impact					0.533**
No of obs.	1095	1095	1095	1095	1095
R2	0.17	0.1688	0.171	0.1689	0.1724
Robust st.error	Yes	Yes	Yes	Yes	Yes
F-test	34.81***	35.03***	35.04***	35.06***	36.17***
Ramsey RESET	2.096	1.939	1.867	2.227	2.184
p-value	0.148	0.164	0.171	0.136	0.140

Note: This table reports the regression analysis of ESG score on fund flow of US equity ETFs. The dependent variable is the ratio of one-year fund flow divided by total net assets.

* Indicates significance at 10%.

** Indicates significance at 5%.

*** Indicates significance at 1%.

Thus, empirical models provide mixed results. The majority of ESG performance measures do not explain the variation in the ETF flows. The sustainable impact index and ESG-Global Percentile positively affect only equity ETF flows. Overall, empirical results do not confirm hypotheses H2a and H2b, which postulate the positive effects of ESG scores on the flows of bond and equity ETFs.

Conclusion and Discussion

The financial market plays a crucial intermediary role in the saving-investment process, and the determination of factors directing investors' resources is highly relevant for both academic discussion and practical implication. In this study, we focus on ESG preferences of ETF market investors and assess the impact of ESG ranking on the attractiveness of exchange-traded funds.

We found that, on average, ETFs that comply with ESG criteria attracted additional net assets per month as compared to conventional ETFs. Thus, our results may indicate that investors pay attention to ESG-related information and have strong preferences toward ESG investing. We also found mixed evidence that ESG ranking measures affect the allocation of resources in the financial market. Our analysis suggests that a higher ESG score is not a prerequisite of the larger investments: differences in scores could not explain the variation in fund flows. Taken together, our findings confirm that ETF market fund flows are not limited by the risk-return profile, and that investors have non-pecuniary motives for their decisions. At the same time, the decision-making process largely ignores ESG scores and follows a simpler behavioral pattern, which is consistent with the previous findings [5; 30].

Since investors have ESG preferences, social and environmental responsibility is one of the factors that should steer companies in allocating their limited resources. Thus, it is of high importance for a firm's management to incorporate ESG policy and increase the attractiveness of their business for potential investors. Ignoring ESG factors may have a negative impact on a firm's performance. Our evidence also emphasizes the need for additional control of ESG information flows. Generally, investors have limited capacities in processing ESG-related information and are looking for a simple signal as to whether the ETF is compliant with ESG criteria or not. However, even though the ESG objective is becoming one of the key factors for asset allocation, the average investor makes decisions in the absence of a unique and transparent methodology behind ESG measurement. The ESG score value may be biased because firms still make misleading ESG disclosures [e.g. 44]. Moreover, most non-institutional investors may not be familiar with the internal procedures behind the ESG rating approach [45]. Thus, market participants would benefit from increasing transparency and unification of rating methodology [46].

Our research has several limitations. First of all, we did not distinguish between professional investors (e.g., institutional investors) and less sophisticated, household investors. Since we focused on the ETF market dominated by household investors, our results may mostly describe the behavior of non-professional investors in ESG assets. The way experts incorporate ESG compliance in their decision-making process may differ significantly, since institutional investors have the capacity to develop their own ESG-related goals and to avoid externally assigned scores.

Secondly, we restricted our sample to the beginning of the Covid-19 pandemic, because of its harsh effect on financial markets and the global economy. Our research revealed the pre-pandemic patterns of decision-making, while the pandemic could have caused dramatic changes in the preferences and behavior of household investors. These limitations suggest avenues for further research.

Acknowledgement

The article was prepared within the framework of the HSE University Basic Research Program.

References

1. Kanamura T. Risk mitigation and return resilience for high yield bond ETFs with ESG components. *Finance Research Letters*. 2021;41:101866. https://doi.org/10.1016/j.frl.2020.101866
2. Fama E.F., French K.R. Disagreement, tastes, and asset prices. *Journal of financial economics*. 2007;83(3):667-689. https://doi.org/10.1016/j.jfineco.2006.01.003
3. Pedersen L.H., Fitzgibbons S., Pomorski L. Responsible investing: The ESG-efficient frontier. *Journal of Financial Economics*. 2021;142(2):572-597. https://doi.org/10.1016/j.jfineco.2020.11.001
4. Broadstock D.C., Chan K., Cheng L.T., et al. The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Finance research letters*. 2021;38:101716. https://doi.org/10.1016/j.frl.2020.101716
5. Hartzmark S.M., Sussman A.B. Do investors value sustainability? A natural experiment examining ranking and fund flows. *The Journal of Finance*. 2019;74(6):2789-2837. https://doi.org/10.1111/jofi.12841
6. Pagano M., Sánchez Serrano A., Zechner J. Can EFTs Contribute to Systemic Risk? *ESRB: Advisory Scientific Committee Reports*. 2019;9. https://doi.org/10.2139/ssrn.3723329
7. Ben-David I., Franzoni F., Moussawi R. Exchange-traded funds. *Annual Review of Financial Economics*. 2017;9:169-189. https://doi.org/10.1146/annurev-financial-110716-032538
8. Cremers K.M., Fulkerson J.A., Riley T.B. Challenging the conventional wisdom on active management: A review of the past 20 years of academic literature on actively managed mutual funds. *Financial Analysts Journal*. 2019;75(4):8-35. https://doi.org/10.1080/0015198X.2019.1628555
9. Kanuri S. Risk and return characteristics of environmental, social, and governance (ESG) equity ETFs. *The Journal of Index Investing Fall*. 2020;11(2):66-75. https://doi.org/10.3905/jii.2020.1.092
10. Pavlova I., de Boyrie M.E. ESG ETFs and the COVID-19 stock market crash of 2020: Did clean funds fare better? *Finance Research Letters*. 2022;44:102051. https://doi.org/10.1016/j.frl.2021.102051
11. Folger-Laronde Z., Pashang S., Feor L., et al. ESG ratings and financial performance of exchange-traded funds during the COVID-19 pandemic. *Journal of Sustainable Finance & Investment*. 2022;12(2):490-496. https://doi.org/10.1080/20430795.2020.1782814
12. Ben-David I., Li J., Rossi A., Song Y. What do mutual fund investors really care about?. *The Review of Financial Studies*. 2022;35(4):1723-1774. https://doi.org/10.1093/rfs/hhab081
13. Global Sustainable Investment Alliance. Global Sustainable Investment Review 2020. URL: http://www.gsi-alliance.org/trends-report-2020/ (Accessed on 07.06.2023)
14. Gillan S.L., Koch A., Starks L.T. Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of Corporate Finance*. 2021;66:101889. https://doi.org/10.1016/j.jcorpfin.2021.101889
15. Borgers A., Derwall J., Koedijk K., et al. Do social factors influence investment behavior and performance? Evidence from mutual fund holdings. *Journal of Banking & Finance*. 2015;60:112-126. https://doi.org/10.1016/j.jbankfin.2015.07.001
16. Barko T., Cremers M., Renneboog L. Shareholder engagement on environmental, social, and governance performance. *Journal of Business Ethics*. 2021;180:777-812. https://doi.org/10.1007/s10551-021-04850-z
17. Amel-Zadeh A, Serafeim G. Why and How Investors Use ESG Information: Evidence from a Global Survey. *Financial Analysts Journal*. 2018;74(3):87-103. https://doi.org/10.2469/faj.v74.n3.2
18. Hong H., Kacperczyk M. The price of sin: The effects of social norms on markets. *Journal of financial economics*. 2009;93(1):15-36. https://doi.org/10.1016/j.jfineco.2008.09.001
19. Auer B.R., Schuhmacher F. Do socially (ir) responsible investments pay? New evidence from international ESG data. *The Quarterly Review of Economics and Finance*. 2016;59:51-62. https://doi.org/10.1016/j.qref.2015.07.002
20. Martin P.R., Moser D.V. Managers' green investment disclosures and investors' reaction. *Journal of Accounting and Economics*. 2016;61(1):239-254. https://doi.org/10.1016/j.jacceco.2015.08.004
21. Karpf A., Mandel A. Does it pay to be green? *Socially Responsible Investment eJournal*. 2017. https://doi.org/10.2139/ssrn.2923484

22. Baker M., Bergstresser D., Serafeim G., et al. *Financing the response to climate change: The pricing and ownership of US green bonds*. National Bureau of Economic Research; 2018. https://doi.org/10.3386/w25194
23. Rompotis G.G. The ESG ETFs in the UK. *Journal of Asset Management*. 2022;23(2):114-129. https://doi.org/10.1057/s41260-021-00251-z
24. Hockerts K., Moir L. Communicating corporate responsibility to investors: The changing role of the investor relations function. *Journal of Business Ethics*. 2004;52:85-98. https://doi.org/10.1023/B:BUSI.0000033109.35980.16
25. Adams C.A., Frost G.R. Integrating sustainability reporting into management practices. *Accounting forum*. 2008;32(4):288-302. https://doi.org/10.1016/j.accfor.2008.05.002
26. Searcy C., Buslovich R. Corporate perspectives on the development and use of sustainability reports. *Journal of business ethics*. 2014;121:149-169. https://doi.org/10.1007/s10551-013-1701-7
27. Slager R., Chapple W. Carrot and stick? The role of financial market intermediaries in corporate social performance. *Business & Society*. 2016;55(3):398-426. https://doi.org/10.1177/0007650315575291
28. Widyawati L. A systematic literature review of socially responsible investment and environmental social governance metrics. *Business Strategy and the Environment*. 2020;29(2):619-637. https://doi.org/10.1002/bse.2393
29. Chatterji A.K., Levine D.I., Toffel M.W. How well do social ratings actually measure corporate social responsibility? *Journal of Economics & Management Strategy*. 2009;18(1):125-169. https://doi.org/10.1111/j.1530-9134.2009.00210.x
30. Hartzmark S.M. The worst, the best, ignoring all the rest: The rank effect and trading behavior. *The Review of Financial Studies*. 2015;28(4):1024-1059. https://doi.org/10.1093/rfs/hhu079
31. Gyönyörová L., Stachoň M., Stašek D. ESG ratings: relevant information or misleading clue? Evidence from the S&P Global 1200. *Journal of sustainable finance & investment*. 2023;13(2):1075-1109. https://doi.org/10.1080/20430795.2021.1922062
32. Rook D.P. How can we know if investors are coherently linking sustainability concepts?. *Journal of Sustainable Finance & Investment*. 2012;2(3-4):198-221. https://doi.org/10.1080/20430795.2012.742634
33. Cornell B. ESG preferences, risk and return. *European Financial Management*. 2021;27(1):12-19. https://doi.org/10.1111/eufm.12295
34. Avramov D., Cheng S., Lioui A., et al. Sustainable investing with ESG rating uncertainty. *Journal of Financial Economics*. 2022;145(2B):642-664. https://doi.org/10.1016/j.jfineco.2021.09.009
35. Krasnikov A., Jayachandran S. The relative impact of marketing, research-and-development, and operations capabilities on firm performance. *Journal of marketing*. 2008;72(4):1-11. https://doi.org/10.1509/jmkg.72.4.001
36. Clifford C.P., Fulkerson J.A., Jordan B.D. What drives ETF flows? *Financial Review*. 2014;49(3):619-642. https://doi.org/10.1111/fire.12049
37. Oztekin A. Information fusion-based meta-classification predictive modeling for ETF performance. *Information Systems Frontiers*. 2016;20:223-238. https://doi.org/10.1007/s10796-016-9704-4
38. Bollen N.P. Mutual fund attributes and investor behavior. *Journal of financial and quantitative analysis*. 2007;42(3):683-708. https://doi.org/10.1017/S0022109000004142
39. Renneboog L., Ter Horst J., Zhang C. Is ethical money financially smart? Nonfinancial attributes and money flows of socially responsible investment funds. *Journal of Financial Intermediation*. 2011;20(4):562-588. https://doi.org/10.1016/j.jfi.2010.12.003
40. Simpson C., Rathi A. How to get an ESG rating upgrade. *Bloomberg*; December 21, 2021. URL: https://www.bloomberg.com/news/articles/2021-12-21/how-to-get-an-esg-rating-upgrade (Accessed 06.07.2023).
41. Lee C.C., Chen M.P., Lee C.C. Investor attention, ETF returns, and country-specific factors. *Research in International Business and Finance*. 2021;56:101386. https://doi.org/10.1016/j.ribaf.2021.101386
42. *The rise of the sustainable fund market and its role in financing sustainable development*. Geneva; 2021. URL: https://unctad.org/system/files/official-document/diae2021d1_en.pdf (Accessed 06.07.2023).
43. Statista Research Department. *Global ESG ETF assets 2006-2022*. 2022. URL: https://www.statista.com/statistics/1297487/assets-of-esg-etfs-worldwide/ (Accessed 06.07.2023).
44. Yu E.P., Van Luu B., Chen C.H. Greenwashing in environmental, social and governance disclosures. *Research in International Business and Finance*. 2020;52:101192. https://doi.org/10.1016/j.ribaf.2020.101192
45. Friede G. Why don't we see more action? A metasynthesis of the investor impediments to integrate environmental, social, and governance factors. *Business Strategy and the Environment*. 2019;28(6):1260-1282. https://doi.org/10.1002/bse.2346
46. In S.Y., Rook D., Monk A. Integrating alternative data (also known as ESG data) in investment decision making. *Global Economic Review*. 2019;48(3):237-260. https://doi.org/10.1080/1226508X.2019.1643059

Appendix A: Issuers of ETFs

Table A1. Issuers of bond ETFs (panels A and B)

Issuer	ESG ETFs (Panels A and B)	Non-ESG ETFs (Panel A)	Non-ESG ETFs (Panel B)
Inspire Investing	1	0	0
IShares	2	3	8
Sage Advisory	1	0	0
J.P. Morgan	3	0	0
Nuveen	1	1	1
Hartford Funds	2	0	0
Vaneck	1	2	2
Invesco	3	3	13
DWS	1	6	6
Total	15	15	30

Table A2. Issuers of equity ETFs (panels A and B)

Issuer	ESG ETFs (Panels A and B)	Non-ESG ETFs (Panel A)	Non-ESG ETFs (Panel B)
Columbia Threadneedle Investments	4	1	1
Ishares	7	9	21
State Street SPDR	5	7	15
FlexShares	1	4	4
Inspire Investing	2	0	0
Global X	2	3	6
Nuveen	5	0	0
ETF Managers Group	1	1	1
VanEck	2	0	0
First Trust	4	5	12
Invesco	7	10	22
Strategy Shares	1	1	1
Tortoise Capital	1	1	1
Total	42	42	84

Appendix B: Results of Breusch–Pagan tests for Heteroscedasticity

Table B1. Breusch–Pagan tests ESG ETFs based on cross-sectional data

Bond ETFs					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BP	10.75	11.053	10.761	10.894	13.067*
p-value	(0.1499)	(0.1363)	(0.1494)	(0.1433)	(0.0705)
Equity ETFs					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
BP	42.417***	39.774***	41.378***	39.936***	39.305***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

* Indicates significance at 10%. ** Indicates significance at 5%. *** Indicates significance at 1%.

We reject the null hypothesis and conclude that all regression models for Equity ETFs and Model 5 for Bond ETFs violate the homoscedasticity assumption. Therefore, for these models we apply robust standard error to obtain unbiased standard errors of OLS coefficients under heteroscedasticity.

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.20-36
JEL classification: G34, G38, H70, O32, O38

State Ownership Heterogeneity and Corporate Innovation: New Evidence from a Hierarchical Perspective

Tingqian Pu
PhD Candidate, School of Management, Universiti Sains Malaysia, Malaysia,
tq_pu@outlook.com, ORCID

Abdul Hadi Zulkafli ✉
PhD, Associate Professor, School of Management, Universiti Sains Malaysia, Malaysia,
hadi_zml@usm.my, ORCID

Abstract

Unlike prior research, this study re-examines the relationship between state ownership and corporate innovation from a hierarchical perspective. Drawing upon institutional theory, our findings reveal the heterogeneous impact of state ownership, elucidating the positive role of central state ownership in fostering corporate innovation, while highlighting the inhibitory effect of local state ownership. This conclusion withstands rigorous scrutiny through a battery of robustness checks. Mechanism analysis indicates that central state-owned enterprises stimulate innovation by increasing innovation investment and enhancing efficiency, whereas local state-owned enterprises create obstacles for both innovation investment and efficiency. Our paper offers a hierarchical interpretation of the mixed evidence regarding the relationship between state ownership and corporate innovation. Whether state ownership serves as a facilitator or a hindrance to innovation depends on whether central or local state-owned enterprises dominate the national innovation process. Overall, this study offers new insights into the complex effects of state ownership heterogeneity on corporate innovation activities in emerging economies like China, advancing our understanding of the subtle relationship between corporate governance and innovation.

Keywords: state ownership heterogeneity, corporate innovation, central state ownership, local state ownership, institutional theory, China

For citation: Pu T., Zulkafli A. H. (2024) State Ownership Heterogeneity and Corporate Innovation: New Evidence from a Hierarchical Perspective. *Journal of Corporate Finance Research.* 18(1): 20-36. https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.20-36

Introduction

Corporate innovation plays a key role in economic growth and enhances competitive advantage [1]. However, due to high institutional divergence, many emerging countries are not easily described by models established in developed countries [2]. For instance, state ownership in China is controlled by the central and local levels of government (Figure 1), so whether different hierarchies of state ownership have different impacts on corporate innovation remains an unsolved puzzle.

Existing literature suggests that state ownership may be a potential factor influencing a firm's innovation activities [2–4]. However, the understanding of how state ownership affects corporate innovation remains limited and marked by conflicting findings. For example, J. Yi et al. [5] assert that state-owned enterprises (SOEs) exhibit a proactive stance in innovation, insofar as governments, as shareholders, exert institutional pressures mandating compliance with regulations and alignment with government objectives [3; 6]. They argue that the efficiency and innovation potential of firms hinge significantly on the quality of the institutional framework [7]. In contrast, H. Kou and K. Kroll [8] establish a negative relationship between state ownership and corporate innovation, attributing this to self-interest-driven SOE managers pursuing goals misaligned with corporate performance [9]. Unless robust corporate governance mechanisms are in place, rent-seeking behaviours prevail in SOEs [10].

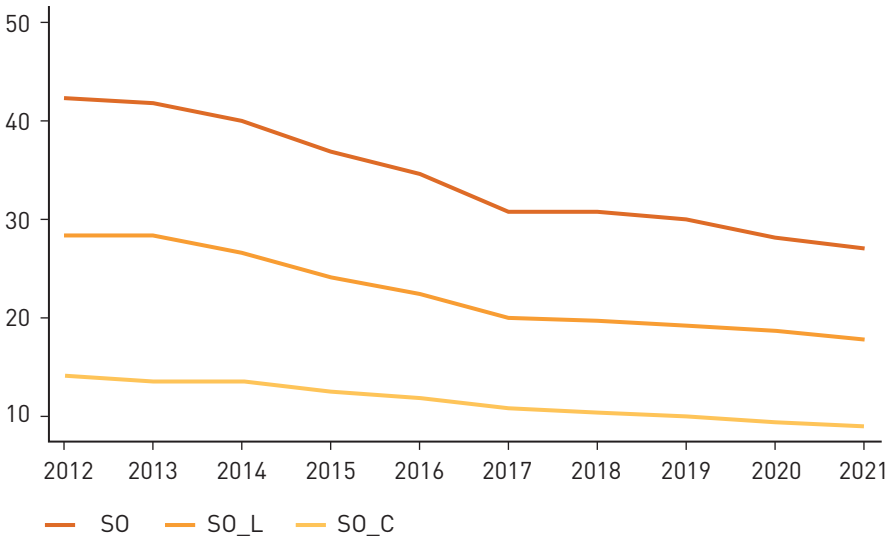
These mixed results may overlook the hierarchical dynamics within SOEs. Specifically, institutional pressures and innovation incentives vary between central and local SOEs. Central SOEs operate under the control of the central government [11]. The central government is responsible for setting and allocating tasks for central SOEs, with long-term sustainable economic growth strategy being a key objective [12]. In contrast, local governments have shorter evaluation periods for performance and heavily rely on quantifiable performance indicators [8; 12]. Therefore, they often lean towards short-term economic growth strategies, while local SOE managers are more inclined to seek promotion rewards within the local political ladder and thus consistency with the local government.

Utilizing data from Chinese listed firms spanning the period 2012–2021, this study employs separate dummy variables to delineate the hierarchy of SOEs at the central and local levels. We provide compelling evidence that the inclination towards innovation is stratified by state ownership: central SOEs tend to foster innovation, whereas local SOEs tend to impede it. In the mechanism analysis, local SOEs hamper innovation by curtailing R&D investment and diminishing innovation efficiency, while central SOEs stimulate innovation primarily by facilitating increased R&D investment and improving innovation efficiency.

Our study makes several contributions. First, we trace how the different hierarchies of state ownership relate to corporate innovation, which goes beyond previous research that focused solely on the relationship between total state ownership and corporate innovation [2; 3; 5]. By examining the nonconformity between the influence of evaluation mechanisms and the hierarchical structure of state-owned enterprises, we can gain a better understanding of how state ownership heterogeneity influences innovation activities.

Second, our research contributes to the ongoing debate on the relationship between state ownership and corporate innovation. Previous studies have yielded mixed results on this issue, partly due to a lack of understanding of the heterogeneity of state ownership. By dividing state ownership into central and local categories, this study innovatively explains the discrepancies observed in prior studies, offering a comprehensive perspective from different levels of state ownership.

Figure 1. Percentage of state-controlled entities among Chinese A-share listed firms (2012–2021)



Note: SO, SO_C, and SO_L refer, respectively, to the percentage of firms ultimately controlled by total government entities, central government entities, and local government entities.

Source: prepared by authors.

Third, the design of government systems emerges as a pivotal factor for both transition countries and developing markets [13]. Previous research has seldom addressed the differences in the propensity to innovate between central and local SOEs from an institutional perspective. This study offers new insights in this domain, serving as an essential reference for developing countries aspiring to emulate the Chinese innovation system and transition towards an innovative economy.

The subsequent sections unfold as follows: the second part describes the theoretical foundations and hypothesis development; the third part sets out the study methodology; the fourth part analyses findings, makes robustness checks and further studies the influence mechanism; and the final part summarizes the conclusions.

Theoretical Foundations and Hypothesis Development

Institutional Theory

Institutional theory focuses on the interactions between institutions and organisations, emphasising that the behaviour of a firm is significantly shaped by the institutional environment in which it operates [14; 15]. Such institutions consist of societal, economic, and political organizations, as well as informal social norms and rules [5; 7]. Companies must adjust to diverse institutional constraints to obtain essential resources and support due to institutional pressures [16; 17].

Owing to path dependence, one of the noticeable aspects of Chinese SOEs is extensive government intervention, which comprises ownership control and personnel management systems [18; 19]. It is widely believed that SOEs enjoy privileges granted by the government and related agencies. According to Y. Liu et al. [20], SOEs in emerging markets often obtain financial support and other resources from the government. Nonetheless, the connection between government and state ownership results in institutional pressures that force SOEs to use resources in accordance with government-set public objectives, for instance, economic growth and national innovation strategies [17; 19].

Hypothesis Development

In emerging markets, distinctive institutional factors wield considerable influence over a firm's impetus and capacity for innovation investment [21; 22]. Within the framework of institutional theory, the role of ownership in corporate governance necessitates the consideration of institutional factors [9; 16]. The process of corporate innovation is perceived as the dynamic accumulation of learning and innovation, intricately entwined with the national economic structure and institutional milieu [23]. Within this trajectory, corporate conduct is frequently moulded by prevailing organisational norms and rules [14].

Diverging from most developed countries, the managerial cadre of Chinese state-owned enterprises (SOEs) typically comprises bureaucrats rather than entrepreneurs [24; 25]. This unique group bears a resemblance to formal government officials [5; 10; 16]. Significantly, within the Chinese institutional context, the evaluation mechanisms of central SOEs and local SOEs exhibit heterogeneity. Central government departments oversee central SOEs, whereas local governments, as the de facto controllers of local SOEs, dictate personnel decisions – such as appointments, transfers, and dismissals of top executives – bypassing market-oriented processes [5; 11].

Prior investigations have affirmed that managers of state-owned enterprises, serving as agents of government shareholders, are driven by political motivations to secure promotions to higher positions [26]. This political motivation transcends mere monetary compensation considerations [27]. However, the hierarchy of state ownership engenders substantial divergence in the political objectives of SOEs. The central government in China is inclined toward adopting long-term strategies to foster innovation and industrial upgrading, aiming to bolster the international competitiveness of Chinese firms. For instance, the 2006 "National Medium and Long-Term Program for Science and Technology Development (2006–2020)" outlined a 15-year government-led strategy for technological innovation, incorporating innovation subsidies, information, and technological support, as well as tax reductions and policy incentives linked to technology. Consequently, potential political motivations impel central SOEs to augment research and development (R&D) investments. Simultaneously, subsidies, tax reductions, and policy incentives hinge largely on firms' innovation achievements, intensifying the impetus for corporate innovation [28]. These advantages also streamline the firms' innovation processes, consequently enhancing innovation efficiency. Hence, central state ownership profoundly fosters corporate innovation, particularly through heightened inputs and efficiency.

Conversely, the advancement of local government officials predominantly hinges on short-term economic growth within their regions and individual accomplishments. The divergence in political objectives underscores substantial disparities in the strategic approach to corporate innovation between central and local SOEs. Given the proclivity of local governments toward GDP-centric goals, they are more prone to steer state-owned enterprises toward investing in fixed assets, concurrently curbing long-term R&D investments fraught with greater uncertainty and higher failure rates [16; 25]. Guided by these policies, SOE managers are predisposed to adopt shorter-term investment strategies in the competitive landscape [8], thereby diminishing the impetus for corporate innovation and R&D expenditures and ultimately reducing the innovation efficiency of local SOEs. Consequently, the inhibitory impact of local state ownership on corporate innovation is more pronounced. Based on the foregoing arguments, we posit the following hypothesis:

H1. The impact of state ownership is hierarchical: central state ownership promotes corporate innovation, while local state ownership inhibits corporate innovation.

Methods

Sample and Data

This study collected ownership and financial data for all Chinese A-share listed firms from the CSMAR database spanning the years 2012–2021, while patent information was sourced from the CNRDS database. We meticulously cross-checked firm data with annual reports and official websites, adhering to the data pre-processing protocols articulated by R. Yuan and W. Wen [29]. First, financial firms (e.g., banks, insurance firms, and mutual funds) were excluded due to their distinctive governance and performance systems compared to non-financial Chinese firms. Second, "special treatment" firms – those experiencing continuous losses for two consecutive years and facing the risk of delisting – were omitted to mitigate the impact of abnormal financial conditions. Third, observations with missing information were discarded to minimize the influence of incomplete data on the results. Last, to further mitigate the impact of outliers, all continuous variables underwent winsorization at the 1st and 99th percentiles.

Variable Measurement and Model Specification

The dependent variables in this study measure corporate innovation (Patent_apply, Patent_grante, and Patent_citation). The measurement method utilizes patent data provided by the CNRDS database. This database serves as a professional source for patent data analysis, covering multiple measurements and patent information, and has been widely accepted in the field. Following prior studies (e.g., R. Yuan, W. Wen; N. Ding et al. [29; 30]), the first measure, Patents_ apply, is the natural logarithm of a firm's total patent applications plus one, including invention patents, design patents, and utility patents. The second, Patents_ grante, is the natural logarithm of a firm's total granted patents plus one. The third, Patent_ citation, represents the natural logarithm of a firm's total patent citation counts plus one.

The independent variables used in this study are state ownership (SO) and its heterogeneous sub-variables – central state ownership (SO_C) and local state ownership (SO_L). In China, the prevalent phenomenon of cross-ownership and pyramidal control has been longstanding. The government often exercises indirect control over a specific enterprise by holding shares in other companies and implementing a hierarchical ownership structure within corporate groups. This intricate ownership framework complicates the calculation of the percentage of state ownership, as the extent of control may not be fully reflected in the direct shareholding percentage. Consequently, there is a risk of underestimating the control exerted by state-owned enterprises when computing ownership percentages, given that their influence may well extend beyond the direct ownership figures. To address this, inspired by P. Pessarossi and L. Weill [31] and N. Lin et al. [32], a dummy variable is employed to indicate state ownership (1 for state-owned entities and 0 otherwise). The two heterogeneous sub-variables are central state ownership (SO_C) and local state ownership (SO_L). SO_C is a dummy variable equal to 1 for central state-owned entities and 0 otherwise, while SO_L is a dummy variable equal to 1 for local state-owned entities and 0 otherwise.

Furthermore, the study incorporates several control factors potentially affecting corporate innovation, aligning with prior research (e.g., R. McGuinness et al.; R. Yuan, W. Wen; N. Jia et al.; D. Kong et al.; N. Ding et al.; G. Liu, L. Lv [19; 29; 30; 33–35]). These include Firm Size (logarithm of total assets), Firm Age (natural logarithm of years since establishment plus one), Return on Assets (net income divided by total assets), Financial Leverage (total debts divided by total assets), Sale Growth (ratio of changed operating income to last year's operating income), Cash Ratio (cash holdings divided by total assets), Board Size (natural logarithm of total board directors), Ownership Concentration (percentage of shares owned by the largest shareholder), and Institutional Ownership (shares held by institutional investors divided by total shares). Refer to Table 1 for variable details and measurements.

To mitigate potential endogeneity, following previous studies (e.g., J. He, X. Tian; R. Yuan, W. Wen [29; 36]), we employ an OLS model and regress contemporaneous innovation measures on one-year lagged values of state ownership and other explanatory variables. The basic empirical model is as follows:

$$Patent\_apply_{i,t+1} = \alpha_0 + \alpha_1 SO_{i,t} + \alpha_2 FS_{i,t} + \alpha_3 FA_{i,t} + \\ + \alpha_4 ROA_{i,t} + \alpha_5 LEV_{i,t} + \alpha_6 SG_{i,t} + \alpha_7 CR_{i,t} + \alpha_8 BS_{i,t} + \\ + \alpha_9 OC_{i,t} + \alpha_{10} IO_{i,t} + Year + Industry + \varepsilon, \quad (1)$$

where α_0 denotes the intercept, and $\alpha_1 - \alpha_{10}$ are the coefficients to be estimated. This study added dummy variables that control for year and industry fixed effects (Year and Industry); ε is the error term; i denotes the cross-sectional dimension for firms; and t denotes the time series dimension.

Table 1. Summary of Variable Descriptions and Measurements

	Measurement
Panel A: Dependent Variables	
Patent_ apply	The natural logarithm of the firm's total patent applications plus one.
Patent_grante	The natural logarithm of the firm's total granted patents plus one.
Patent_ citation	The natural logarithm of the firm's total patent citation counts plus one.
Panel B: Independent Variables	
State Ownership (SO)	A dummy variable which equals 1 if the firm is a state-owned entity and 0 otherwise.

	Measurement
Central State Ownership (SO_C)	A dummy variable which equals 1 if the firm is a central state-owned entity and 0 otherwise.
Local State Ownership (SO_L)	A dummy variable which equals 1 if the firm is a local state-owned entity and 0 otherwise.
Panel C: Control Variables	
Firm Size (FS)	The logarithm of total assets.
Firm Age (FA)	The natural logarithm of the number of years since the firm's establishment plus one.
Return on Assets (ROA)	The book value of net income divided by total assets.
Financial Leverage (LEV)	The book value of total debts divided by total assets.
Sale Growth (SG)	The ratio of the changed operating income to the operating income in the last year.
Cash Ratio (CR)	The book value of cash holdings divided by the book value of total assets.
Board Size (BS)	The natural logarithm of the total number of directors on the firm's board.
Ownership Concentration (OC)	The percentage of shares owned by the largest shareholder.
Institutional Ownership (IO)	The number of shares held by institutional investors divided by the total shares.
Panel D: Other Variables	
Research and Development Expenditure (R&D)	The ratio of R&D expenditure to total assets.
Innovation Efficiency (IE)	Number of patent applications per unit of R&D input.

Source: prepared by authors.

Findings and Discussion

Descriptive Statistics and Correlation Matrix

The descriptive statistics for the key variables in our study are presented in Table 2, including the mean, standard deviation, minimum, and maximum values. For Patent_apply, the mean and standard deviation are 2.622 and 1.721; for Patent_grante, 2.451 and 1.643; and, for Patent_citation, 1.959 and 1.803, respectively. These values reveal slight variations in innovation measures among the sampled firms. On average, 32.9% of firm-year observations pertain to state-owned entities, with central state ownership (local state ownership) accounting for 11.2% (21.7%). This confirms the existence of state ownership heterogeneity.

Regarding control variables, the sample firms exhibit an average Firm Size of 22.200, Firm Age of 2.908, ROA of 0.041, Financial Leverage of 0.412, Sale Growth of 0.169, Cash Ratio of 0.049, Board Size of 2.120, Ownership Concentration of 34.383, and Institutional Ownership of 44.234. Additionally, R&D is 0.021, and Innovation Efficiency is 0.140.

Table 3 displays the Pearson correlation matrix for the major variables. The correlation coefficients between the explanatory and control variables are mostly below 0.50. Furthermore, we conducted a multicollinearity diagnostic test among the continuous variables. Each control variable exhibits a low variance inflation factor (VIF) in the test (less than 2), indicating the absence of multicollinearity issues in our model.

Univariate Analysis

Table 4 presents the findings of univariate tests conducted on the dependent variable in our study. The mean of Patent_apply is 3.241 for firms classified as central state-owned entities and 2.544 for those not falling under central state ownership. These differences are statistically significant at the 1% level, indicating that firms classified as central state-owned entities exhibit higher levels of innovation output compared to their counterparts.

Conversely, being categorized as a local state-owned entity significantly diminishes innovation output (Differences T-value = –0.477; P-values < 0.01). The negative t-statistics for the mean differences, coupled with a 1% significance level, confirm the statistical significance of these variations based on whether the firm is a local state-owned entity. In summary, these outcomes lend initial support to Hypothesis 1, suggesting that central state ownership fosters corporate innovation, while local state ownership hampers it.

Multivariate Results

The results of the OLS models are presented in Table 5, where the dependent variable is corporate innovation (Patent_apply). H1 is supported by the positive or negative coefficients and significance level in the regressions of SO_C and SO_L. Specifically, the coefficient of SO_C in Column (2) is 0.265, significant at the 1% level, indicating that

central state ownership promotes corporate innovation. However, the coefficient of SO_L in Column (3) is –0.072, significant at the 1% level, suggesting that local state ownership inhibits corporate innovation. Additionally, to examine whether the impact of total state ownership (SO) on corporate innovation is driven by central state ownership or local state ownership, Column (1) tests the relationship between SO and Patent_apply. The coefficient of SO is significant at the 1% level (α = 0.105), indicating that state ownership has a significantly positive overall effect on corporate innovation.

The aforementioned findings suggest that the relationship between state ownership and corporate innovation is hierarchical, with central state ownership promoting innovation and local state ownership inhibiting it. This provides a new explanation for the mixed evidence on the relationship between state ownership and corporate innovation (e.g., K. Kroll, H. Kroll; Y. Liu et al. [8; 20]), indicating that whether state ownership promotes or inhibits corporate innovation depends on whether central or local state ownership predominates in the innovation process.

Furthermore, the signs of the control variables are consistent with previous literature (e.g., Q. Hou et al.; K. Kroll, H. Kroll; R. Zhang et al. [8; 17; 37]). The results demonstrate that firm size, return on assets, and board size are positively and significantly related to Patent_apply in all columns, while firm age and financial leverage exhibit negative relationships with Patent_apply in all columns. Institutional ownership, however, is only negatively and significantly related to Patent_apply in Column (2). Sales growth, cash ratio, and ownership concentration are not significant with Patent_apply.

Table 2. Descriptive Statistics

Variables	N	Mean	Std	Min	Max
Patent_apply	29 108	2.622	1.721	0.000	6.690
Patent_grante	29 108	2.451	1.643	0.000	6.409
Patent_citation	29 108	1.959	1.803	0.000	7.014
SO	29 108	0.329	0.470	0.000	1.000
SO_C	29 108	0.112	0.315	0.000	1.000
SO_L	29 108	0.217	0.412	0.000	1.000
FS	29 094	22.200	1.296	19.814	26.153
FA	29 094	2.908	0.325	1.609	3.497
ROA	27 239	0.041	0.063	–0.239	0.222
LEV	29 094	0.412	0.204	0.050	0.893
SG	27 234	0.169	0.390	–0.544	2.445
CR	29 094	0.049	0.067	–0.159	0.241
BS	29 053	2.120	0.197	1.609	2.708
OC	29 056	34.383	14.817	8.630	74.180
IO	29 025	44.234	25.232	0.321	94.529
R&D	29 108	0.021	0.020	0.000	0.101
IE	29 108	0.140	0.093	0.000	0.332

Source: calculated by authors.

Table 3. Pearson Correlation

	Patent_apply	SO	FS	FA	ROA	LEV	SG	CR	BS	OC	IO	VIF
Patent_apply	1.000											-
SO	–0.008	1.000										1.41
FS	0.293***	0.385***	1.000									1.78
FA	–0.036***	0.206***	0.183***	1.000								1.09
ROA	0.076***	–0.117***	–0.003	–0.080***	1.000							1.55
LEV	0.081***	0.309***	0.533***	0.178***	–0.358***	1.000						1.71
SG	0.027***	–0.088***	0.037***	–0.043***	0.259***	0.021***	1.000					1.11
CR	0.052***	–0.017***	0.064***	0.004	0.411***	–0.169***	0.026***	1.000				1.24
BS	0.046***	0.277***	0.274***	0.057***	–0.003	0.156***	–0.024***	0.036***	1.000			1.14
OC	–0.006	0.210***	0.186***	–0.084***	0.127***	0.051***	–0.010*	0.102***	0.017***	1.000		1.39
IO	0.045***	0.415***	0.440***	0.053***	0.102***	0.208***	0.028***	0.119***	0.230***	0.485***	1.000	1.78

Note. This table shows the correlation coefficients for the main variables defined in Table 1. The lower triangle in this table shows the Pearson correlation coefficients. VIF indicates the variance inflation factor. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively.
Source: calculated by authors.

Table 4. Univariate Analysis

	Dummy (CSO) = 1		Dummy (CSO) = 0		Differences	Dummy (LSO) = 1		Dummy (LSO)=0		Differences
	N	Mean	N	Mean	T-value	N	Mean	N	Mean	T-value
Patent_apply	3256	3.241	25852	2.544	0.697***	6321	2.249	22787	2.725	-0.477***

Note. This table presents the results of univariate analysis on the mean difference of the corporate innovation indicator Patent_apply between "the firm is a central (local) state-owned entity" and "the firm is not a central (local) state-owned entity". The t-values for the mean differences are based on t-tests. ***denotes significance at the 1% level.

Source: calculated by authors.

Table 5. Multivariate Results

	Patent_apply $_{(t+1)}$		
	(1)	(2)	(3)
SO	0.105***		
	(0.02)		
SO_C		0.265***	
		(0.03)	
SO_L			−0.072***
			(0.02)
FS	0.623***	0.625***	0.633***
	(0.01)	(0.01)	(0.01)
FA	−0.217***	−0.201***	−0.177***
	(0.03)	(0.03)	(0.03)
ROA	2.113***	2.172***	2.104***
	(0.18)	(0.18)	(0.18)
LEV	−0.158***	−0.125**	−0.106*
	(0.06)	(0.06)	(0.06)
SG	0.001	−0.004	−0.015
	(0.03)	(0.03)	(0.03)
CR	0.169	0.130	0.099
	(0.15)	(0.15)	(0.15)
BS	0.206***	0.198***	0.231***
	(0.05)	(0.05)	(0.05)
OC	−0.001	−0.001	−0.000
	(0.00)	(0.00)	(0.00)
IO	−0.000	−0.001*	−0.000
	(0.00)	(0.00)	(0.00)
Cons	−10.975***	−11.034***	−11.368***
	(0.23)	(0.22)	(0.22)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	22 935	22 935	22 935
Adj. R^2	0.493	0.495	0.493

Note. This table presents the baseline result of the impact of state ownership heterogeneity on corporate innovation. The dependent variable is Patent_apply, while the independent variables are total state ownership (SO), central state ownership (SO_C) and local state ownership (SO_L). All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Robustness Check

Thus far, the estimations reveal a nuanced relationship between state ownership and corporate innovation. We employ various methods in this section to ensure the robustness of our results.

First, alternative dependent variables. To address concerns regarding potential measurement errors, following D. Kong et al. [33] and N. Ding et al. [30], we introduce two alternative dependent variables: the natural logarithm of the total number of patents granted to a firm plus one (Patent_grante) and the natural logarithm of the number of patent citations received by a firm plus one (Patent_citation). Unlike the past reliance on the number of patent applications as an innovation indicator, the number of granted patents represents the actual quantity recognized and certified by governmental intellectual property agencies. Patent citations provide a quality-oriented perspective on innovation activity [30]. Panel A of Table 6 presents the robustness test results based on these two alternative dependent variables. The estimated coefficients of the primary variables exhibit similar magnitudes and directions as shown in Table 6, confirming the robustness of the baseline regression.

Second, two subsample tests. Addressing the argument by R. Zhang et al. [17] that firms in high-tech industries may have distinctive innovation needs, this study re-evaluates primary models using two different subsamples: one composed of high-tech industry firms and the other consisting of non-high-tech industry firms. Results in Panel B of Table 7 demonstrate that both SO and SO_C have a significantly positive influence on corporate innovation in both high-tech and non-high-tech industries. However, SO_L continues to exhibit a negative impact on corporate innovation at the 1% significance level within this subset. These results are in line with previous findings, confirming the consistency of our conclusions.

Third, alternative estimation methods. Considering the count nature of patents, R. Zhang et al. [17] suggest that fixed-effect model estimation might be misleading even with the logarithmic transformation of patent data. Therefore, this section employs the maximum likelihood method to estimate the Poisson regression model in Panel C of Table 8. Additionally, inspired by H. Kim et al. [38] to address truncation in patent data, the Tobit regression model is introduced. The results from both the Poisson model and the Tobit model (cf. Table 8) align with conclusions drawn in the previous main regression model.

Fourth, correcting for selection bias with the Heckman two-step selection model. Since the propensity of different SOEs to apply for patents may be non-random, causing self-selection bias, following R. Zhang et al. [16], the first stage estimates a probit model with a binary dummy (Dummy_Patent) as the dependent variable, equal to 1 if a firm has ever applied for a patent and 0 otherwise. The following probit model is used to estimate the probability of firms applying for patents:

$$Probit\left(Dummy\_Patent\right)_{i,t} = \alpha_0 + \alpha_1 FS_{i,t} + \alpha_2 FA_{i,t} + \\ + \alpha_3 ROA_{i,t} + \alpha_4 LEV_{i,t} + \alpha_5 SG_{i,t} + \alpha_6 CR_{i,t} + \alpha_7 BS_{i,t} + \\ + \alpha_8 OC_{i,t} + \alpha_9 IO_{i,t} + Year + Industry + \varepsilon. \quad (2)$$

The inverse Mills ratio (IMR) is then obtained from this probability and included in the second stage regression. The results in Panel D of Table 9, after correcting for selection bias, indicate that the estimated coefficients of SO, SO_C, and SO_L consistently maintain the same signs as the previous ones and remain statistically significant. Thus, potential selection bias does not compromise our main findings.

Fifth, the application of a two-stage Data Envelopment Analysis model to control for managerial ability. Recognizing the pivotal role of managers in corporate innovation, differences in their ability levels can significantly impact innovation outputs. To address these differences, following R. Yuan and W. Wen [29], we employ a two-step procedure developed by P. Demerjian et al. [39] to estimate managerial ability.

In the first step, we assess the relative corporate efficiency of peer decision units using Data Envelopment Analysis (DEA). In the second step, we separate managerial contributions from corporate efficiency because the latter encompasses both corporate-level efficiency and manager-specific efficiency. This measurement criterion has been widely applied in accounting, finance, and management research (e.g., Z. Wang et al.; R. Yuan, W. Wen [15; 29]. In Equation (1), we introduce managerial ability (MA) as a new control variable and re-conduct a regression analysis.

The results in Panel E of Table 9 demonstrate that the signs and significance levels of all independent variables (SO, SO_C, and SO_L) remain consistent with our previous conclusions, suggesting that managerial ability is unlikely to drive our research findings.

Mechanism analysis

Research and development (R&D) expenditure and innovation efficiency (IE) are two pivotal determinants influencing corporate innovation [37; 40]. On the one hand, allocating funds and resources consistently to innovation activities enables firms to acquire new knowledge and technologies (referred to as the "input channel"). On the other hand, by enhancing innovation efficiency, organizations can bolster production efficiency, reduce costs, and consequently enhance innovation output (referred to as the "efficiency channel"). This section aims to investigate whether the heterogeneity in state ownership impacts these channels differently.

This research further adapts the baseline Equation (1) by replacing the dependent variable with R&D expenditure and innovation efficiency measured according to J. Lantz, J. Sahut [41] and A. Arundel, I. Kabla [42]. Table 10 presents regression results testing the impact on the input channel and the efficiency channel separately in panels F and G, respectively. These findings reveal a hierarchical influence of state ownership on innovation inputs and efficiency in which central state ownership (SO_C) notably amplifies firm R&D expenditure and innovation efficiency, while local state ownership (SO_L) inhibits both firm R&D expenditure and innovation efficiency.

Table 6. Robustness Check (1)

	Panel A: Alternative Dependent Variables					
	Patent_grante $_{(t+1)}$			Patent_ citation $_{(t+1)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
SO	0.096***			0.187***		
	(0.02)			(0.02)		
SO_C		0.243***			0.476***	
		(0.03)			(0.03)	
SO_L			−0.066***			−0.136***
			(0.02)			(0.02)
FS	0.599***	0.595***	0.603***	0.688***	0.680***	0.696***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
FA	−0.220***	−0.204***	−0.183***	−0.089***	−0.057*	−0.014
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ROA	1.412***	1.416***	1.353***	1.078***	1.084***	0.960***
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
LEV	−0.103*	−0.088	−0.070	−0.403***	−0.374***	−0.337***
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
SG	−0.021	−0.021	−0.031	−0.069***	−0.070***	−0.090***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
CR	0.278**	0.268*	0.239*	0.001	−0.018	−0.076
	(0.14)	(0.14)	(0.14)	(0.15)	(0.15)	(0.15)
BS	0.190***	0.194***	0.224***	0.097**	0.105**	0.164***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
OC	0.000	0.000	0.000	−0.003***	−0.003***	−0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IO	−0.001***	−0.001***	−0.001	−0.000	−0.001	0.001*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cons	−10.576***	−10.535***	−10.841***	−12.915***	−12.834***	−13.441***
	(0.21)	(0.21)	(0.21)	(0.23)	(0.22)	(0.22)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	22 935	22 935	22 935	22 935	22935	22935
Adj. R^2	0.513	0.514	0.512	0.534	0.539	0.533

Note. This table presents the results of the impact of state ownership heterogeneity on corporate innovation using alternative innovation measures. The dependent variables are Patent_grante and Patent_citation, and the independent variables are total state ownership (SO), central state ownership (SO_C), and local state ownership (SO_L). All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Table 7. Robustness Check (2)

	Panel B: Alternative Samples					
	High–Tech Firms			Non–High–Tech Firms		
	Patent_apply $_{(t+1)}$			Patent_apply $_{(t+1)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
SO	0.094***			0.068**		
	(0.03)			(0.03)		
SO_C		0.234***			0.312***	
		(0.04)			(0.05)	
SO_L			−0.095***			−0.104***
			(0.03)			(0.03)
FS	0.677***	0.675***	0.683***	0.570***	0.561***	0.572***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
FA	−0.160***	−0.154***	−0.119***	−0.334***	−0.307***	−0.292***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
ROA	2.740***	2.742***	2.690***	1.234***	1.273***	1.160***
	(0.22)	(0.22)	(0.22)	(0.30)	(0.30)	(0.30)
LEV	0.157**	0.183**	0.214***	−0.571***	−0.576***	−0.563***
	(0.07)	(0.07)	(0.07)	(0.10)	(0.10)	(0.10)
SG	−0.017	−0.018	−0.029	0.019	0.023	0.010
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
CR	0.446**	0.455**	0.404**	−0.108	−0.140	−0.151
	(0.20)	(0.20)	(0.20)	(0.22)	(0.22)	(0.22)
BS	0.104*	0.109*	0.150***	0.311***	0.304***	0.333***
	(0.06)	(0.06)	(0.06)	(0.08)	(0.08)	(0.08)
OC	−0.003***	−0.004***	−0.003***	0.003***	0.003***	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IO	−0.000	−0.001	0.000	−0.002**	−0.002***	−0.001*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cons	−11.567***	−11.548***	−11.911***	−10.360***	−10.200***	−10.541***
	(0.27)	(0.26)	(0.27)	(0.37)	(0.37)	(0.37)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	13 337	13 337	13 337	9598	9598	9598
Adj. R^2	0.428	0.430	0.428	0.447	0.449	0.447

Note. This table presents the results of the impact of state ownership heterogeneity on corporate innovation using alternative samples. The dependent variable is Patent_apply, and the independent variables are total state ownership (SO), central state ownership (SO_C), and local state ownership (SO_L). All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Table 8. Robustness Check (3)

	Panel C: Alternative Estimation Methods					
	Poisson Method			Tobit Method		
	Patent_apply$_{(t+1)}$			Patent_apply$_{(t+1)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
SO	0.018**			0.105***		
	(0.01)			(0.02)		
SO_C		0.076***			0.265***	
		(0.01)			(0.03)	
SO_L			−0.044***			−0.072***
			(0.01)			(0.02)
FS	0.219***	0.218***	0.221***	0.629***	0.625***	0.633***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
FA	−0.088***	−0.086***	−0.074***	−0.218***	−0.201***	−0.177***
	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)
ROA	0.899***	0.911***	0.880***	2.169***	2.172***	2.104***
	(0.07)	(0.07)	(0.07)	(0.17)	(0.17)	(0.17)
LEV	−0.044*	−0.041*	−0.030	−0.142**	−0.125**	−0.106*
	(0.02)	(0.02)	(0.02)	(0.06)	(0.06)	(0.06)
SG	−0.001	0.000	−0.004	−0.003	−0.004	−0.015
2	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
CR	0.005	0.008	−0.009	0.142	0.130	0.099
	(0.06)	(0.06)	(0.06)	(0.14)	(0.14)	(0.14)
BS	0.103***	0.103***	0.115***	0.194***	0.198***	0.231***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)
OC	0.000	0.000	0.000	−0.001	−0.001	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IO	−0.000***	−0.001***	−0.000**	−0.001	−0.001*	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cons	−3.806***	−3.769***	−3.901***	−12.444***	−12.392***	−12.692***
	(0.08)	(0.08)	(0.08)	(0.24)	(0.24)	(0.24)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	22 935	22 935	22 935	22 935	22935	22935
Log-likelihood	−38 795.19	−38 779.14	−38 789.57	−37 453.41	−37 419.07	−37 460.17
Wald/LR chi^2	7554.85	7705.62	7783.11	15 685.10	15 753.80	15 671.58
Pseudo R^2	0.150	0.150	0.149	0.173	0.174	0.173

Note. This table presents the results of the impact of state ownership heterogeneity on corporate innovation using alternative estimation methods. The dependent variable is Patent_apply, and the independent variables are total state ownership (SO), central state ownership (SO_C), and local state ownership (SO_L). All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * p < 0.1, ** p < 0.05, *** p < 0.01, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Table 9. Robustness Check (4)

	Panel D: Correcting Selection Bias			Panel E: Controlling Managerial Ability		
	Patent_apply$_{(t+1)}$			Patent_apply$_{(t+1)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
SO	0.087***			0.122***		
	(0.02)			(0.02)		
SO_C		0.256***			0.282***	
		(0.03)			(0.03)	
SO_L			−0.087***			−0.057**
			(0.02)			(0.02)
FS	0.740***	0.735***	0.748***	0.574***	0.571***	0.580***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
FA	−0.290***	−0.277***	−0.254***	−0.170***	−0.149***	−0.127***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ROA	2.319***	2.329***	2.265***	3.441***	3.435***	3.367***
	(0.18)	(0.18)	(0.18)	(0.19)	(0.19)	(0.19)
LEV	−0.243***	−0.230***	−0.212***	0.129**	0.149**	0.162***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
SG	−0.016	−0.016	−0.028	0.059**	0.058**	0.046*
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
CR	0.057	0.049	0.012	0.261*	0.243	0.214
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
BS	0.304***	0.305***	0.343***	0.170***	0.180***	0.210***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
OC	−0.001	−0.001	−0.000	−0.000	−0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IO	−0.002***	−0.002***	−0.001**	−0.000	−0.001	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IMR	0.882***	0.883***	0.918***			
	(0.08)	(0.08)	(0.08)			
MA				−1.702***	−1.691***	−1.689***
				(0.07)	(0.07)	(0.07)
Cons	−13.763***	−13.694***	−14.140***	−10.143***	−10.137***	−10.473***
	(0.30)	(0.29)	(0.29)	(0.23)	(0.23)	(0.23)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	22 898	22 898	22 898	21 603	21603	21603
Adj. R^2	0.496	0.498	0.496	0.504	0.506	0.504

Note. This table presents the results of the impact of state ownership heterogeneity on corporate innovation by correcting selection bias and controlling managerial ability. The dependent variable is Patent_apply, and the independent variables are total state ownership (SO), central state ownership (SO_C), and local state ownership (SO_L). IMR denotes the inverse Mills ratio. MA denotes managerial ability. All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Table 10. Mechanism Analysis

	Panel F: Input Channel R&D Expenditure		Panel G: Efficiency Channel Innovation Efficiency	
	(1)	(2)	(3)	(4)
SO_C	0.001***		0.012***	
	(0.00)		(0.00)	
SO_L		−0.001***		−0.003**
		(0.00)		(0.00)
FS	−0.001***	−0.001***	0.027***	0.027***
	(0.00)	(0.00)	(0.00)	(0.00)
FA	−0.003***	−0.003***	−0.013***	−0.012***
	(0.00)	(0.00)	(0.00)	(0.00)
ROA	0.031***	0.030***	0.101***	0.098***
	(0.00)	(0.00)	(0.01)	(0.01)
LEV	−0.002**	−0.001*	−0.007**	−0.006*
	(0.00)	(0.00)	(0.00)	(0.00)
SG	0.000	0.000	0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
CR	0.021***	0.021***	−0.004	−0.005
	(0.00)	(0.00)	(0.01)	(0.01)
BS	0.001*	0.001**	0.012***	0.014***
	(0.00)	(0.00)	(0.00)	(0.00)
OC	−0.000***	−0.000***	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
IO	0.000***	0.000***	−0.000**	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Cons	0.046***	0.044***	−0.442***	−0.457***
	(0.00)	(0.00)	(0.01)	(0.01)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	22 935	22 935	22 935	22935
Adj. R^2	0.468	0.468	0.458	0.457

Note. This table shows the regression results of the two channels through which state ownership influences corporate innovation. The dependent variables are R&D Expenditure and Innovation Efficiency, and the independent variables are central state ownership (SO_C) and local state ownership (SO_L). All regressions include year fixed effects and industry fixed effects. Parentheses show robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively. All variables are defined in Table 1.

Source: calculated by authors.

Conclusion

Utilizing firm-level data spanning the period 2012–2021 in China, this study addressed the puzzle surrounding the impact of state ownership on corporate innovation, focusing on the context of Chinese SOEs. From a hierarchical perspective, our findings helped to resolve the inconsistency observed in previous research, which has been attributed to the hierarchical structure of state ownership and to differences in human resource control mechanisms within SOEs. Owing to dissimilarities in evaluation protocols and the hierarchical configuration of SOEs, the innovation orientation of state ownership revealed a hierarchical pattern: central state ownership tends to foster innovation, while local state ownership tends to impede it. The result was shown to be robust by a series of checks, including alternative dependent variables, subsample tests, the Poisson model, the Tobit model, the Heckman two-step sample selection model, and the application of a two-step Data Envelopment Analysis model to control for managerial ability.

Additionally, this paper substantiated the existence of two influential channels through which state ownership heterogeneity impacts corporate innovation – the input channel and the efficiency channel. The hierarchical structure extends its influence to these pivotal facets of corporate innovation, with central state ownership positively affecting both channels and local state ownership exerting a negative influence.

This study contributes to the literature on state ownership and corporate innovation within the framework of institutional theory. Prior research has underscored the pivotal role of political affiliations in overcoming institutional voids in emerging markets [15; 17]. This study suggests that state ownership serves as a crucial means for accessing scarce resources and addressing institutional voids. Simultaneously, the heterogeneous impact of central and local state ownership on corporate innovation indicates that state-owned enterprises may exhibit varying levels of innovation inputs, innovation efficiency, and innovation outputs due to distinct institutional pressures stemming from state ownership heterogeneity. These findings illuminate the intricate interplay between China's institutional landscape, state ownership, and corporate innovation, providing fresh insights into the ongoing development of institutional perspectives.

Furthermore, our findings have significant practical implications for emerging countries seeking to emulate the Chinese system of governance in their transition to an innovative economy. In such contexts, the government's control over corporate ownership is divided between the central and local governments, whose institutional frameworks may be said to consist of government entities rather than purely private enterprises. Our findings suggest that the personnel control systems of hierarchical state ownership take different approaches to the political promotion and incentives of managers of state-owned enterprises, making central state ownership more conducive to corporate innovation. Additionally, the conclusions of this study imply that policymakers should recognize the nuanced relationship between state ownership and corporate innovation to take institutional differences into account for the purposes of creating appropriate innovation-oriented systems and avoiding a one-size-fits-all approach.

At the same time, this study has several limitations. First, it does not split local state ownership types into sub-levels. For example, the impact of local state ownership may change if one considers the provincial, city, and county levels separately. Second, the generalisability of the findings is limited by our use of a single country as the research context. Future work should address these limitations by considering a more fine-grained decomposition of the various forms of local state ownership, as well as other transitioning economies. These extensions would further develop our understanding of corporate innovation in a transition economy from a hierarchical state ownership perspective.

References

1. Jiang X., Yuan Q. Institutional investors' corporate site visits and corporate innovation. *Journal of Corporate Finance*. 2018;48:148–168. https://doi.org/10.1016/j.jcorpfin.2017.09.019
2. Choi S.B., Lee S.H., Williams C. Ownership and firm innovation in a transition economy: Evidence from China. *Research Policy*. 2011;40(3):441–452. https://doi.org/10.1016/j.respol.2011.01.004
3. Tõnurist P. Framework for analysing the role of state owned enterprises in innovation policy management: The case of energy technologies and Eesti Energia. *Technovation*. 2016;38:1–14. https://doi.org/10.1016/j.technovation.2014.08.001
4. Li J., Shan Y., Tian G. et al. Labor cost, government intervention, and corporate innovation: Evidence from China. *Journal of Corporate Finance*. 2020;64:101668. https://doi.org/10.1016/j.jcorpfin.2020.101668
5. Yi J., Hong J., Hsu W., et al. The role of state ownership and institutions in the innovation performance of emerging market enterprises: Evidence from China. *Technovation*. 2017;62–63:4–13. https://doi.org/10.1016/j.technovation.2017.04.002
6. Baum J. a. C., Oliver C. Institutional Linkages and Organizational Mortality. *Administrative Science Quarterly*. 1991;36(2):187-218. https://doi.org/10.2307/2393353
7. Tebaldi E., Elmslie B. Does institutional quality impact innovation? Evidence from cross-country patent grant data. *Applied Economics*. 2011;45(7):887–900. https://doi.org/10.1080/00036846.2011.613777

8. Kroll H., Kou K. Innovation output and state ownership: empirical evidence from China's listed firms. *Industry and Innovation*. 2018;26(2):176–198. https://doi.org/10.1080/13662716.2018.1456323
9. Peng M.W., Bruton G.D., Stan C.V., et al. Theories of the (state-owned) firm. *Asia Pacific Journal of Management*. 2016;33(2):293–317. https://doi.org/10.1007/s10490-016-9462-3
10. Chen H.Y.H., Yoon S.S. Government efficiency and enterprise innovation – evidence from China. *Asian Journal of Technology Innovation*. 2019;27(3):280–300. https://doi.org/10.1080/19761597.2019.1678389
11. Ding M., Suardi S. Government ownership and stock liquidity: Evidence from China. *Emerging Markets Review*. 2019;40:100625. https://doi.org/10.1016/j.ememar.2019.100625
12. Zhang M., Yu F., Zhong C. How State Ownership Affects Firm Innovation Performance: Evidence from China. *Emerging Markets Finance and Trade*. 2022;59(5):1390–1407. https://doi.org/10.1080/1540496x.2022.2137374
13. Blanchard O., Shleifer A. Federalism With and Without Political Centralization: China versus Russia. *IMF Staff Papers*. 2001;48(1):171–179. https://doi.org/10.2307/4621694
14. Scott W.R. *Institutions and Organizations: Ideas, Interests, and Identities*. SAGE Publications; 2013.
15. Wang Z., Chen M., Chin C., et al. Managerial ability, political connections, and fraudulent financial reporting in China. *Journal of Accounting and Public Policy*. 2017;36(2):141–162. https://doi.org/10.1016/j.jaccpubpol.2017.02.004
16. Dacin M.T., Oliver C., Roy J. The legitimacy of strategic alliances: an institutional perspective. *Strategic Management Journal*. 2006;28(2):169–187. https://doi.org/10.1002/smj.577
17. Zhang R., Xiong Z., Li H., et al. Political connection heterogeneity and corporate innovation. *Journal of Innovation & Knowledge*. 2022;7(3):100224. https://doi.org/10.1016/j.jik.2022.100224
18. Chen S., Sun Z., Tang S., et al. Government intervention and investment efficiency: Evidence from China. *Journal of Corporate Finance*. 2011;17(2):259–271. https://doi.org/10.1016/j.jcorpfin.2010.08.004
19. Liu G., Lv L. Government regulation on corporate compensation and innovation: Evidence from China's minimum wage policy. *Finance Research Letters*. 2022;50:103272. https://doi.org/10.1016/j.frl.2022.103272
20. Liu Y., Zhang Z., Zhai H., et al. Does flattening the government hierarchy improve corporate innovation? Evidence from China. *Regional Studies*. 2023;57(8):1559–1577. https://doi.org/10.1080/00343404.2022.2148644
21. Chen V.Z., Li J., Shapiro D., et al. Ownership structure and innovation: An emerging market perspective. *Asia Pacific Journal of Management*. 2014;31(1):1–24. https://doi.org/10.1007/s10490-013-9357-5
22. Yang X., Sun S.L., Yang H. Market-based reforms, synchronization and product innovation. *Industrial Marketing Management*. 2015;50:30–39. https://doi.org/10.1016/j.indmarman.2015.04.015
23. Lundvall B. Why study national systems and national styles of innovation? Technology *Analysis & Strategic Management*. 1998;10(4):403–422. https://doi.org/10.1080/09537329808524324
24. Xu E., Zhang, H. The impact of state shares on corporate innovation strategy and performance in China. *Asia Pacific Journal of Management*. 2008;25(3):473–487. https://doi.org/10.1007/s10490-008-9093-4
25. Lou X.Y., Qian A., Zhang C. Do CEO's political promotion incentives influence the value of cash holdings: Evidence from state-owned enterprises in China. *Pacific-Basin Finance Journal*. 2021;68:101617. https://doi.org/10.1016/j.pacfin.2021.101617
26. Li H., Zhou L. Political turnover and economic performance: the incentive role of personnel control in China. *Journal of Public Economics*. 2005;89(9–10):1743–1762. https://doi.org/10.1016/j.jpubeco.2004.06.009
27. Cao X., Lemmon M.D., Pan X., et al. Political Promotion, CEO Incentives, and the Relationship Between Pay and Performance. *Management Science*. 2019;65(7):2947–2965. https://doi.org/10.1287/mnsc.2017.2966
28. Bronzini R., Piselli P. The impact of R&D subsidies on firm innovation. *Research Policy*. 2016;45(2):442–457. https://doi.org/10.1016/j.respol.2015.10.008
29. Yuan R., Wen W. Managerial foreign experience and corporate innovation. *Journal of Corporate Finance*. 2018;48:752–770. https://doi.org/10.1016/j.jcorpfin.2017.12.015
30. Ding N., Gu L., Peng Y. Fintech, financial constraints and innovation: Evidence from China. *Journal of Corporate Finance*. 2022;73:102194. https://doi.org/10.1016/j.jcorpfin.2022.102194
31. Pessarossi P., Weill L. Choice of corporate debt in China: The role of state ownership. *China Economic Review*. 2013;26:1–16. https://doi.org/10.1016/j.chieco.2013.03.005
32. Lin N., Chen H.Y.H., Zhang P., et al. Does gambling culture affect firms' investment efficiency? *Finance Research Letters*. 2022;49:103148. https://doi.org/10.1016/j.frl.2022.103148

33. Kong D., Wang Y., Zhang J. Efficiency wages as gift exchange: Evidence from corporate innovation in China. *Journal of Corporate Finance.* 2020;65;101725. https://doi.org/10.1016/j.jcorpfin.2020.101725

34. McGuinness P.B., Vieito J.P., Wang, M. The role of board gender and foreign ownership in the CSR performance of Chinese listed firms. *Journal of Corporate Finance.* 2017;42:75–99. https://doi.org/10.1016/j.jcorpfin.2016.11.001

35. Jia N., Mao X., Yuan R. Political connections and directors' and officers' liability insurance – Evidence from China. *Journal of Corporate Finance.* 2019;58:353–372. https://doi.org/10.1016/j.jcorpfin.2019.06.001

36. He J., Tian X. The dark side of analyst coverage: The case of innovation. *Journal of Financial Economics.* 2013;109(3):856–878. https://doi.org/10.1016/j.jfineco.2013.04.001

37. Hou Q., Hu M., Yuan Y. Corporate innovation and political connections in Chinese listed firms. *Pacific-basin Finance Journal.* 2017;46(Part A):158–176. https://doi.org/10.1016/j.pacfin.2017.09.004

38. Kim H.D., Park K., Song, K. Do long-term institutional investors foster corporate innovation? *Accounting and Finance.* 2017;59(2):1163-1195. https://doi.org/10.1111/acfi.12284

39. Demerjian P.R., Lev B., McVay S. E. Quantifying Managerial Ability: A New Measure and Validity Tests. *Management Science.* 2012;58(7):1229–1248. https://doi.org/10.1287/mnsc.1110.1487

40. Pu T., Zulkafli A. H. Managerial ownership and corporate innovation: evidence of patenting activity from Chinese listed manufacturing firms. *Cogent Business & Management*. 2024;11(1):2289202. https://doi.org/10.1080/23311975.2023.2289202

41. Lantz J., Sahut, J. R&D investment and the financial performance of technological firms. *International Journal of Business.* 2005;10(3):251.

42. Arundel A., Kabla I. What percentage of innovations are patented? empirical estimates for European firms. *Research Policy.* 1998;27(2):127–141. https://doi.org/10.1016/s0048-7333(98)00033-x

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.37-48
JEL classification: G14, Q27, Q51, G30

Market Reaction to Environmental Disasters

Victoria Cherkasova ✉
Associate Professor, Faculty of Economic Sciences, School of Finance,
National Research University Higher School of Economics, Moscow, Russia,
vcherkasova@hse.ru, ORCID

Daria Zakharova
Master's Degree in Law, Economics, and Management, Financial Economics,
University Paris I Panthéon-Sorbonne 12, Paris, France,
daria.zakharova.fr@gmail.com, ORCID

Abstract

Despite the fact that environmental issues are coming to the fore today, the market reaction to environmental disasters is not strong enough. This article examines the impact of a number of major industrial disasters on the companies' stock performance, depending on financial health of the companies involved in an accident. We assessed the impact of financial indicators such as: financial leverage, profitability, balance value per share, capital expenditures, market capitalization and revenue on the amplitude of cumulative average abnormal returns (CAAR). The sample consists of 32 companies from the oil, chemical, mining and energy industries of developed countries involved in 80 major accidents between 2000 and 2020. The majority of disasters occurred in North America (47.5%) and in Europe (26.3%). Using the event study method to assess shareholders' reaction and regression analysis, we proved that the financial leverage, profitability and book value per share has a positive impact on the amplitude of CAAR, while the ratio of capital expenditures to revenue has a negative impact on cumulative returns. The results showed that market capitalization and revenue growth do not affect the dynamics of stock prices after industrial disasters. In general, our study shows that the impact of all financial indicators on CAAR is small (<1%). That is, despite the mandatory publication of climate risk reports, investors did not actively sell shares of companies guilty of industrial disasters. The results of the study are useful in several areas. On the one hand, by forming a diversified investment portfolio, investors taking into account the type of companies that are more sensitive to disasters. On the other hand, knowing such a market reaction, the state should provide financial players with strict rules and penalties for companies responsible for accidents.

Keywords: environmental issue, stock performance, cumulative average abnormal return, financial indicator, shareholders' reaction

For citation: Cherkasova V., Zakharova D. (2024) Market Reaction to Environmental Disasters. *Journal of Corporate Finance Research.* 18(1): 37-48. https://doi.org/10.17323/j. jcfr.2073-0438.18.1.2024.37-48

Introduction

Nowadays environmental problems are coming to the fore on the global agenda. Under Paris Agreement 193 countries set specific emission targets to reduce the influence of business activity on climate change and mobilize financial resources to make existing production technologies more sustainable. At the company level in European Union and the UK, it is mandatory to publish reports on climate risks; the mcfrost popular framework is the Task Force on Climate-related Financial Disclosures (TCFD)[1]. However, even though the ESG topic is currently integrated into the investment process of the majority of financial institutions, environmental disasters still happen and the market reaction to such accidents is not strong enough.

The threat of severe market response can complement government regulation by providing incentives to comply with safety and environmental standards and/or to introduce innovations to prevent accidents[2]. Without large financial losses for unscrupulous companies, green regulation is not efficient. Market actors use climate risk disclosure for marketing reasons without significantly changing their business processes as it is costly. While green regulation needs to become much more precise itself: provide financial players with accurate definitions and strict rules, market punishment for industrial disasters should be also damaging for the companies responsible for the accidents. This paper is dedicated to the investigation of the impact of various industrial disasters on companies' stock performance and the influence of balance sheet metrics on the amplitude of cumulative average abnormal returns (CAARs).

While event studies are well-represented in scientific literature, the market reaction to environmental disasters has not been fully investigated yet. In most cases, research is dedicated to a single event study that is not representative (R. Ferstl et al., S. Kawashima and F. Takeda, A. Betzer et al., K. Lopatta and T. Kaspereit, Y. Koda, F. Heflin and D. Wallace [1–6]). However, several researchers have already gathered extended samples for more general analyses, but mostly they are focused on one specific industry (J. Feria-Domínguez et al., S. Katsikides et al., R. Makino, O. Kowalewski and ´P. Spiewanowski, T. Huynh and Y. Xia [7–11]). The research studies of O. Kowalewski and ´P. Spiewanowski, T. Huynh and Y. Xia [10; 11] investigated the relationship between the financial health of companies and their performance after an accident.

The aim of this research is to investigate the financial markets' response to industrial disasters depending on the previous performance and financial health of the companies involved in an accident. The object of research is the companies' performance after an industrial disaster. The original sample comprises 32 companies from the petroleum, chemical, mining, and energy industries involved in 80 accidents in 2000–2020.

Based on the latest empirical research and available data we propose to test the relationship between the amplitude of cumulative average abnormal stock return after an industrial accident and the company's financial metrics (Market Capitalization, CAPEX to Revenue, Book Value per Share, Leverage and Profit Margin). Also, we check whether there is a trend in the data and if shareholders started reacting stronger to industrial accidents after the adoption of the Paris Agreement in 2015.

The research makes several scientific contributions. Firstly, we gathered an original updated sample of 80 industrial accidents that occurred in companies from various industries. According to our literature review, it is the most extensive sample of industrial disasters in petrochemical, mining, and energy industries for the time period starting in 2000. Secondly, we estimated the influence of many metrics on stock price's cumulative average abnormal return after an industrial disaster. Thus, we contribute to the scientific literature focused on both the synthesis of market response to environmental disasters in various industries (G. Capelle-Blancard et al. [12]) and the research of financial metrics that influence stock price performance after an accident (T. Huynh and Y. Xia, [11]).

The results of the paper might be useful for both companies at risk and investors: the former will gain a better understanding of the market behavior after an industrial disaster and the specific financial metrics that help to mitigate losses after an accident. The latter will be able to better diversify their portfolio by taking into account the type of companies that are more sensitive to industrial disasters and to adjust their trading strategy right after an accident.

Literature review

Empirical Research Papers

There are many empirical studies on the influence of a single industrial accident on the stock performance. Most of them prove a negative shareholder's reaction by estimating cumulative average abnormal returns. In this literature review, we focus on papers dedicated to the analyses of samples of various accidents (nuclear disasters, oil spills, chemical disasters, accidents in mining industry etc.).

M. Grand and V. D'Elia [13] gathered a sample of 61 environmental news in 1995–2001 in Argentina to check market reactions to positive and negative environmental news. The authors revealed that while positive environmental news had no impact on the publicly traded companies in the sample, negative news had a harmful effect on average rates of return a few days following its appear-

[1] European Commission. Corporate disclosure of climate-related information. URL: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/corporate-disclosure-climate-related-information_en

[2] European Commission. Initiative on substantiating green claims. URL: https://ec.europa.eu/environment/eussd/smgp/initiative_on_green_claims.htm

ance. The most powerful news was those linked to citizen complaints and government rulings. S. Katsikides et al. [8] also investigated the relationship between corporate social responsibility and stock market performance. The authors chose 5 events: two from the oil industry (BP and Exxon oil spills) and three from the banking industry (HSBC – money laundering; Barclays and Royal Bank of Scotland – Libor scandal). Apart from the HSBC money laundering event, all other events had statistically significant negative effects on stock performance. Moreover, the results were more pronounced over a longer timeframe (from 10 days) as information on some events was not fully available for the market during the first days.

C. Carpentier and J. Suret [14] investigated the influence of 161 major environmental and non-environmental accidents (reported on the front page of the New York Times during the last 50 years) on stock performance. On average, the market reacts negatively to the announcement of an accident. However, this average effect is largely driven by the airline industry and by government interventions. The authors showed that significant negative CAAR estimated immediately after an environmental accident does not persist a year later. That is why the authors came to the conclusion that in markets driven mostly by institutional investors, the negative effect on companies' equity value is likely to be weak in medium term.

J. Feria-Domínguez et al. [7] gathered a small sample of 5 oil-and-gas companies listed in the New York Stock Exchange that were involved in 7 different major environmental accidents between 2005 and 2011. The authors revealed statistically significant negative CAR after the accidents, the effect was more pronounced 10 days after the disasters. The authors identified and measured reputational risk by adjusting ARs by a certain loss ratio. A new metric, CAR(Rep), is then proposed to distinguish operational losses from the reputational damage caused by an oil spill. The reputational effect is more pronounced in the longest event window that the authors used (41 days after the event). Nowadays, a company's reputation significantly depends on its environmental risk disclosure. However, while the obligatory disclosure of information on accident risks was supposed to motivate management to improve workplace safety and equipment maintenance, it is still costly; thus, many companies avoid implementing risk reduction measures due to their low direct effect on stock performance.

R. Makino [9] investigates whether firms with high accident risks experience share the price drop when the market receives this new information after the issuance of risk disclosure or the market punishment arrives only after a realized risk, e.g., an industrial accident. On the sample of 18 chemical accidents that occurred in publicly traded Japanese companies in 2005–2012, the author shows that estimated CAAR was negative after all events and that risk information is not reflected in the stock price. Thus, there are not enough incentives for management to significantly decrease accident risks while the market stays indifferent.

O. Kowalewski and ´P. Spiewanowski [10] examine the stock market reaction to natural and industrial disasters in potash mines. The authors gathered a sample of 44 mining accidents worldwide for the period of 1995–2016. 50% of the events are work accidents often associated with serious injury or death, 25% of the sample are natural disasters, such as flooding, and the remaining part consists of accidents caused by human error. On average, mining firms experience a drop in their market value of 0.89% on the day of a disaster. The authors estimate a significantly stronger response of the stock market to natural events. They proved that the firm's market loss is significantly related to the seriousness of the accident. The authors could not find any other micro- or macro-level factors that would determine the stock market reaction following a disaster.

G. Capelle-Blancard and M. Laguna [15] examine the stock market reaction to chemical disasters. The authors consider a sample of 64 accidents at chemical plants and refineries worldwide from 1990 to 2005. On average, petrochemical firms in the sample experience a drop in their market value of 1.3% over the two days right after the disaster. The authors show that this loss is significantly related to the gravity of the disaster as measured by the number of casualties and by chemical pollution: each casualty corresponds to a loss of $164 million and toxic release – to a loss of $1 billion.

T. Huynh and Y. Xia [11] investigate a firm's exposure to physical climate risk and examine investors' reaction to natural disasters in both the U.S. corporate bond and stock markets. The authors find that, when a firm is exposed to disasters, investors overreact by depressing the current bond and stock prices, causing future returns to be higher. However, firms with a strong environmental profile experience lower selling pressure on their bonds and stocks, even though their fundamentals weakened following disasters. The evidence suggests that corporate investment in improving environmental profiles pays off when climate change risk is materialized.

Finally, G. Capelle-Blancard et al. [12] provide a synthesis of four decades of empirical research regarding the reaction of shareholders to more than 100 environmental events. One of the main contributions of this paper is that the authors reveal that stock market penalties in the event of environmental concerns are likely to be quite low: on average there is a temporary drop of about 2% in the excess stock market return to events that are harmful to the environment and the median is −0.6.

Hypotheses

According to the above-discussed empirical research papers, the financial performance metrics of a company can indeed influence the amplitude of shareholders' reactions after an industrial disaster. After careful analyses of the models presented in the relevant papers, we formulated the hypothesis for our own research. We anticipate that if the influence of any single factor is positive, a higher financial metric will counteract the negative effects of an industrial disaster that might otherwise cause a decline in stock prices.

Conversely, if the influence is negative, it will further amplify the negative impact of an event, pushing the stock's abnormal return into an even more negative territory.

H1: Larger companies experience a more drastic drop in returns after an industrial disaster.

On the one hand, firms that have greater market capitalization are likely to experience a more dramatic drop in share price after an accident as such companies draw more attention from investors than small ones (M. Khanna et al. [16], G. Capelle-Blancard and M. Laguna [15]). Indeed, large companies, especially public ones included in indices are coved by a higher number of brokers/financial analysts as one of their responsibilities is to monitor the companies in the portfolio. In this case, the news about an industrial disaster will spread very quickly from the initial source to brokers and then to institutional and individual investors. Thus, as many more market players become aware of this news, market response to a disaster might be greater. On the other hand, larger firms are more diversified, and it would be easier for them to absorb losses incurred due to an industrial accident (O. Kowalewski and P. Spiewanowski [10]). An industrial disaster of the same range can significantly disrupt the activity of a small firm and has minimal impact on the operational performance of a larger firm that can compensate for lost capacity with additional sources of production or supply.

H2: Companies with higher leverage experience a more dramatic decrease in return after an industrial disaster.

Debt financing allows a company to grow faster by attracting capital for new investments and benefiting from tax shields. When the ratio gets too high or major new investments prove to be unsuccessful, the company with a significant share of debt financing will face problems with meeting financial obligations. That is why after a certain threshold debt becomes very expensive, as the risk of bankruptcy gets higher. Thus, companies tend to maintain an efficient Leverage ratio, benefitting from extra capital for development and tax efficiency with a relatively low debt burden. The impact greatly depends on the median Leverage of the sample, as very low Leverage might be a sign of lack of access to debt financing due to higher risks associated with the business, and does not characterize a company as financially healthier than the one with a higher but efficient Leverage ratio that allows it to grow faster with a moderate debt burden (O. Kowalewski and P. Spiewanowski [10]).

H3: Higher profitability has a positive influence on cumulative average abnormal returns after an industrial disaster.

The stock price of less profitable firms, by gross margin, is likely to fall more drastically as investors consider such companies riskier because they don't have enough financial inflows to quickly absorb the losses (O. Kowalewski and P. Spiewanowski [10]). Indeed, in order to generate positive cash flows the company needs to be profitable. If the gross margin is rather low and unsustainable, an accident can bring much more harm to a company's economy and push cash flows into a negative zone. These can influence a company's future dividend policy and interest payments. Thus, we suppose that share price of more profitable companies will drop less significantly than that of less profitable ones.

H4: Companies with higher Revenue Growth experience a smaller decrease in returns after an industrial disaster.

The increase in Sales Growth leads to a smaller drop in CAAR. Such companies grow faster than the industry average and thus are traded at a relatively high multiple. They do not pay dividends as profits are reinvested and investors earn money through capital gains after an exit in a couple of years in case of a realized company's growth. Hence, investors are ready to pay more for companies if they grow fast and if investors believe they will keep growing further (T. Huynh and Y. Xia [11]). Therefore, we suggest that share price of companies with higher Revenue Growth will be less sensitive to an environmental disaster – it still has a catalyst for expected growth after an accident.

H5: The returns of companies with higher Book Value per share decreases less after an industrial disaster.

We want to check if Book Value (BV) per share has a positive influence on CAAR (T. Huynh and Y. Xia [11]). Companies with higher BV per share are less risky and should absorb any losses more easily. Market value depends on what people are willing to pay for a company's stock, while book value is similar to a firm's net asset value, which is less volatile than stock price and market capitalization. In case of a major disruption or bankruptcy, the investors of a company with a large share of tangible assets will be relatively less affected as they would be able to partially get their investments back through the restructuring process while investing in a company with a "lite balance sheet", with a small share of tangible assets is generally riskier as it is much harder to sell intangible assets if they are illiquid. Thus, we suggest that the value of companies with a higher Book Value per share will drop less after an accident than those with relatively lower ratio.

H6: Higher Capex to Revenue ratio has a positive influence on company's cumulative average abnormal returns after an industrial accident.

Capex to Revenue ratio shows to what extent the company is re-investing its revenue back into productive assets such as property, plant, equipment, etc. Since the companies in our sample operate in petrochemical, mining and energy industries, they need expensive production assets. They should be renovated and replaced regularly. Equipment failures have a major effect on the number and severity of accidents (D. Bourassa et al. [17]). Thus, we expect a positive influence of a higher Capex to Revenue ratio on a company's return after an accident as high capital expenditures mean that the company invests a lot in its fixed assets, i.e., on average the equipment/pipes/factories should be in good condition and up to date. However, it is necessary to keep in mind that a very high Capex to Revenue ratio compared to peers might be a sign of inefficient use of capital as earnings should also be reallocated to strategic investments to maintain the growth pace, to dividends, etc.

H7: After the Paris Agreement in 2015, market losses after an industrial disaster became bigger for companies.

We intend to check if the conclusion of Paris Agreement[3] has strengthened the reaction of shareholders to an industrial accident, thus pushing the CAARs further into negative zone. The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at Conference of the Parties 21 in Paris, on 12 December 2015. In order to align with long-term temperature strategy, countries tend to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by mid-century. The conclusion of the Paris Agreement is a milestone in the global climate change because, for the first time, an agreement unites all nations to decrease the impact of human activity on the environment and to adapt to climate changes that are currently underway. That is why we chose this specific event as a starting point of active work on the energy transition of the economy. We expect that after the conclusion of the Paris Agreement investors will gradually become less tolerant to even small industrial accidents, selling related stocks more aggressively in case of a disaster.

H8: The reaction of shareholders to industrial events strengthens with time.

Continuing the idea of a higher role of climate change agenda in the investment process, we tend to increase the time frame compared to the previous hypothesis and check if during the investigated period between 2000 and 2020 there is a negative time trend in CAAR after the industrial disasters as investors are becoming more sensitive to environmental problems[4].

Research Design and Data

In order to measure the shareholders' reaction to industrial disasters, we decided to apply the event study methodology, calculating the market model using the ordinary least square (OLS) method. This type of model assumes a stable linear relationship between *the market return* and *the individual stock return*:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}, \quad (1)$$

where $R_{i,t}$ and $R_{m,t}$ are the returns of company i and the corresponding market index in period t.

We estimate the stock price reaction to various industrial accidents by calculating *cumulative average abnormal returns* (*CAAR*).

$$CAAR(t_1, t_2) = \sum_{t=t_1}^{t_2} AAR_t, \quad (2)$$

where *CAAR* is cumulative average abnormal return, *AAR* – average abnormal returns, t_1 – the first period of the event window and t_2 – the last period of the event window.

Using a *control variable* allows to check if there is a statistically significant difference in market reaction to an accident by adding a trend or/and a dummy identifying a specific period. Then, it is necessary to control for the country of listing of a responsible company and/or for a country and industry where the disaster happened (G. Capelle-Blancard and M. Laguna [15]). Table 1 shows the control variables and their effect on CAAR.

Based on the literature review and business news agencies, we formed a sample of 80 events of industrial disasters from 2000 to 2022. It is possible to divide the sample by industry: petroleum, chemical, mining, and energy. The event selection process is rather tough due to several reasons: the fact that the majority of oil spills happen with non-public companies that we cannot analyze due to the lack of data, and our exclusion of small oil spills (less than 1,000 tons) as this loss is not significant for big public companies and cannot greatly affect the stock price. Then we also excluded oil spills that occurred not due to a company's fault. We excluded such events because when the company is not guilty, there will be no fine after the disaster, moreover, the losses may be reimbursed by insurance, thus there should not be a great impact on stock price. According to these criteria, we selected 80 events around the world from 2000 to 2020.

The data for independent variables were gathered in the Bloomberg terminal. All financial metrics are taken as of December 31 of the year preceding the event in order to avoid the reverse causality problem. We checked all the variables for quadratic fit. Estimated CAAR [0;10] for the 80 events becomes a dependent variable in the regression. Based on the results, we decided to choose this event window out of the five windows examined before.

In the sample there are companies that are listed in many countries: the USA, Canada, the UK, France, Netherland, Spain, Germany, Japan, South Africa, Norway, China, Israel, Russia and Brazil. Some of them have a double listing. However, the majority of them originate in either North America (47.5%) or Europe (the EU, 26.3%) categories, which is why we added only two dummies to control for the county of listing. Oil spills account for 25% of the sample, chemical disasters for – 25%, and accidents in the mining industry for – 47.5%. To test our hypotheses, we use the following regression equation:

$$CAAR010_i = \beta_0 + \beta_1 MarketCap_i + \beta_2 CapexRevenue_i + \\ + \beta_3 RevenueGr_i + \beta_4 BVpershare_i + \beta_5 Leverage_i + \\ + \beta_6 ProfitMargin_i + \beta_7 Controls_i + \varepsilon_i, \quad (3)$$

where $CAAR010_i$ – Cumulative Average Abnormal Return [0;10], %; Market Cap – Market Capitalization, m USD; CapexRevenue – Capex to Revenue, %; RevenueGr – Revenue growth, %, BVpershare – Book Value per share, USD; Leverage – Total Debt to Total Assets, %; ProfitMargin –

[3] United Nations Climate Change. The Paris Agreement. URL: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[4] Ernst & Young. Why investors are putting sustainability at the top of the agenda. URL: https://www.ey.com/en_gl/power-utilities/why-investors-are-putting-sustainability-at-the-top-of-the-agenda

Net Income to Revenue, %; *Controls:* NorthAm – dummy variable: 1 – if a company is registered in the North America (the USA, Canada), 0 – otherwise; Europe (UK, France, Spain, Germany or Netherland) – dummy variable: 1 – if a company is registered in the EU, 0 – otherwise; OilSpill – dummy variable: 1 – if an event is an oil spill, 0 – otherwise; ChemicalDis – dummy variable: 1 – if an event is a chemical disaster, 0 – otherwise.

Table 2 shows the descriptive statistics for all variables.

Table 1. Summary of model inputs and expected results

	Source	Expected influence on CAAR
Financial metrics		
Market Capitalization	M. Khanna et al. [16]; G. Kaplanski and H. Levy [18]; G. Capelle-Blancard and M. Laguna [15]; O. Kowalewski and P. Spiewanowski [10]	Negative
Capex to Revenue	Not investigated yet	Positive
Revenue Growth	T. Huynh and Y. Xia [11]	Positive
BV per share	Not investigated yet. Inspired by T. Huynh and Y. Xia [11]	Positive
Leverage	G. Kaplanski and H. Levy [18]; O. Kowalewski and P. Spiewanowski [10]	Negative
Profitability	G. Kaplanski and H. Levy [18]; O. Kowalewski and P. Spiewanowski [10]; T. Huynh and Y. Xia [11]	Positive
Non-Financial variables		
Paris Agreement	Not investigated yet, inspired by G. Capelle-Blancard and M. Laguna [15]	Negative
Trend	G. Capelle-Blancard and M. Laguna [15]	Negative
Controls (countries and industries)	G. Capelle-Blancard and M. Laguna [15]; O. Kowalewski and P. Spiewanowski [10]	

Source: Authors' analysis.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CAAR [0;10]	80	–.82	8.66	–32.37	30.25
Market Capitalization	80	61234.92	92390.94	56.48	394611.00
Capex to Revenue	80	12.64	11.22	1.74	72.48
Revenue Growth	79	15.40	34.85	–57.90	146.39
BV per share	80	104.70	788.51	.05	7067.66
Leverage	80	23.26	12.33	3.47	58.31
Profit Margin	80	11.46	11.16	–18.53	42.63
North America	80	.48	.50	0	1
Europe	80	.26	.44	0	1
Oil Spill	80	.25	.44	0	1
Chemical Disaster	80	.25	.44	0	1

Source: Authors' calculations.

Results

Cumulative average abnormal return after disasters

In order to estimate CAAR by market approach, we gathered daily firms' stock prices and the corresponding market index prices. Then we calculated daily returns. Table 3 reveals the results of CAAR estimations for the events in oil industry with different event windows. For all the events in the sample, the event day is the first day of the environmental disaster whether the market reacted promptly or not. The majority of the events didn't have a statistically significant effect on companies' stock prices. The main reason is that the scale of a disaster has a strong influence on stock performance (G. Capelle-Blancard and M. Laguna [15]; O. Kowalewski and P. Spiewanowski [10]), and major industrial accidents do not happen that often. If we used only events with a strong market response, the sample would not be sufficient for comprehensive research.

Table 3. CAARs for oil spill events

Date	Security	CAAR [–10,10]	CAAR [0,2]	CAAR [0,5]	CAAR [0,10]	CAAR [0,20]
31/08/2005	Murphy Oil Corp.	–12.00% (0.1074)	0.21% (0.9412)	–1.98% (0.5417)	–6.93% (0.1617)	–7.96% (0.2843)
13/02/2006	Chevron Corp.	–8.69% (0.1040)	–2.46% (0.2328)	–1.05% (0.6941)	–3.59% (0.3219)	–6.35% (0.2357)
02/03/2006	BP	–1.24% (0.8750)	0.26% (0.7227)	0.26% (0.7917)	2.25% (0.4997)	3.61% (0.6850)
01/06/2006	Valero Energy Corp.	–3.69% (0.6841)	–1.41% (0.7097)	–4.78% (0.3935)	–3.21% (0.6461)	1.34% (0.9705)
01/08/2008	Royal Dutch Shell	–2.69% (0.1565)	–2.33% (0.1303)	–3.82% (0.2279)	–1.03% (0.1561)	6.87% (0.5095)
20/04/2010	BP	–11.47%* (0.0548)	–1.39% (0.7318)	–4.68% (0.1923)	–10.42%** (0.0325)	–12.98%*** (0.0681)
01/05/2010	ExxonMobil	–2.65% (0.6458)	–0.93% (0.5967)	0.14% (0.9584)	–2.47% (0.5344)	–3.80% (0.5031)
11/06/2010	Chevron Corp.	–3.92% (0.5127)	–1.50% (0.4962)	–1.48% (0.6390)	–5.21% (0.2194)	–3.03% (0.5715)
01/07/2011	ExxonMobil	0.76% (0.8864)	–0.67% (0.5401)	–0.21% (0.8559)	2.36% (0.5470)	–0.08% (0.9533)
29/04/2011	Plains All American Pipeline	–6.44% (0.3325)	–3.84% (0.1298)	–4.22% (0.2363)	–6.47% (0.1804)	–4.44% (0.4980)
21/12/2011	Royal Dutch Shell	2.01% (0.7524)	1.13% (0.9359)	2.50% (0.9154)	1.01% (0.9870)	–4.27% (0.3435)
30/03/2013	ExxonMobil	–3.77% (0.5376)	–0.74% (0.7852)	–1.50% (0.8834)	–3.86% (0.4270)	–4.80% (0.4517)
22/03/2014	Kirby Corp.	–6.62% (0.3840)	–2.64% (0.2699)	–4.17% (0.2710)	–6.31% (0.2393)	–4.21% (0.5801)
13/10/2014	Sunoco	–19.02%** (0.0282)	1.32% (0.6801)	9.34%** (0.0406)	–0.08% (0.9900)	–5.05% (0.5594)

Date	Security	CAAR [–10,10]	CAAR [0,2]	CAAR [0,5]	CAAR [0,10]	CAAR [0,20]
24/12/2014	Transneft	24.49%** (0.0000)	–3.61% (0.1160)	2.68% (0.6285)	12.16%*** (0.0002)	12.28% (0.0227)
16/11/2017	TransCanada Corp.	–0.34% (0.5191)	0.38% (0.7231)	–0.88% (0.1836)	–2.59% (0.7327)	–2.76% (0.5688)
29/10/2019	TransCanada Corp.	–1.58% (0.5191)	–0.39% (0.7231)	–2.50% (0.1836)	0.02% (0.7327)	–1.23% (0.5688)
29/05/2020	Nornickel	–3.97% (0.3163)	–1.71% (0.5999)	–10.61%** (0.0149)	–15.11%*** (0.0073)	–12.26%* (0.0954)
01/10/2021	Amplify Energy	7.15% (0.3163)	–37.51%*** (0.0001)	–30.43%** (0.0279)	–25.07% (0.1817)	–35.22% (0.1763)
27/12/2021	PBF Energy	27.05%* (0.0799)	2.74% (0.5828)	8.46% (0.2044)	30.25%*** (0.0069)	35.71%*** (0.0176)
15/01/2022	Repsol	7.07% (0.3163)	–0.75% (0.5999)	–3.87% (0.1849)	2.04% (0.6273)	5.67% (0.3354)

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

Source: Authors' calculations.

Regression results

Estimated CAAR [0;10] for these 80 events becomes a dependent variable in the regression. Based on the results, we decided to choose this event window out of five previously tested windows (we have more statistically significant results using this event window) and literature review. Before interpreting the results, we run the tests and improved the quality of the model. According to Table 4, we can see that the majority of correlation coefficients are rather small. The highest correlation coefficients are –0.561 between Europe and North America and Chemical Disasters and Mining.

Table 4. Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) CAAR [0;10]	1.000											
(2) Market Capitalization	0.050	1.000										
(3) Capex to Revenue	–0.161	–0.202	1.000									
(4) Revenue Growth	0.054	0.120	–0.073	1.000								
(5) BV per share	0.170	–0.070	0.170	–0.098	1.000							
(6) Leverage	0.079	–0.548	0.204	–0.115	0.038	1.000						
(7) Profit Margin	–0.072	–0.124	0.376	–0.242	0.094	–0.032	1.000					
(8) North America	0.072	0.014	0.078	–0.104	–0.103	–0.032	0.063	1.000				
(9) Europe	0.173	0.292	–0.215	0.084	–0.064	–0.214	–0.197	–0.561	1.000			
(10) Oil Spill	–0.010	0.401	0.038	0.179	0.204	0.016	–0.100	0.229	–0.055	1.000		
(11) Chemical Disaster	0.261	0.153	–0.296	0.074	–0.066	–0.111	–0.281	–0.386	0.531	–0.328	1.000	
(12) Mining	–0.142	–0.448	0.175	–0.306	–0.112	0.104	0.405	0.138	–0.386	–0.542	–0.561	1.000

Source: Authors' calculations.

According to the VIF test, the values of Mining, Chemical Disasters and Oil Spill factors are rather high (above 6), so we decided to sequentially exclude each of these variables to check which specification will have the lowest mean VIF. Then we need to test our model for heteroskedasticity. According to the result of the White test, we cannot reject the null hypothesis about homoskedasticity because p-value is higher than 10%. That means that the least squares estimator is linear, unbiased, and has the smallest variance among all estimators. Also, the standard errors computed for the least squares are correctly estimated, so we can rely on estimated confidence intervals and test the hypotheses. Then in order to improve the quality of the model we decided to exclude studentized residuals below –2 and above 2. After the exclusion we can interpret the results of the statistically significant coefficients in regression (Table 5).

Table 5. Regressions' results

VARIABLES	(1) CAAR [0;10]	(2) CAAR [0;10]	(3) CAAR [0;10]
Market Capitalization	0.0000156	0.0000169	0.0000153
	(0.0000102)	(0.0000104)	(0.0000103)
Capex to Revenue	–0.174**	–0.155*	–0.181**
	(0.075)	(0.079)	(0.078)
Revenue Growth	0.025	0.019	0.026
	(0.022)	(0.023)	(0.023)
BV per share	0.00311***	0.00317***	0.00315***
	(0.000865)	(0.000872)	(0.000878)
Leverage	0.198**	0.219**	0.191**
	(0.0815)	(0.0866)	(0.0848)
Profit Margin	0.190**	0.182**	0.191**
	(0.0864)	(0.0873)	(0.0872)
North America	4.975***	4.872***	4.994***
	(1.772)	(1.785)	(1.786)
Europe	4.577**	4.395**	4.567**
	(2.102)	(2.125)	(2.118)
Oil Spill	–2.720	–3.105	–2.661
	(2.190)	(2.260)	(2.213)
Chemical Dis	4.511**	2.914	4.635**
	(1.992)	(2.956)	(2.041)
Trend		–0.0434	
		(0.0592)	
Paris Agreement			0.735
			(2.226)
Constant	–11.16***	–9.505**	–11.10***
	(3.048)	(3.805)	(3.075)
Observations	73	73	73
R-squared	0.378	0.383	0.379
Adjusted R-squared	0.278	0.272	0.267

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

Source: Authors' calculations.

The Market Cap coefficient is not statistically significant so we cannot make any conclusions on the influence of a company's size on CAAR. We did not find any evidence that firm size is related to abnormal returns similar to the results of O. Kowalewski and P. Spiewanowski [10]. Thus, we can neither accept Hypothesis 1 *nor reject* it. Leverage is statistically significant at the 5% significance level: if Leverage increases by 10%, the CAAR increases by 1.98%, ceteris paribus. According to Corporate Finance theory, financial leverage increases a company's profit through the interest tax shield, and when the assets are purchased with the debt capital, they earn more than the cost of the debt that was used to finance them. Meanwhile, if the company does not have sufficient taxable income to shield or if its operating profits are below a critical value, financial leverage will reduce equity value and thus reduce company value, making it riskier. Thus, it seems that there are more companies in the sample with efficient financial leverage that give positive signals to shareholders. Based on our sample, we came to the opposite result (positive instead of negative relationship) than G. Kaplanski and H. Levy [18] and O. Kowalewski and P. Spiewanowski [10] in their research dedicated to aviation and mining industries. Hence, Hypothesis 2 about the negative influence of Leverage on CAAR *is rejected*. Profit margin also proved to be significant at the 5% significance level. The results correspond to our expectations: the influence on the dependent variable is positive. If the Profit Margin increases by 1%, it will lead, ceteris paribus, to a 0.19% increase in CAAR. That means that shareholders react less negatively to industrial accidents that happened through the fault of a more profitable company. We can suggest that the investors believe that more profitable companies can absorb the losses related to the accident more easily, and can thus show better financial performance after the industrial disaster than less profitable firms. The obtained result matches the results described in previous research of T. Huynh and Y. Xia [11], and O. Kowalewski and P. Spiewanowski [10]. We do *not reject* Hypothesis 3.

Revenue Growth does not have a statistically significant influence on CAAR. That means that in our sample the investors were indifferent to the previous growth pace of a company when they made a trading decision after the accident. On the one hand, a high growth pace can mean an active development of an already established company (new big clients, M&A etc.) that could help to absorb the losses from the accident by generating new cash flows. However, on the other hand, high growth pace might be explained by the low base effect: the initial revenue was too small, so even a slight increase in revenue in absolute terms leads to a relatively high Revenue Growth metric value. Hence, we can neither *accept* Hypothesis 4 nor reject it.

We proceed with BV per share. The coefficient is statistically significant at the 1% significance level, and the sign of the coefficient matches our expectations: an increase in net asset value makes the company less risky for investors, and the stock price drops less after an industrial disaster. Thus, we can conclude that financially healthy companies benefit from a less aggressive share price decline after an industrial accident as investors do not consider losses related to the accident crucial for the company's future performance. And even if losses are significant and a company cannot absorb them, valuable tangible assets (high BV per share as a proxy) can be strong collateral for rising debt capital to help the company to recover and to stimulate its performance. Hence, Hypothesis 5 *is not rejected*.

As for the influence of Capex to Revenue ratio on CAAR, it is proven to be negative, while we expected a positive relationship. Our logic was that the higher the investments in fixed assets, the smaller the effect on the stock price of an industrial disaster (a loss of a fixed asset in case of an accident is not very significant for a company that invests a lot in new equipment). The opposite effect might be explained as follows: the companies have a high Capex to Revenue ratio either if they invest a lot in capital expenditures or have relatively small Revenue. In the sample, many companies with a high Capex to Revenue ratio have negative revenue growth that can discourage investors more than relatively high investment in CAPEX. Moreover, if a company generates relatively high revenue and keeps investing in capital expenditures, the ratio will be rather small, despite investments that are large in absolute terms. Another explanation can be the sample specifics: around 40% of the sample consists of events with positive and/or insignificant CAAR [0;10], i.e., an industrial accident didn't influence the stock performance. That also can bias the obtained results. If we use only major events with strong market response, the sample would be very small (less than 20 observations). Thus, Hypotheses 6 *is rejected*.

Then we need to check the hypothesis about the change in shareholders' behavior related to an industrial disaster after the adoption of the Paris Agreement. We compare the events before 2016 (29% of the sample) and after (71%). According to the results presented in Table 6, the coefficient of the Paris Agreement is not significant, i.e., there is no statistically significant influence of the Paris Agreement on the market reaction to an industrial accident. That means that the market did not adjust its behavior despite the active promotion of the energy transition. Thus, Hypotheses 7 *is rejected*. Moreover, we come to the same conclusion based on the results of the trend test. The coefficient proved to be insignificant, which means that investors did not become more sensitive to environmental problems during the last 20 years despite the integration of climate risk disclosure in the investment process and green strategies at country level. Hypotheses 8 *is rejected*.

As for control variables, if a company from our sample is listed in North America (either the USA or Canada), ceteris paribus, the CAAR will be 4.98% higher at the 1% significance level. Unexpectedly listing in Europe has a positive influence on CAAR as well. That means that investors do not sell American/Canadian or European stocks after an industrial disaster as aggressively as those in other markets. In the case of Europe, it is unexpected because green legislation and energy transition play a very important role in these markets. Such a result might be explained

by the very recent progress in implementing green strategy in Europe, while the sample cover events from as early as 2000. As for the industry control variable, investors are less sensitive to industrial disasters in the chemical industry. It is explained by the specifics of the sample: the majority of the events in the chemical industry were minor, and CAARs were generally insignificant. Thus, there was no pronounced market reaction to the event.

Conclusion

We estimated the cumulative average abnormal return (CAAR) for the updated sample of 80 events and tested the influence of companies' financial metrics on the amplitude of their CAARs after industrial disasters. We estimated the CAAR in several event windows for all the events in the sample. Leverage, Profitability and BV per share proved to have a positive influence on CAAR, i.e., an industrial accident has a smaller effect on the stock performance of financially healthy companies with tax-efficient Debt to Equity ratio, relatively high profitability and a high share of valuable tangible assets. Higher Capex to Revenue ratio proved to have a negative influence on CAAR in our sample, i.e., it leads to a stronger market reaction. Such a result is explained by the nature of the ratio (if Revenue is high and investments in equipment are also elevated in absolute terms, the ratio will be rather small) and the bias of the sample. However, the effect of all independent variables on CAAR is rather negligible. Market capitalization and Revenue Growth do not influence investors' trading decisions after accidents. Moreover, based on our results, shareholders didn't change their attitude towards industrial disasters after the adoption of the Paris Agreement in 2015 and did not start reacting more strongly to industrial accidents since 2000 despite the promotion of green economy and energy transition strategies.

The obtained results depend a lot on the sample. The event selection process is rather tough due to several reasons: the majority of oil spills happen with non-public companies that we cannot analyze due to the lack of data; we also excluded small oil spills (less than 100,000 tons) as this loss is not significant for big public companies and cannot significantly affect the stock price. Then we also excluded oil spills that occurred not due to a company's fault (for instance, due to military actions: on 6 October 2002 the French double hull oil tanker was hit by explosives from a small craft in Yemen[5], or due to shooting: a man fired a bullet into the Trans-Alaska Pipeline in 2001)[6]. We excluded such events because when the company is not guilty, there will be no fine after the disaster, moreover, losses may be reimbursed by insurance, thus there should not be a great impact on stock price. According to these criteria, we selected 80 events around the world from 2000 to 2020 from various industries.

It is the most extensive sample of industrial disasters in petrochemical, mining, and energy industries over the course of twenty years. However, the sample still consists of events of different scale as major industrial disasters happen rarely and thus the number of observations would be very low. The CAARs after minor events proved to be positive and/or insignificant. As this accounts for almost half of the dependent variable values (mean CAAR value is –0.82%), it can also have an impact on the results of the models. Another limitation of the research is that we focused mostly on the effect of financial metrics, while the extent of damage and the number of casualties could influence stock performance after an accident as well. The main conclusion of the papers devoted to the stock performance after the industrial disasters is that the company's returns are not significantly affected by an event. In the context of the increasing importance of the green economic transformation, the authorities need to create a financial tool to stimulate investors to opt for clean energy projects and make brown production less attractive. Future research is needed to better understand the drivers of the market reaction to industrial disasters and find the economic incentives to strengthen this reaction.

References

1. Ferstl R., Utz S., Wimmer M. The effect of the Japan 2011 disaster on nuclear and alternative energy stocks worldwide: an event study. *Journal of Business Research.* 2012;5:25–41. https://doi.org/10.1007/BF03342730
2. Kawashima S., Takeda F. The effect of the Fukushima nuclear accident on stock prices of electric power utilities in Japan. *Energy Economics.* 2012;34:2029–2038. https://doi.org/10.1016/j.eneco.2012.08.005
3. Betzer A., Doumet M., Rinne U. How policy changes affect shareholder wealth: the case of the Fukushima Daichi nuclear disaster. *Applied Economics Letters.* 2013;20(8):799–803
4. Lopatta K., Kaspereit T. The cross-section of returns, benchmark model parameters, and idiosyncratic volatility of nuclear energy firms after Fukushima Daiichi. *Energy Economics.* 2014;41:125-136. https://doi.org/10.1016/j.eneco.2013.10.006
5. Koda Y. Do peers get punished: stock market effect of BP oil spill on peers. *Journal of Environmental and Resource Economics at Colby.* 2016;3(1):9.
6. Heflin F., Wallace D. The BP oil spill: shareholder wealth effects and environmental disclosures. *Business Finance & Accounting.* 2017;44(3-4):337–374. https://doi.org/10.1111/jbfa.12244

[5] Cedre. URL: http://wwz.cedre.fr/en/Resources/Spills/Spills/Limburg

[6] The New York Times. URL: https://www.nytimes.com/2001/10/06/us/pipeline-crews-tackle-huge-oil-spill-caused-by-shooting.html

7. Feria-Domínguez J, Jiménez-Rodríguez E., Merino I. Financial perceptions on oil spill disasters: isolating corporate reputational risk. *Sustainability.* 2016;8(11):1090. https://doi.org/10.3390/su8111090

8. Katsikides S., Markoulis S., Papaminas M. Corporate social responsibility and stock market performance: an event study approach. *International Journal of Engineering and Advanced Technology.* 2016;6(2):1–8.

9. Makino R. Stock market responses to chemical accidents in Japan: an event study. *Journal of Loss Prevention in the Process Industries.* 2016;44:453–458. https://doi.org/10.1016/j.jlp.2016.10.019

10. Kowalewski O., Spiewanowski P. Stock market response to potash mine disasters. *Journal of Commodity Markets.* 2020;20:100124. https://doi.org/10.1016/j.jcomm.2020.100124

11. Huynh T., Xia Y. Panic Selling When Disaster Strikes: Evidence in the Bond and Stock Markets. *Management Science.* 2021;69(12):7151-7882. https://doi.org/10.1287/mnsc.2021.4018

12. Capelle-Blancard G., Desroziers A., Scholtens B. Shareholders and the environment: a review of four decades of academic research. *Environmental Research Letters.* 2021;16(12):123005. https://doi.org/10.1088/1748-9326/ac3c6e

13. Grand M. C. and D'Elia V. V. 2005. Environmental news and stock markets performance: further evidence for Argentina. *Working Paper* (Universidad del CEMA)

14. Carpentier C., Suret J. M. Stock market and deterrence effect: a mid-run analysis of major environmental and non-environmental accidents. *Environmental Economics and Management.* 2015;71:1–18. https://doi.org/10.1016/j.jeem.2015.01.001

15. Capelle-Blancard G., Laguna M.A. How does the stock market respond to chemical disasters? *Environmental Economics and Management.* 2010;59(2):192–205. https://doi.org/10.1016/j.jeem.2009.11.002

16. Khanna M., Quimio W., Bojilova D. Toxics Release Information: A Policy Tool for Environmental Protection. *Journal of Environmental Economics and Management.* 1998;36(3):243–266. https://doi.org/10.1006/jeem.1998.1048

17. Bourassa D., Gauthier F., Abdul-Nour G. Equipment failures and their contribution to industrial incidents and accidents in the manufacturing industry. *International Journal of Occupational Safety and Ergonomics*. 2016;22(1):131-141. https://doi.org/10.1080/10803548.2015.1116814

18. Kaplanski G., Levy H. Sentiment and stock prices: The case of aviation disasters. *Journal of Financial Economics.* 2010;95(2):174–201. https://doi.org/10.1016/j.jfineco.2009.10.002

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.49-61
JEL classification: G32, M42

The Influence of Corporate Governance Mechanisms on Fraud Probability: Evidence from Russian Companies

Oksana Soboleva ✉
Senior lecturer, National Research University Higher School of Economics, Moscow, Russia,
osoboleva@hse.ru, ORCID

Elena Makeeva
Candidate of Sciences (PhD), Associate Professor,
National Research University Higher School of Economics, Moscow, Russia,
emakeeva@hse.ru, ORCID

Gayane Aslanyan
Product owner, Yandex Technologies, Moscow, Russia,
g_aslanyan@inbox.ru, ORCID

Abstract

This study examines the impact of corporate governance mechanisms on the probability of corporate fraud occurrence. We evaluate the board size, the degree of independence, and the frequency of meetings of the board and its committees. We also attempt to analyse the board's gender diversity, but since boards are not gender-diverse in Russia, the significance of this variable cannot be tested. Our empirical study is based on 160 observations of MOEX-listed Russian companies, among which fraudulent behaviour has been revealed in 32 companies over a 5-year period from 2014 to 2018. The relationship between the probability of fraud occurrence and corporate governance was investigated employing a logit model. The data was collected from firms' annual reports and Thomson Reuters Eikon. Data on fraud cases is based on the evidence from the press (including the leading news sources and specialised websites). We detected a significant negative relationship between nomination and remuneration committee chairmen's independence, the share of independent directors, the independence of board and audit committee chairmen and the likelihood of fraud. We also discovered the insignificant influence of board and its committees' size and their meetings' frequency on fraud probability. This paper contributes to the academic research on the relationship between corporate governance mechanisms and probability of fraud occurrence, emphasizing the special role of the establishment of nomination and remuneration committee chairman independence in Russian companies.

Keywords: board of directors, corporate governance, audit committee, nomination and remuneration committee, corporate fraud

For citation: Soboleva O., Makeeva E., Aslanyan G. (2024) The Influence of Corporate Governance Mechanisms on Fraud Probability: Evidence from Russian Companies. *Journal of Corporate Finance Research.* 18(1): 49-61. https://doi.org/10.17323/j. jcfr.2073-0438.18.1.2024.49-61

Introduction

The modern business environment, characterised by complex internal corporate processes, has resulted in a rise in the level of information asymmetry. In such an environment, the monitoring function of the board of directors is increasingly relevant. Due to the presence of adverse selection and the temptations of moral hazard in the current digitalised environment, opportunities for fraudulent behaviour become increasingly more numerous. Thus, more attention and effort are required on the part of the board.

According to Deloitte's legal insight [1], fraud related to financial reporting is rare (9%) in comparison to other compliance risks. The main risks arise when working directly with the counterparty (at an 86% incidence rate), due to a conflict of interest (73%), or corruption (59%). Overall, fraudulent behaviour in financial reporting is less frequent in comparison to other risks. The composition of the board of directors influences the monitoring function inside the firm, and the presence of an audit and remuneration committee decreases risks. The compliance function of the board is consequently more critical, so effective corporate governance ought to be able to decrease it. Hence, all types of fraud may be considered in terms of the present corporate governance mechanisms analysis.

Corporate governance management practices are also reflected in the composition of the board of directors and the nomination and remuneration committees [2]. The board acts as a monitoring agent: it decides what punishment to implement in case of a violation of shareholder interests [3]. Senior management may have an incentive to undertake fraudulent action, however, if the board of directors connects the shareholders and management of a company, it partially solves the information asymmetry problem. Board members have the right to claim compensation from the CEO, or, on the other hand, impose punishment in case of non-desirable actions.

Besides, committees also fulfill a monitoring function. According to the Sarbanes-Oxley Act of 2002, audit committee participants should be independent because they are responsible for financial reporting quality and fairness. Members of the audit and remuneration committees are also members of the board. The nomination and remuneration committee authorises the CEO's and other executive officers' optimal remuneration scheme, which decreases their incentive to deviate from fair principles. It is important to note that despite the generality of the foregoing summary, the effect of corporate governance on fraud occurrence may differ in the case of Russian companies because of Russia's unique historical context and legislation.

We present an empirical study based on 160 observations of MOEX-listed Russian public companies. Instances of fraudulent behaviour are accounted for in 32 companies in credible news sources for the period from 2014 to 2018. We will primarily examine the following hypotheses: (1) independence of presiding officers serves to decrease fraud, (2) the level of a board's gender diversity decreases fraud risk, and (3) the frequency of board and committees' meetings decreases fraud probability. We investigated empirical research both for developed and developing countries, including the USA, Canada, Malaysia, and Indonesia.

The examined literature includes the following papers. The papers written by D.W. Yiu et al. [4], and J.F. Brazel, J.J. Schmidt [5], investigated the relationship between corporate governance characteristics and the likelihood of fraud. N. Nasir et al. [6] in their paper, provide evidence on the difference in financial statement fraud probabilities based on whether board directors are Malay or not. Y.G. Shan et al. [7] provide evidence that the size variable is insignificant in their research into the relationship between size and fraud occurrence. I.V. Berezinets et al. [8] outline how Russian companies' corporate structure influences financial quality.

However, we have not found any research papers explaining the relationship between corporate governance characteristics and fraud probability for Russian companies. Countries with developing economies, such as Russia, have specific local characteristics that affect corporate governance and information asymmetry, so we rely upon the results of existing studies and analyse the external effects.

The focus of our research considers whether board structure, audit, and nomination committee presence influence the probability of corporate fraud. We investigate the role of corporate governance mechanisms and their influence on the likelihood of fraud in the context of Russian companies. In particular, we evaluate the effect of gender diversity, number of members, degree of independence, and frequency of board and its committees meetings. The aim of the study is to find the key determinants to optimise corporate governance in Russia, which would decrease the likelihood of fraud in a company, as "enhancing corporate governance in the Russian Federation is the most important measure necessary to increase the stability and efficiency of joint stock companies' operations, as well as the flow of investment in all sectors of the Russian economy both from sources within the country and from foreign investors" (Corporate Governance Code (Russia)).

Our paper considers the case of Russia as a developing country since it is rated "4" in the appropriate OECD classification. It is in the 28th place out of 190 in the business development rating, 58th place in taxation, and 72nd in terms of protecting minority shareholders (Rating Forbes [9]).

We evaluate the specifics of the Russian environment and its law, and hypothesise how this may affect the probability of fraud using actual observations from companies with published news. In particular, Russian laws propose a required minimum size of the board of directors. Hence, the size variable may have an insignificant effect on the probability of fraud in Russia. Usually, the government owns a large stake in a major infrastructural firm in Russia. This situation resulted from the privatisation process in the 1990s, when the government invested in strategically essential companies for the sake of the economy [10]. To

highlight this statement, one may consider P.V. Fedotov, V.I. Murar [10], who report Russian board structure statistics. These authors further highlight that boards mainly consist of independent directors (22%), professional attorneys (52%), and civil servants (26%).

In contrast to conventional practice in foreign jurisdictions, the Russian business environment, is characterised by integrated remuneration and nomination committees [11]. Furthermore, compared to foreign countries, there has not been a long history of joint fiduciary responsibility. The Federal Law [12] on amendments to certain legislative acts of the Russian Federation on the regulation of the activities of Non-State Pension Funds was adopted in 2018 (Federal Law of March 7, 2018, No. 49). The Central Bank of Russia decided to unify fiduciary responsibility for non-state pension funds, brokers, and investment advisors in the autumn of 2020. Another distinction is that fraud cases in Russia are not recorded in explicit detail. Subsequently, our study focuses only on the specifics of Russian corporate governance practices.

The remainder of the paper is as follows. First, the literature review presents evidence on the effectiveness of corporate governance and its relationship to the board and committees' characteristics, including size, frequency of meeting, and independence. Second, we investigate the gender diversity of the board. Third, we present the research on the board's members' independence in more detail. Then the hypotheses are articulated, and the methodology, data, and empirical results are described. In conclusion we present the results of the study and its implications for future studies.

Literature review

Influence of the board and its committees on the likelihood of fraud

In this section, we will explore whether the board and its committees influence corporate fraud. Prior research shows that the most frequent corporate governance mechanisms comprise the board and committee meetings, the level of board members' independence, and the level of women's representation [13]. Some papers, e.g. R. Labelle et al. [14], provide research and analysis of Financial Reporting Quality (FRQ) as an internal governance mechanism – if the quality of a financial report is low, it is easier to find a way to conduct fraud. The literature [15; 16] includes the analysis of the dependence of FRQ on various variables, for example, board independence, tenure, institutional directors' presence, gender diversity, and directors' shareholding.

Shareholders can rebalance a corporate governance policy to decrease the probability of fraud. D.W. Yiu et al. [4] provide research about alternative corporate governance mechanisms to identify those that reduce fraudulent behaviour. The authors used a bivariate probit model and base their research on data from Chinese companies. D.W. Yiu et al. concluded that "strategic alliances, business group affiliation, non-tradable state shares, local government ownership, use of foreign auditors, and foreign listing can deter corporate financial fraud" [4].

Besides this, other studies have found that an internal audit can significantly deter the effectiveness of corporate governance with no outsourced auditors. S. Johl et al. [17] stipulate that an internal audit may substantially affect board quality due to the presence of institutional features mandated by the government. The authors explained that the Malaysian government specifically requires companies to conduct an internal audit and report it in that country, and to submit the results to the local 'Institute of Internal Auditors'. As such, following the institutional features introduced by the government contributes to higher internal audit quality.

The audit committee has a function of reviewing significant issues relevant to the financial reporting preparation, and a function in terms of monitoring internal control and risk management systems. M. Beasley [18] evaluated how board composition influences the probability of fraud, investigated the effect of involving external operators in the audit, and the relevance of the audit committee's presence in a company. This study included 75 companies where fraud was confirmed and 75 non-fraud companies and used a logit model for the analysis. The results indicated that the presence of an audit committee had an insignificant influence on the likelihood of fraud. J.F. Brazel, J.J. Schmidt [5] provided a more detailed analysis of audit committee composition. The authors found that the presence of audit committee members with longer tenure seem to decrease fraud probability. The study revealed that companies with a high fraud likelihood have a pervasive tendency to hire expert directors in audit committees compared to companies where fraud occurrence is less likely.

On the other hand, M.M. Marzuki et al. [2] showed that the characteristics of audit committees might have a positive relationship with the likelihood of fraudulent financial reporting. In particular, the authors considered the level of financial accounting expertise of board members, and whether the committee is 'grey' or not. The data included 64 observations from Malaysian firms for the period between 2002 and 2014. Authors found little evidence that audit committee characteristics decrease fraud, in particular, they suggested the "possible cosmetic role of independent non-executive directors in preventing fraud" [2].

Furthermore, increases in the efficiency of the audit committee's characteristics might not decrease fraudulent activity, but, on the contrary, hide it. The paper by N. Nasir et al. [6] analyses the presence of Malay directors on the board. Authors explore 76 firms exhibiting financial statement fraud and 76 non-fraud firms between 2001 and 2008, and find a positive correlation between the presence of fraud and the presence of Malay directors. This phenomenon may be related to the hypothesis that Malaysians are culturally predisposed towards having 'secretive' personalities. Consequently, the authors suppose that fraud companies tend to 'over-hedge' against fraudulent behaviour

in order to demonstrate their innocence to authorities. N. Nasir et al. explain that "they significantly increase the proportion of independent directors on their boards, increase the frequency of board and audit committee meetings and reduce duality subsequent to the detection of financial statement fraud compared to the non-fraud firms" [6].

Ghafoor et al. [19] have a similar view about excessive corporate governance efforts. From their perspective, tax aggressiveness increases the probability of fraud because tax overpay decreases suspicions on the part of the authorities. Overall, the authors conclude that the presence of institutional investors, an independent board, the presence of females in the board, and the presence of an influential audit committee decrease fraudulent behaviour. As such, greater efforts to increase corporate governance effectiveness may have a reverse relationship to the probability of fraud, depending on the relevant incentives.

Other corporate governance characteristics can also result in counter-intuitive signals to the market about the effectiveness of fraud prevention. S. Ghannamet al. [20] show that experienced directors in the U.S. between 2005–2015 joined the board of a company even if they knew that financial fraud was being conducted, mainly because of a better compensation scheme. So, independent directors may not be an immutable sign of low fraud probability. Hence, the audit committee and directors' independence may provide inconclusive results depending on data. So, while considering the analysis of Russian companies, one can identify several points that require attention.

E.V. Nikitchanova et al. [11] compose an overview of the corporate governance and boards of directors in Russia. They classify committees as "nominal" or "informative". For example, a nomination committee tends to advise on the designation of directors and plays no direct governance role. A recent review of corporate governance in Russian public companies in 2019 [21] shows the principles of the relevant code's chapter 2 that are the most and the least actually observable. According to this review, the principle about independent directors in the formation of remuneration committees is at its least observable level (38%) as of 2019.

Also, P.V. Fedotov, V.I. Murar [10] explain that Russian economy went through a privatisation process, which is why a large share of companies' ownership is governmental. Concerning law specifics, V. Aglamazova [22] writes that the law provides two clauses where CEO must carry out current company's activities (Art. 273 of the Labor Code of the Russian Federation, paragraph 2 of article 69 of the Law on JSC, paragraph 3 of article 40 of the Law on LLC) and to act reasonably and in good faith (Clause 3 of Article 55 of the Civil Code of the Russian Federation). Consequently, the author outlines that Russian corporate legislation defines fiduciary responsibility as based on the trust between the principal and the attorney, whereas in the U.K. and the U.S. it is not only being someone›s legal representative, but one that is about power over another person. The author believes that such a difference can significantly influence this law's effectiveness [22].

The size of the board, the audit committee, the nomination committee, and the remuneration committee may also influence the probability of fraud. In Russia "it is recommended that each committee should consist of at least three board members" (Corporate Governance Code (Russia). Further literature provides some clues on the board composition significance. J. Coles et al. [23] note that a larger board size is necessary for diversified, larger, and high-debt firms. The reason is that such companies need more guidance to function effectively. The main result of this paper is the significantly positive relationship between board size and corporate performance proxied by Tobin's Q. A positive relationship is also found for some audit committee members. E. Al-Matari, M. Mgammal [24] find that audit committee size improves corporate governance effectiveness and outline that corporate performance is significantly less effective with an increased board size.

In addition to the direct influence of the board and committees, some studies are specifically devoted to the influence of their size. Some papers concerning corporate governance in fraud cases show an insignificant relationship between size and fraud probability. For example, H. Uzun et al. [25] use U.S. corporate fraud data between 1978 and 2001 and find that the size of the board and the size of committees does not reflect their efficiency and their incentives to grow. Additionally, Y.G. Shan et al. [7] report no significant relationship between board size and fraud occurrence for Malaysian listed companies from 2007 to 2009.

Moreover, the research shows that the frequency of board's and its committees' meetings might be another determinant in reducing corporate fraud. Russian Corporate Governance Code does not predetermine the exact number of meetings but recommends to hold board meetings "as needed, as a rule, at least once every two months" and audit committee meetings at least once a quarter (Corporate Governance Code (Russia)). Some studies completed in this area show the interdependence between the frequency of meetings and fraud likelihood. The investigation conducted by M.M. Marzuki et al. [2] finds that the frequency of audit committee meetings is insignificantly related to the probability of fraud in Malaysian companies. N. Nasir et al. [6] propose that increasing meeting frequency can result from over-hedging in not to arouse the suspicion of authorities. Therefore, our first hypothesis (H1) is as follows:

H1.a. The number of board meetings increases fraud probability.

H1.b. The number of audit committee meetings increases fraud probability.

H1.c. The number of nomination and remuneration committee meetings increases fraud probability.

A larger number of board meetings and committee meetings indicates the directors' interest in and responsible attitude to the future of the company. However, we believe that it also reflects company rules, which determine the minimum number of meetings.

Gender diversity as a factor in decreasing the likelihood of fraud

Gender diversity-related board characteristics are a prominent topic that usually results in significant improvements in company performance, because women are more risk-averse and ethical than men [26; 27]. Several papers consider the relationship of financial fraud to the gender diversity of the board of directors. J. Liao et al. [28] find a lower probability of accounting fraud in the presence of female CFOs than with male CFOs for Chinese listed firms between 2003 and 2015. Another interesting result is that the relationship between a female CFO and a lower fraud probability is less significant when the government is the main shareholder in a company. Besides, the authors found that gender-diverse boards significantly decrease fraud probability comparing to boards without women.

In its turn, higher Corporate Social Responsibility (CSR) is associated with lower fraud probability, so one may link it to gender diversity. L. Liao et al. [29] research the relationship between CSR and financial fraud in China. They find that the CSR score is negatively related to fraud and conclude that CSR "is an ethical behaviour that reduces financial misconduct". Concerning recent papers on the topic, A. Wahid [27] evaluates gender diversity of the board of directors. The author states that an increasing number of women on the board leads to fewer financial reporting mistakes, because men are more prone to cognitive conflict. However, the benefit of diversity increases at a diminishing rate, so the board should theoretically balance its gender composition. M.M. Marzuki et al. [2] find that the probability of fraud decreases as the percentage of female directors on the board increases. As such, we may assert that the female directors are necessary for the effectiveness of the Malaysian board.

The question remains as to whether the presence of women is correlated with fewer fraud cases because of individual gender characteristics, or if lower fraud likelihood is, on the other hand, the consequence of board diversity. N. Sandhu [30] provides research about different behavioural "red flags" where the two genders are represented, so that one may consider the probability of a fraudster's gender based on the presence of those red flags. Some authors also show that gender is not as crucial as individual characteristics and state that gender is insignificantly related to fraud. For example, one may consider a paper about women's aversion to corruption by A.-R.Lee, K. Chávez [31], who find that corruption is heterogeneous among women with different individual opportunities. The authors propose that the probability of women's fraud cases varies among different corruption types, and cannot analyse corruption as a general concept. T. Hilliard, P. Neidermeyer [32] provide international evidence that the probability of asset misappropriation in the workplace is higher for women than for men. The authors found a higher probability of asset misappropriation by women than men: twice as likely in Asia and Europe and four times as likely in the Middle East.

T. Hilliard, P. Neidermeyer [32] find that the probability of asset misappropriation by women is higher than by men. Nevertheless, we believe that gender diversity plays an essential role in the board's composition in Russia. Many empirical research studies show a positive dependence of a higher percentage of women on the board and committees on low fraud levels , e.g., the study by J. Liao et al. [28], I.V. Berezinets et al. [8] also provides evidence of a positive relationship between board gender diversity and company performance. Therefore, we expect to find significance in the results of the following hypothesis (H2):

H2: There is a negative relationship between the gender diversity of the board and fraud probability.

Independence of the board and its committees' members

The next corporate governance characteristic to outline is the independence of certain directors and committee members. There are particular recommendations provided in terms of that matter by Russian Code of Corporate Governance. First, it recommends that at least one-third of all directors on the board should be independent directors. Second, the audit committee is expected to consist of independent directors only. Third, for the remuneration committee it is advisable to be "comprised of independent directors and chaired by an independent director who should not concurrently be the board chairman". Forth, the majority of nominating committee members must be independent directors (Corporate Governance Code (Russia)).

A number of studies is dedicated to the investigation of board members' independence. E. Fama, M. Jensen [3] found that the board is most effective in monitoring when it consists of a mix of insiders and outsiders, where the percentage of outsiders is a proxy for a significant level of independence. Also, R. Labelle et al. [14] defined outsiders as "non-executive directors".

Various papers consider independence a significant variable which influences the probability of fraud. For example, M. Beasley [18] concludes that the probability of fraud decreases when the board comprises many outsiders. R. Labelle et al. [14] conducted a comparative analysis of data from the U.S., the U.K., and continental European countries. They investigated the dependence of characteristics of the board of directors and internal audit committees on FRQ and found significant results for the U.S. This allows for claiming that the independence of the board most significantly influences fraudulent reporting. One should note that R. Labelle et al. [14] report contradictory results for Europe because "cultural or legal variables need to be considered". This shows the importance of taking into account continental and country-specific cultural factors. Also, V. Oba et al. [16] provide empirical findings from Nigeria, testing FRQ on board independence, tenure, gender diversity, and directors' shareholding. They found board independence to be the only variable leading to improved financial quality, whereas the remaining factors influence a decrease in financial quality in the context of Nigeria.

R. Aguilera et al. [33] analyse how different corporate governance structures' interdependence influences the performance outcomes on the U.S. and U.K. data. They show that board independence in the U.S. may be more effective than in the U.K. because of information disclosure regulations in the U.S. Hence, directors can communicate with the shareholders, leading to true independence. There is little communication in countries with lower information disclosure; hence, the board is not truly independent. The authors also compared Russian and Japanese automobile companies, finding significant insider control in both. Because of the privatisation of state property after the Soviet Union's collapse in 1991, a large portion of control is assumed by employees and managers in Russia, leading to a large stake in ownership [34].

E. Al-Matari, M. Mgammal [24] find that corporate governance effectiveness is significantly positively related to board member independence. Also, A. Ghafoor et al. [19] investigate fraudulent financial reporting for the period of 1996–2016. The authors show a significant adverse effect on the probability of financial reporting fraud with regard to board independence, the level of influence of the audit committee, the number of women on the board, and the presence of institutional investors. A. Ghafoor et al. [19] find independence to be among variables that significantly deter corporate governance effectiveness. The authors proposed that institutional investors, board independence, an influential audit committee, and the presence of a woman on the board are also among the relevant variables.

By contrast with emerging market examples, empirical evidence from Thailand shows that independence is unnecessary. P. Inya et al. [13] found that board independence is insignificant in terms of corporate governance effectiveness. Nevertheless, the authors present results to the effect that the presence of experienced independent directors (and absence of CEO duality) showed a positive relationship with corporate governance effectiveness. Even if fraud cases were present in the company, independent directors might agree to come aboard if offered an appropriate compensation scheme. S. Ghannam et al. [20] found that outsiders commonly agree to be directors in companies that have previously committed fraud.

Conducting a more detailed analysis of the US legislation, S. Avci et al. [35] demonstrated that attention to outside directors in the U.S. law was excessive because outside directors could be eventually employed by management. Hence, they were not entirely independent, and the hiring of such CEOs cannot be considered an efficient measure to protect shareholders' interests. Authors proposed that giving a greater emphasis to shareholders' monitoring function rather than the presence or characteristics of external agents may be a more optimal solution.

Y.G. Shan [38] found a negative relationship between a firm's performance and board independence using the data of 9302 Australian listed companies. Also, R. Aguilera et al. [33] wrote that insider control leads to a low efficiency of corporate governance strategies. They noted that the intervention of the Central Bank and an independent reward system that make insider control effective in Japan are absent in Russia. Thus, corporate governance with high insider control in Russia appears to be completely ineffective.

Returning to the papers based on developed countries' cases, J. Wall, J. Gissel [36] investigated the board's monitoring function's effectiveness, since directors have a fiduciary responsibility to shareholders. Their goal was to suggest an optimal remuneration scheme to prevent fraudulent actions. The authors conducted a psychological experiment based on the questionnaire and, as a result of the study, recommend more severe sanctions in order to decrease fraud probability. Thus, the number of independent directors had a positive impact on fraud detection.

Based on the paper of R. Labelle et al. [14] who found that the board in the U.S. is effective if it is fully independent, V. Oba et al. [16] also reported a positive relationship in the case of Nigeria. Besides, A. Ghafoor et al. [19] revealed a negative relationship between board independence and the probability of financial reporting fraud.

Research carried out on Russian companies by I.V. Berezinets et al. [8] showed no significant relationship between the degree of board independence and FRQ. P. Inya et al. [13] also indicated that board independence is insignificant for corporate governance effectiveness. Besides, Y.G. Shan [38] found the negative relationship between a firm's performance and board independence. Thus, taking into account that the results are quite different, we present the following hypothesis:

H3.a. The degree of board independence decreases the probability of fraud.

H3.b. The degree of audit committee independence decreases the probability of fraud.

H3.c. The degree of nomination committee independence and remuneration committee independence decreases the probability of fraud.

We also consider the committee chairman's independence separately because a chairman supervises the committee's work. If the chairman is independent, they are interested in lobbying on behalf of company issues, not the specific stakeholders. According to Corporate Governance Code [37], independent directors are the board members who have sufficient expertise and professional work experience, can make objective decisions, are not affiliated with the government, the company, or its significant shareholder, partner, or competitor. We pay special attention to the nomination and remuneration committee chairman because the board and the audit committee chairmen are usually independent in Russian public corporations. In our opinion, in contrast to the board and the audit committee, the chairman's independence of the nomination and remuneration committees is due to a real desire to follow corporate standards to attract investors. We present the following Hypothesis 4:

H4: The independence of the nomination and remuneration committee chairman decreases the probability of fraud.

We believe that the independence of the nomination and remuneration committees' chairman raises corporate governance effectiveness, so we apply a factor considering the relative frequency of meetings to consider the company's demand to organise such sessions.

Size of the board and its committees

In addition to the board, committees, and chairman's independence, we consider the size factor in terms of corporate governance characteristics. The relationship between the size of the board and the firm's performance appears to be controversial. Some papers show a positive relationship between the size variable and corporate performance [23; 24]. Furthermore, I.V. Berezinets et al. [8] find a significant relationship of the board's size with listed public Russian companies' performance. The paper's results are such that the smallest and the largest boards are associated with higher-quality performance. However, the positive relationship outlined is between size and corporate performance, not fraud level. H. Uzun et al. [25], as well as Y.G. Shan et al. [7] showed that board and committee size has an insignificant effect on fraud probability. Consequently, we would like to analyse the effect of board and committee sizes on fraud probability. We present the following Hypothesis 5:

H5.a. The influence of the board size on the level of fraud rate is insignificant.

H5.b. The influence of the audit committee size on the level of fraud rate is insignificant.

H5.c. The influence of the nomination and remuneration committee size on the level of fraud rate is insignificant.

The board and committee size should not reflect their efficiency and pursuit of company growth; which is why we do not consider these factors significant. Similar results, discovered by Y. Uzun et al. [25] and Y.G. Shan et al. [7], support our perspective.

Methodology

The literature review provided us with several clues on evaluating board and committee composition's influence on fraud level. However, we could not use the methodology with absolute values in the dependent variable like S. Johl et al. [17] due to the low information available, such as, i.e., the rare disclosure of losses from internal frauds by Russian companies. For that reason, to assess the influence of board and committees' membership on the probability of fraud, we preferred to apply a binary model, particularly a logit one, following the experience of many researchers [14; 15], due to several disadvantages that probit and linear probability models (LPM) have presented. They include the heteroskedasticity problem (particularly for LPM) and difficulties in result interpretation. Thus, the dependent variable (*fraud*) equals '1' if a fraud case was detected, and '0' otherwise. We also included the logarithm of the market capitalisation (*lnsize*) as a control variable in the models. The reason for this is the firm size's expected impact on the subject of the study, so we preferred not to ignore it, even though it was not within the scope of research.

According to H1, we should test the influence of the board and committee meetings. So, we use three variables (Table 1): *board_freq* (for the board), *audit_freq* (for the audit committee), and *nc_freq* (for the nomination and remuneration committee), which reflect the number of meetings per fiscal year (i.e., meeting frequency). Additionally, the variables take into account both face-to-face and alternative meeting methods. The reason for this was the absence of reasons to believe that only face-to-face meetings are useful in the Russian case.

As for H2, in order to test the relationship between the board's gender diversity and the probability of fraud, we included the gender diversity variable (*gender*) in the model, calculated as the percentage of women among board members.

To examine H3, as in the case of H1, we included the corresponding variables: *board_ind* – the share of independent directors on the board, *audit_ind* – the share of independent directors on the audit committee, and *nc_ind* – the share of independent directors on the nomination and remuneration committee. To provide for comparability, we outline that the relative variable allows us not to depend on the board size.

H4 required inclusion of the *nc_chair_ind* dummy variable, which equals "1" in the presence of an independent chairman of the nomination and remuneration committee, and '0' otherwise.

Testing H6 about the influence of the board and committee sizes was connected with the inclusion of the corresponding variables: *board_size* – number of board members, *audit_size* – number of audit committee members, and *nc_size* – number of nomination and remuneration committee members.

Table 1. Table of variables

Variable	Symbol	Operationalisation
Fraud event	*fraud*	Dummy variable (1 – fraud is detected; 0 – otherwise)
Company size	*ln_size*	The natural logarithm of the firm's market capitalisation at the end of the year
Board gender	*gender*	The share of women among board members
Board size	*b_size*	The number of board members
Board independence	*b_ind*	The share of the independent directors on the board
Board effort	*b_freq*	The number of board meetings per fiscal year

Variable	Symbol	Operationalisation
Audit committee size	*a_size*	The number of audit committee members
Audit committee independence	*a_ind*	The share of independent directors on the audit committee
Audit committee effort	*a_freq*	The number of audit committee meetings per fiscal year
Audit committee's chair independence	*a_chair_ind*	Dummy variable (1 – the chair of the audit committee is independent; 0 – otherwise)
Nomination & remuneration committee size	*nc_size*	The number of members on the nomination and remuneration committee
Nomination & remuneration committee independence	*nc_ind*	The share of the independent directors on the nomination and remuneration committees
Nomination & remuneration committee effort	*nc_freq*	The number of the nomination and remuneration committee meetings per fiscal year
Nomination & remuneration committee's chair independence	*nc_ind_chair*	Dummy variable (1 – the chair of the nomination and remuneration committee is independent; 0 – otherwise)

Thus, initially, we examine 3 models with the following specifications:

$$Fraud(t) = \frac{e^Z}{1+e^Z}, (1)$$

where

Model 1 (for the board):

$$Z = \beta_0 + \beta_1 \ln(\text{market cap})_i + \beta_2 \text{gender}_i + \\ + \beta_3 \text{board}_i \text{freq}_i + \beta_4 \text{board}_i \text{ind}_i + \\ + \beta_5 \text{board size}_i + \varepsilon; \quad (2)$$

Model 2 (for the audit committee):

$$Z = \beta_0 + \beta_1 \ln(\text{market cap})_i + \beta_2 \text{audit freq}_i + \\ + \beta_3 \text{audit ind}_i + \beta_3 \text{audit size}_i + \varepsilon; \quad (3)$$

Model 3 (for the nomination and remuneration committee):

$$Z = \beta_0 + \beta_1 \ln(\text{market cap})_i + \beta_2 \text{nc freq}_i + \\ + \beta_3 \text{nc ind}_i + \beta_4 \text{nc size}_i + \\ + \beta_5 \text{nc chair ind}_i + \varepsilon. \quad (4)$$

As we tested the models, we realized what factors are the most significant. Using the consistent exception approach, we checked the significance of the variables, then we formulated the new model with the sustainably significant factors. Thus, we selected the necessary analysis variables and decided to implement a logit model to test the hypotheses. Lastly, we formulated the basic models and indicated the next steps of the research process.

Data

Panel data consists of 160 observations for 32 listed Russian public companies for five years (2014–2018). The presence of a listing of the chosen corporations on the Moscow Stock Exchange is considered first. We selected listed companies because the standard of information disclosure is weak in Russia. In contrast, the largest and most reliable companies seek to attract foreign, institutional, and other investors for whom it is crucial to know whether the company meets their internal criteria. Correspondingly, corporations usually inform the market about changes better than private firms, or those less interested in the stock market.

Moreover, according to Russian legislation, listed companies must disclose information that can be crucial for stock evaluation (Regulation of the Bank of Russia dated February 24, 2016 No. 534-P (as amended on June 27, 2019) "On the admission of securities to organized securities") [39]. Published companies' information (e.g., reports) is retrieved from www.e-disclosure.ru. The leading source for us are the companies' annual reports. Furthermore, part of the necessary information is from the Thomson Reuters Eikon terminal.

We found fraud cases by searching through news due to the absence of fraud databases for Russia's public or private companies. We monitored the leading news sources (e.g., Kommersant, Interfax, Ria) and specialised sites (e.g., Pravo (pravo.ru), Banki (banki.ru)). For our purposes, a fraud case is defined as any news about financial reporting scandals, corruption, conflict of interests and local fraud. Overall, we found 32 fraud cases, however, we should emphasise that it is not a full list of fraud cases, as companies often prefer to address conflicts and problems internally and shield the details from publicity.

Statistical description and sample

Means, medians, and pairwise comparisons (fraud vs. non-fraud companies) for the board, committees, and companies' characteristics are found in Table 2. The matched pairs for the pairwise comparison varied from 80 to 71 based on data availability.

The pairwise differences in board composition show that differences in the share of female directors, independent directors, and the annual number of board meetings (both online and offline) are statistically different from zero. On average, non-fraudulent companies in the sample had a higher percentage of women on the board and a higher percentage of independent directors. Non-fraud-linked companies also hold fewer board meetings. The pairwise differences between fraudulent and non-fraudulent companies' audit committees demonstrate no difference in the number

of members or annual meetings. However, non-fraudulent companies have, on average, a significantly higher percentage of independent directors on the committee.

Non-fraudulent companies also have a higher percentage of independent directors on the nomination committee, while the difference in the annual number of meetings and the number of members is insignificant. Also, the pairwise analysis of the companies' market capitalisation shows that fraudulent companies, on average, tend to have a higher valuation.

The percentage of independent directors on the audit and nomination committees, as well as the number of both committees' meetings, are strongly positively correlated. Also, the number of members in both committees is positively correlated (>0.5) with the board size. The firm size (market capitalisation) shows a positive correlation with the board and committee size, and the frequency of their meetings. Firm size correlates negatively (–0,4 to –0.2) with the committee size, meeting frequency, and the independence of the committees' chairmen.

Table 2. Statistical description of board and committees: fraudulent vs. non-fraudulent companies

	Mean			Median		
Category	Fraud	No-Fraud	p-Value	Fraud	No-Fraud	p-Value
Board composition						
Board size (number)	11.32	11.34	0.98	11	1	0.65
Female directors (% of board size)	4.39	8.38	0.08*	0	7.14	0.00***
Independent directors (% of board size)	33.46	39.39	0.05**	36.35	40	0.13**
Meeting frequency (annual number)	26.84	19.88	0.03**	18	15	0.15
Audit Committee						
Committee size (number)	3.26	3.41	0.29	3	3	0.5
Independent directors (% of members)	71.83	83.36	0.02**	66.7	100	0.00***
Meeting frequency (annual number)	7.87	9.09	0.45	8	8	0.47
Nomination Committee						
Committee size (number)	3.23	3.33	0.55	3	3	0,64
Independent directors (% of members)	66.7	81.54	68.48	100		0.03**
Meeting frequency (annual number)	6.07	7.43	0.32	7	7	0.65
Company specifics						
Market capitalisation (bln. rub)	1275.6	611.27	868	200.5		0.00***

***, ** and * indicate significance levels of 1%, 5% and 10% respectively.

Sources: Authors calculations.

Overall, the statistical analysis of the sample showed that the main difference between fraudulent and non-fraudulent companies is the number of independent directors.

Empirical Results

Our empirical analysis consisted of two parts:

- We constructed the correlation matrix of all the dependent variables
- We evaluated the influence of the board and committee composition on the probability of fraud using a logit model.

Model 1

The first model aimed to assess how board composition in terms of gender diversity (*gender*), number of members (*b_size*), degree of independence (*b_ind*), and its frequency of meetings (*b_freq*) affect the fraud probability. The regression model was evaluated in two stages. The first stage included all the variables, and the only significant variable appeared to be company size (*lnsize*). At the second stage, when the *gender* variable was excluded, the model provided better results. As we can see from Table 3, due to negligible number of women among board members, this variable was eliminated from the model. According to the data,

the boards are not gender diverse in Russia since the mean value is only 0.069. Consequently, H2 is not supported. The independence variable (*b_ind*) had a significant effect on fraud probability. Its value indicates that a 1% increase in the degree of board independence results in fraud probability reduction by 0.41%. Significance of the number of members (*b_size*) and frequency of meetings (*b_freq*) is not confirmed.

In addition, the Wald test does not detect multicollinearity problem.

Model 2

Model 2 evaluated how the audit committee performance, reflected by the meetings' frequency (*a_freq*), the number of members (*a_size*), and the degree of independence (*a_ind*), impacts fraud probability. The results shown in Table 3 indicate that among all Model 2 variables, there are two significant variables – the level of independence and the control variable size. Consequently, the increment in the share of independent directors by 1% leads to a decline in the fraud probability by 0.26%, proving H3.b at the 5% significance level. Significance of the meetings› frequency (*a_freq*) and the number of members (*a_size*) is not revealed.

Besides, the Wald test does not detect multicollinearity.

Model 3

With Model 3, we examined the influence of the last committee's under consideration – the nomination and remuneration committee. It can be seen from Table 3 that there are one significant variable and one significant control variable. It refers to the independence of the chairman (*nc_chair_ind*): the independent committee head noticeably diminishes probability of fraud by 0.24%, consistent with H4. The independence variable (*nc_ind*) appears to be insignificant, even though it is negatively correlated with the dependent variable, as we proposed. Also, *nc_freq* seems to have an insignificant effect, and has a negative relationship that contradicts our hypothesis. Consequently, we reject H1.c and H3.c. The insignificance of the committee size (*nc_size*) was anticipated, and thus H6.c is proven.

The model was also tested for multicollinearity, and the Wald test does not detect it.

Table 3. Logit model's specifications

Independent variable	Model 1	Model 2	Model 3
Lnsize	0.00057***	0,00055***	0.00047**
	0.0002	0,0002	
Gender	–4.62603		
	3.61615		
b_ind	–2.7775		
	1.74383		
b_size	–0.0349		
	0.120356		
b_freq	0.017734		
	0.013941		
a_size		0.0931769	
		0.3662542	
a_freq		–0.0333549	
		0.080822	
a_ind		–1.671224**	
		0.9166131	
nc_size			0.399214
			0.308366
nc_freq			0.009023
			0.0961266
nc_ind			0.009489
			1.14994
nc_chair_ind			–1.66421*
			0.865961
Const	–0.7096	–1.207474	–1.998201
	1.575665	1.646325	1.804469
Pseudo R2	0.1406***	0.097**	0.0963*

***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Sources: Authors calculations.

Control variable

According to the models, company size (*ln_size*) has a significantly positive effect on the fraud probability at the 1% and 5%, levels. However, the relationship is relatively stable, so we conclude that company size should be incorporated into the regressions to receive accurate estimations.

Conclusion

Overall, we couldn't test the hypothesis on the negative relationship between the gender diversity and fraud probability as the representation of women on the board is extremely scarce in Russia. Nevertheless, the mean-median

analysis shows that non-fraud companies in the sample had a higher percentage of women on the board and a higher percentage of independent directors.

If a non-executive director is present on the nomination and remuneration committee, the board's and committees' efforts reduce fraud at a decreasing rate. The independence, effort, and size of the board and committees are insignificant variables.

The degree of independence of board and committee members is not statistically significant. This aligns with the results obtained by I.V. Berezinets et al. [8], who also explore Russian data and does not align with research using data from the U.S. and Nigeria, which, on the contrary, found this variable significant. Such insignificance does not allow us to reveal the effect of members' independence on the probability of fraud. However, the independence of the nomination and remuneration committee chairman significantly decreases the probability of fraud. This result indicates that hiring an independent chairman can prevent fraud. However, nomination and remuneration committees frequently play just a minor role in the Russian context [8].

The non-control size variable is insignificant in all our hypotheses. We may suppose that the reason behind this is the minimum board size, as set by Russian legislation. We furthermore accept the last hypothesis (H5), i.e., that the board and committee size does not influence the probability of fraud. This result is in alignment with foreign literature on the topic. However, I.V. Berezinets et al. [8] found the size variable to be the only significant one in terms of the quality of financial reporting. We suggest that size may be significant for reporting quality, as I.V. Berezinets et al. [8] found, because one of the board's and audit committee's functions is to provide and review financial reporting. However, we investigate the effects on the probability of fraud that includes financial reporting manipulation, and is much more comprehensive, according to Deloitte's legal insight [1].

To conclude, the result is that shareholders who desire optimisation should pay more attention to board and committee chairpersons' diversity and independence. According to our results, the independence of the whole board and committees can be ignored, and it seems to be more convenient and cheaper for the company to pay attention to just one person's independence.

One of the possible reasons for fraud is inadequate manager remuneration. Salary rigidity may provide incentives for fraud on the part of top managers. Hence, the probability of fraud occurring in the whole company increases. One possible method to reduce it is to set stricter rules as a reference for the nomination and remuneration committee. For example, a more severe punishment suggestion acts as a signal that prevents fraud.

Possible future studies and limitations

Future studies should aim to replicate the results in a larger sample. Besides, they may focus on financial accounting fraud in Russian companies and consider various levels of fraud: the levels of employees and top management. We suggest that conducting an anonymous survey among Russian companies and creating a database can contribute to significant progress in the study of the influence of corporate governance on the level of corporate fraud. Also, Russian specifics would be taken into account in the survey. The results could be useful for Russian companies and firms from other developing countries in demonstrating similar institutional characteristics. Our findings may be used to inspire the reduction of losses from internal offenses.

Furthermore, the results of the investigation of Russian companies presented in this study provide an opportunity to highlight the direction for further research involving Russian-language news.

References

1. Grechanic, L., Abdullina, A., & Kareev, O. (2017). Deloitte legal insight.
2. Marzuki, M. M., Haji-Abdullah, N. M., Othman, R., Wahab, E., & Harymawan, I. (2019). Audit committee characteristics, board diversity, and fraudulent financial reporting in Malaysia. *Asian Academy of Management Journal*, 24 (2):143-167.
3. Fama, E., & Jensen, M. (1998). Separation of Ownership and Control. *FOUNDATIONS OF ORGANIZATIONAL STRATEGY, Harvard University Press and Journal of Law and Economics*, Vol. 26, June 1983.
4. Yiu, D. W., Wan, W. P., & Xu, Y. (2019). Alternative Governance and Corporate Financial Fraud in Transition Economies: Evidence From China. *Journal of Management, 45(7), 2685–2720.*, https://doi.org/10.1177/0149206318764296.
5. Brazel, J. F., & Schmidt, J. J. (2019). Do auditors and audit committees lower fraud risk by constraining inconsistencies between financial and nonfinancial measures? *Auditing*, 38 (1), 103-122.
6. Nasir, N., Ali, M., & Ahmed, K. (2019). Corporate governance, board ethnicity and financial statement fraud: evidence from Malaysia. *Accounting Research Journal*, vol. 32, issue 3, 514-531.
7. Shan, Y. G., Graves, C., & Ali, H. H. (2013). Effect of board composition and ownership characteristics on fraud: Evidence from Malaysian listed companies. *South East Asia Research*, 21(2), 323–342.
8. Berezinets, I. V., Ilyina, Y. B., & Cherkasskaya, A. D. (2013). Board structure and financial performance of Russian open joint stock companies. *Bulletin of St. Petersburg University. Management*, (2), 52.
9. Raiting Forbes [Internet]. Available from: https://www.forbes.com/best-countries-for-business/list/#tab:overall

10. Fedotov, P. V., & Murar, V. I. (2014). Management of state blocks of shares in Russia. *Bulletin of Eurasian Science*, (5 (24)), 31.

11. Nikitchanova, E. V., Lihacheva, N. G., & Gulayev, K. A. (2013). Corporate governance practice in Russia: what has changed over the year? *Results of the annual survey by the Russian Institute of Directors. Management Sciences*, (1 (6)), 14-23.

12. *The Federal Laws.* The Federation Council of the Federal Assembly of the Russian Federation (2020)

13. Inya, P., Psaros, J., & Seamer, M. (2017). The Relevance of Western Corporate Governance in Mitigating Management Misconduct in Thailand. *Emerging Markets Finance and Trade.*, 54. 10.1080/1540496X.2017.1307102.

14. Labelle, R., Thornton, D., He, L., & Piot , C. (2009). Board Monitoring, Audit Committee Effectiveness, and Financial Reporting Quality: Review and Synthesis of Empirical Evidence. *Journal of Forensic & investigative Accounting.*, 1.

15. Pucheta-Martínez, M. C., & García-Meca, E. (2014). Institutional Investors on Boards and Audit Committees and Their Effects on Financial Reporting Quality. *Corporate Governance: An International Review*, 22. 10.1111/corg.12070.

16. Oba, V., Musa, I., & Fodio, M. (2012). Board Characteristics and the Quality of Environmental Reporting in Nigeria. *The Journal of Accounting and Management*.

17. Johl, S., Johl, S., Subramaniam, N., & Cooper, B. (2013). Internal audit function, board quality and financial reporting quality: Evidence from Malaysia. *Managerial Auditing Journal*, 28. 10.1108/MAJ-06-2013-0886.

18. Beasley, M. (1996). An Empirical Analysis of the Relation between the Board of Director Composition and Financial Statement Fraud. *The Accounting Review*, 71(4), 443-465., from http://www.jstor.org/stable/248566.

19. Ghafoor, A., Zainudin, R., & Mahdzan, N. (2019). Factors Eliciting Corporate Fraud in Emerging Markets: Case of Firms Subject to Enforcement Actions in Malaysia. *Journal of Business Ethics*, 160.

20. Ghannam, S., Bugeja, M., Matolcsy, Z., & Spiropoul, H. (2019). Are qualified and experienced outside directors willing to join fraudulent firms and if so, why? *Accounting Review*, 94 (2), 205-227.

21. *The review of corporate governance in Russian public companies in 2019.* Central Bank of Russia (2020).

22. Aglamazova, V. (2012). The concept of fiduciary relationships and the possibility of its application in the corporate law of Russia. *Business Law. The app "Business and Law in Russia and za rubezhom"*, – N 1., 23-29.

23. Coles, J., Daniel, N., & Naveen, L. (2008). Boards: Does one size fit all. *Journal of Financial Economics*, 87, issue 2, 329-356.

24. Al-Matari, E., & Mgammal, M. (2019). The moderating effect of internal audit on the relationship between corporate governance mechanisms and corporate performance among Saudi Arabia listed companies. *Contaduría y Administración*, 65. 1-36. 10.22201/fca.24488410e.202.

25. Uzun , H., Szewczyk, S., & Varma, R. (2004). Board Composition and Corporate Fraud. *Financial Analysts Journal.*, 60. 10.2469/faj.v60.n3.2619.

26. Luo, J.-h., Peng, C., & Zhang, X. (2020). The impact of CFO gender on corporate fraud: Evidence from China. *Pacific-Basin Finance Journal, Elsevier*, vol. 63(C).

27. Wahid, A. (2019). The Effects and the Mechanisms of Board Gender Diversity: Evidence from Financial Manipulation. *Journal of Business Ethics*, 159. 10.1007/s10551-018-3785-6.

28. Liao, J., Smith, D., & Liu, X. (2019). Female CFOs and accounting fraud: Evidence from China. *Pacific Basin Finance Journal*, 53, 449-463.

29. Liao, L., Chen, G., & Zheng, D. (2019). Corporate Social Responsibility and Financial Fraud: Evidence from China. *Accounting & Finance*, Vol. 59, Issue 5, 3133-3169.

30. Sandhu, N. (2020). Behavioral red flags of fraud: a gender-based ex post analysis. *Journal of Financial Crime*, Vol. 27 No. 4, pp. 1307-1322. https://doi.org/10.1108/JFC-04-2020-0048.

31. Lee, A.-R., & Chávez, K. (2020). Are Women More Averse to Corruption than Men? The Case of South Korea. *Social Science Quarterly*, 101 (2), 473-489.

32. Hilliard, T., & Neidermeyer, P. (2018). The gendering of fraud: an international investigation. *Journal of Financial Crime*, 25 (3), 811-837.

33. Aguilera, R., Filatotchev, I., Gospel, H., & Jackson, G. (2008). An organizational approach to comparative corporate governance: Costs, contingencies, and complementarities. *Organization Science*, 19(3), 475-4 92.

34. Buck, T., Filatotchev, I., Nolan, P., & Wright, M. (2000). Different path to economic reform in Russia and China: causes and consequences. *Journal of World Business*, 35(4), 379- 400.

35. Avci, S. B., Schipani, C. A., & and Seyhun, N. (2018). Do Independent Directors Curb Financial Fraud? The Evidence and Proposals for Further Reform. *Indiana Law Journal*, Vol. 93: Iss. 3, Article 5.

36. Wall, J., & Gissel, J. (2019). Board of Directors' Sanction Judgments: The Effect of Situational Factors. *Journal of Managerial Issues*.

37. *Corporate Governance Code.* The Central Bank of the Russian Federation.

38. Shan, Y. G. (2019). Managerial ownership, board independence and firm performance. *Accounting Research Journal*, 32(2), 203.

39. *On the admission of securities to organized securities.* Regulation of the Bank of Russia dated February 24, 2016 N 534-P. (as amended on June 27, 2019).

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.62-74
JEL classification: G32, G34, G35

Dividend Payments by Russian Companies: A Signal to the Market or a Consequence of Agency Conflicts?

Anton Puzakov
Engineer, Department of Finance and Credit, Faculty of Economics,
Lomonosov Moscow State University, Moscow, Russia,
puzakov.inc@yandex.ru, ORCID

Ashot Mirzoyan
Senior Lecturer, Department of Economics of Innovations, Faculty of Economics,
Lomonosov Moscow State University, Moscow, Russia,
kell56@yandex.ru, ORCID

Anastasia Galich ✉
Engineer, Department of Finance and Credit, Faculty of Economics,
Lomonosov Moscow State University, Moscow, Russian Federation,
nastyagalich02@mail.ru, ORCID

Abstract

The article analyzes the dividend policies of Russian companies using two dividend payment theories: signaling theory and agency cost theory. A sample of 30 Russian companies over the period 2010–2021 is used. To test the applicability of signaling theory, pooled regression and fixed effects models are developed. It is shown that an increase/reduction in dividend payments exceeding 20% in the current year allows one to predict an increase/decrease in the return on assets in one or two subsequent years (in comparison to the year preceding dividend payments). However, the growth rate of dividend payments shows no stable relationship with the future return on assets. To test the applicability of agency cost theory, a Tobit model is used with the participation of a principal majority shareholder represented by the government as the dependent variable. This binary variable is equal to 1 if the government owns directly or indirectly over 30% of corporate stocks and 0 otherwise. The results do not confirm the applicability of agency theory to the Russian market. Government participation in stock capital exerts no significant impact on the dividend payout ratio. These findings contribute to understanding the relationship between a company's dividend policy and its future financial performance, providing a useful tool for Russian investors.

Keywords: dividends, company, signaling theory, agency theory, profitability, state-owned companies, ownership structure

For citation: Puzakov A., Mirzoyan A., Galich A. (2024) Dividend Payments by Russian Companies: A Signal to the Market or a Consequence of Agency Conflicts? *Journal of Corporate Finance Research.* 18(1): 62-74. https://doi. org/10.17323/j.jcfr.2073-0438.18.1.2024.62-74

Introduction

A lot of stakeholders are involved in making decisions about dividend payments. They have differing and largely conflicting interests. This makes the analysis and forecasting of dividend payments difficult from both theoretical and practical points of view. Existing dividend payment theories often consider company behavior from the standpoint of developed capital markets. At the same time, the dividend policies of companies from emerging markets are often shaped by the unique factors of the latter [1]. In particular, the Russian market is characterized by significant ownership concentration, major government participation and high information asymmetry [2]. All these factors raise doubts about the applicability of conventional dividend payment theories.

The high volatility of the Russian stock market due to economic crises and heightened geopolitical risks make dividend payments a perspective tool for boosting the investment attractiveness of companies [2]. The dividend yield of the Russian market is one of the highest among emerging and mature markets [2]. Moreover, large Russian companies that seek to enhance their investment attractiveness show a steady trend towards an annual increase in dividend payments [3]. However, the economic troubles caused by different factors such as sanctions and the COVID-19 pandemic may lead the dividend policies of Russian companies to change significantly.

In the present study, we consider the Russian stock market from the point of view of two different perspectives on dividend payments: signaling theory and agency cost theory. Multiple empirical studies show that changes in dividends provide little or no information on future company income [4–8]. However, our results for the Russian market differ: using a sample of 30 Russian companies over the period 2010–2021, we partially confirm the applicability of signaling theory to the relation between dividend payments and future company profitability. Dividend changes serve as a signal of future company financial standing.

A high government share in the ownership structure of companies is characteristic of the Russian market. The government, as the controlling owner, may prefer its interests over those of minority shareholders, resulting in nonoptimal dividend payments. However, we find no confirmation of the agency theory in the Russian market: the fact of government participation[1] in stock capital has no significant impact on the payout ratio of companies.

This paper consists of three parts. The first part reviews previous studies of factors that influence corporate dividend payments and uses them to generate the research hypotheses. The second part describes the methodology of building econometric models for verifying the suggested hypotheses. The third part draws the conclusions of our empiric study.

Literature Review

M. Miller and F. Modigliani advanced the dividend irrelevance theory, which states that a company's value remains unchanged regardless of whether it pays dividends or reinvests its profits [9]. However, due to the inflexible character of its premises, the Modigliani – Miller theory has been criticized for a number of years, resulting in the development of alternative approaches: signaling theory [10] and agency cost theory [11].

In signaling theory, high dividends are considered to be a signal of the future financial performance and financial resilience of the company [12]. Several verifiable conclusions follow from signaling theory [13]. First, the market response should be positively related to the change of dividend policy: so, an unexpected increase in dividend payments should cause a rise in the stock value. Second, an increase in the profit growth rates or return on assets should follow an increase in dividend payments. Hypotheses of the first type are verified by means of event study. Hypotheses of the second type require the construction of regression models, where the dependent variable is indicators of future financial performance, while variables related to paid dividends are used as regressors.

In times of uncertainty, high dividends turn out to be a more informative signal than the profit generated by a company [14]. In periods of stability and growth, the situation is opposite: a reduction in dividends without a simultaneous stock buyback sends signals to the market, exerting a detrimental effect on stock yields [15]. Managers in foreign markets consider dividend increases as signals of profit growth [16]. I. Ivashkovskaya and E. Kukina showed a significant positive relation between the dividends paid during the preceding period and the economic profit of Russian companies [17].

Some empiric studies obtain results that contradict signaling theory: an increase in dividend payments has no impact on profit growth rates, while a reduction in dividends results in a significant increase in dividend payments over a two-year horizon [18]. At the same time, an increase in dividends signals the mitigation of corporate systematic risk, while a reduction in dividend payments signals the augmentation of systematic risk [5].

Research on dividend payments in the Russian market most often uses event studies to verify signaling theory [19–23]. The results of this verification vary depending on the methodology and period of study. For example, a paper by T. Teplova based on a sample of 24 Russian companies from 1999 to 2006 showed that the stock market responds negatively to the announcement of dividend increases in comparison with the previous period [23]. I. Berezinets et al. reveal a negative response of the Russian stock market both to positive and negative dividend "surprises" from companies over the period 2010–2014 [22]. Their earlier research confirmed the applicability of signaling theory to the Indian stock market: the positive impact of high-

[1] Government participation is understood as a situation when the government owns more than 30% of company shares.

er dividends on stock returns and the negative impact of dividend reductions [24]. The aforementioned paper by I. Berezinets et al. shows that, over the period 2010–2012, the Russian stock market responded negatively to announcements of both dividend increases and reductions. The authors attribute this to the specifics of the development and dividend policies of Russian companies after the financial and economic crisis of 2008–2009 [21]. E. Rogova and G. Berdnikova obtained results similar to those of T. Teplova: over the period 2009–2013, the Russian market responded negatively to dividend increases and positively to dividend reductions [20; 23]. Nevertheless, the response of corporate stocks to announcements of changes in dividend payments depends on the industry. While stocks of iron and steel as well as fuel and power companies respond weakly to announcements of dividend increases, the shares of chemical and mineral extraction companies (except for the fuel and power sector) show a strong negative response to dividend increases.

The ambiguity of the signal of high dividend payments is among the limitations of signaling theory: investors may regard an increase in dividends as a sign that the company has no profitable investment opportunities [24].

There is a substantial number of studies which call the applicability of signaling theory into question. Usually, large companies have sufficient financial resources to pay regular dividends to their shareholders. If signaling theory was the key factor for decisions on dividend payments, one would expect a wide range of companies to make such payments in order to transfer information to stakeholders [25; 26].

Agency cost theory posits that there exists a conflict of interests between company shareholders and management. Managers are not interested in dividend payments, because they can use funds to get personal privileges or invest in activities related to the payment of higher manager remunerations, which is often loss-making for the company [27]. A conflict of interests often increases shareholder expenses on monitoring the management's activities (agency costs). Another explanation of the conflict of interests is that the amount of manager remuneration is often related to company size, which drives managers to enlarge their company beyond its optimal size. If a company has excess funds, the management may also use them for projects with a negative net present value [28]. Dividend payments defuse the conflict by decreasing the amount of funds available for the management [29].

The conflict of interests may be partially solved by letting managers own company shares. In this case, the management becomes interested in providing a positive cash flow necessary to pay dividends, which matches the shareholders' interests. This, in turn, decreases the agency costs caused by possible conflicts of interests between the parties [30].

The greater the percent of management-owned shares, the lower the dividend payments. The greater the number of independent directors on the board, the higher the dividend payments [31]. The market highly rates the expected decrease in agency costs caused by a company's decision to pay out dividends [32].

A lot of papers studying agency theory focus on the analysis of the corporate ownership structure and its influence on the dividend policy. For example, a study of emerging markets shows that companies with major shareholders make larger dividend payments [33]. In contrast, other studies show a negative relationship between the share of majority shareholders and the amount of dividend payments, which contradicts the assumption that the largest shareholder may expropriate corporate wealth [34–36].

The presence of a principal shareholder can either defuse or exacerbate agency conflicts. On the one hand, principal shareholders are at an advantage in collecting information and monitoring the management's activity [37]; on the other, their interests may clash with those of minority shareholders resulting in the possible expropriation of the latter's resources [38]. Some studies show a positive relationship between the presence of a majority shareholder and the amount of dividend payments [39], while others find a negative relationship [40]. Thus, the application of agency cost theory can lead to contradictory conclusions.

In this way, the conclusions of previous studies are ambiguous. Signaling theory is mainly verified by means of event study, which shows the market response to dividend changes instead of the actual state of business in a company. It should be noted that a lot of studies pay insufficient attention to verifying the sustainability of attained results.

Hypotheses

In the present paper, we attempt to use signaling theory and agency cost theory to explain dividend payments in the Russian market.

Hypothesis 1: An increase (reduction) in dividend payments in comparison to the preceding period is positively (negatively) related to the future return on assets.

Changes in dividends send signals to investors about alterations in the financial standing of the company and its future prospects [26]. Companies which announce an increase in dividends signal investors that they are showing high financial performance and have good growth prospects [10].

Hypothesis 2: The presence of a principal shareholder represented by the government increases the payout ratio.

The government may place its own interests above those of minority shareholders, resulting in nonoptimal dividend payments from the point of view of the company's development [3]. At the same time, the government should be interested in getting large cash flows from the company in the form of dividend payments [34].

Data

To test the proposed hypotheses, we sourced data from Bloomberg on 30 companies from the Moscow Exchange index and the first level of the quotation list. A sample of

companies from this index may be considered representative, because the Moscow Exchange index and the first level of the quotation list comprise the largest and most liquid Russian companies. Financial companies have been excluded from the sample because of their specific rules of financial statement submission. The capitalization of the companies under consideration is over half of the capitalization of the whole Russian market. The analysis was performed over the years 2010–2021, which comprises periods of economic growth and recession as well as changes in national policy, which could also influence corporate dividend policy. See the descriptive statistics in the Appendix (Table P1).

Figures 1 and 2 show the average return on assets in the period before and after the year in which changes in dividend payments took place. When constructing the charts, we used the criterion that the amount of dividend payments changes if the annual dividend growth rate modulo exceeds 20%.

In the case of a dividend increase (Figure 2), the average return on assets grows significantly in the years following the year of dividend changes (as compared to the year before the increase). Graphical analysis suggests that the fact of dividend changes may indicate changes in the return on assets.

Figure 1. Average return on assets before and after dividend reduction

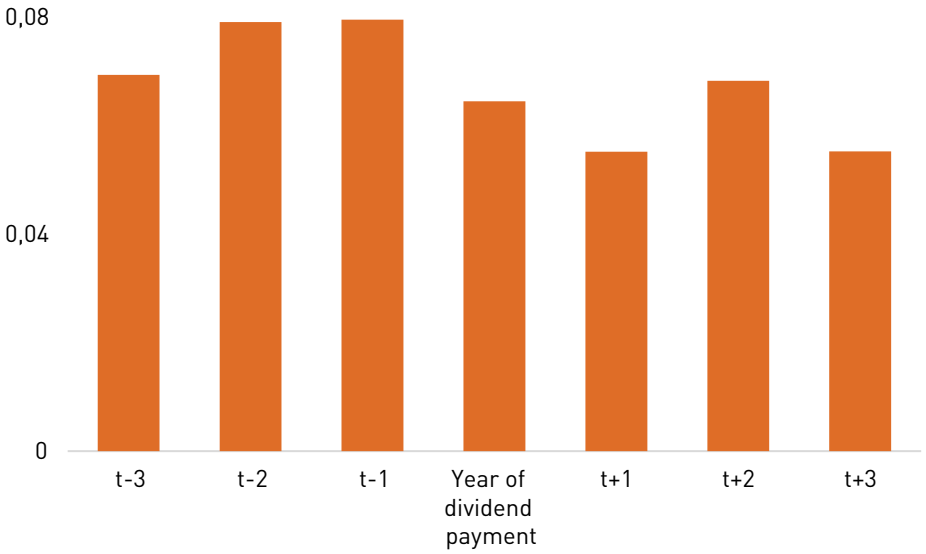
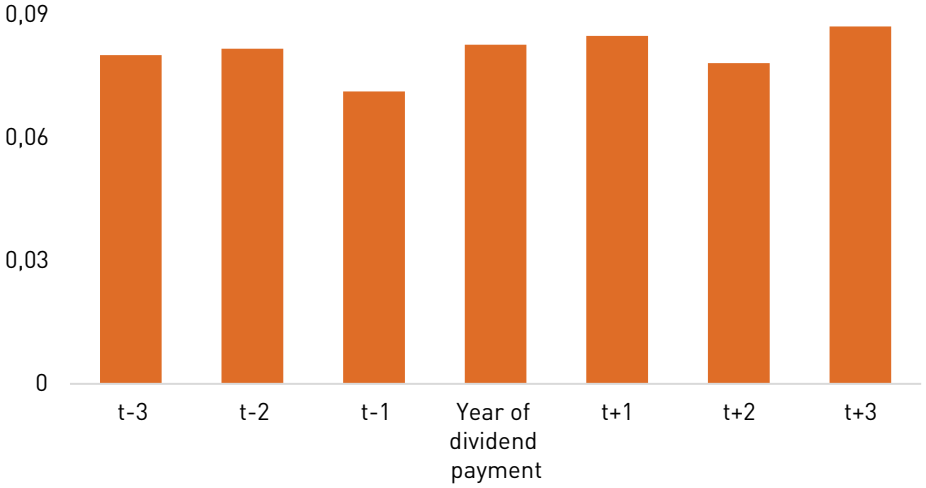


Figure 1 shows that the average return on assets decreases in the first, second and third years after the dividend payment as compared to the year before dividend reduction (t-1).

Figure 2. Average return on assets before and after dividend increase



Research Methodology

Signaling Theory

To verify the provisions of signaling theory, we evaluate the relationship between dividend changes and changes in the future return on assets of a company. We use the difference between the return on assets one year (Equation 1) or two years (Equation 2) after the dividend payment and the return on assets a year before the payment as the dependent variable. Another dependent variable is the change in the average return on assets for three years after the dividend payment in comparison to the three-year period before the payment (Equation 3). G. Grullon et al. [5] applied a similar approach to creating variables.

$$\Delta ROA_t^1 = ROA_{t+1} - ROA_{t-1} \quad (1)$$

$$\Delta ROA_t^2 = ROA_{t+2} - ROA_{t-1} \quad (2)$$

$$\Delta ROA_t^3 = \frac{1}{3}\bullet\left(ROA_{t+3} + ROA_{t+2} + ROA_{t+1}\right) - \\ -\frac{1}{3}\bullet\left(ROA_{t-1} + ROA_{t-2} + ROA_{t-3}\right). \quad (3)$$

We use binary variables representing an increase (Equation 4) or reduction (Equation 5) in dividend payments as variables of interest.

$$I_i^{increase}(k) = \begin{cases} 1, if\ r_i^{\mathrm{d}} \geq k \\ 0, r_i^{\mathrm{d}} < k \end{cases}; \quad (4)$$

$$I_i^{reduction}(k) = \begin{cases} 1, if\ r_i^{\mathrm{d}} \leq -k \\ 0, r_i^{\mathrm{d}} > -k \end{cases}, \quad (5)$$

where r_i^{d} is the growth rate of dividend payments, and k is the threshold value set at 0.1, 0.2 or 0.3, depending on the model specification.

Following [41], we assume that there is an asymmetric influence of the dividend growth rate on changes in the corporate return on assets. We further introduce indicators of positive and negative dividend growth rate, respectively:

$$r_i^+ = I_i^{\text{increase}}(0)\bullet r_i^{\mathrm{d}}(6)$$

$$r_i^- = I_i^{\text{reduction}}(0)\bullet r_i^{\mathrm{d}}. \quad (7)$$

The following specifications are used:

$$Y_{it} = \gamma_0^{(1)} + \gamma_1^{(1)}\bullet I_{it}^{\text{increase}}(k) + \sum_{n=1}^{j}\gamma_{n+1}^{(1)}\bullet z_{itn} + \varepsilon_{it}^{(1)} \quad (8)$$

$$Y_{it} = \gamma_0^{(2)} + \gamma_1^{(2)}\bullet I_{it}^{\text{reduction}}(k) + \sum_{n=1}^{j}\gamma_{n+1}^{(2)}\bullet z_{itn} + \varepsilon_{it}^{(2)} \quad (9)$$

$$Y_{it} = \gamma_0^{(3)} + \gamma_1^{(3)}\bullet r_i^+(k) + \gamma_2^{(3)}\bullet r_i^-(k) + \\ + \sum_{n=1}^{j}\gamma_{n+2}^{(3)}\bullet z_{itn} + \varepsilon_{it}^{(3)}, \quad (10)$$

where Y_{it} is a dependent variable, $\varepsilon_{it}^{(s)}$ is the normally independently distributed random variable with mathematical expectation equaling zero, and z_{itn} is the control variable n.

Signaling theory implies that a dividend increase sends a positive signal of the company's future profitability, while a reduction sends a negative signal.

This means that the coefficients $\gamma_1^{(1)}$, $\gamma_1^{(3)}$, $\gamma_2^{(3)}$ should be positive ($r_i^-(k) \leq 0$ and a reduction in dividend payments should result in a decrease of return on assets, which implies that $\gamma_2^{(3)} > 0$), while $\gamma_1^{(2)}$ should be negative.

Agency cost theory

We use a model specification similar to that of N. Ramli [33] to analyze the relationship between the dividends paid and the presence of a majority shareholder. The payout ratio is the dependent variable. As long as this parameter is non-negative, we can apply the Tobit model, in which the dependent variable cannot assume negative values. The binary variable of the presence of a majority shareholder represented by the government serves as the variable of interest. It is equal to 1 if the government owns directly or indirectly over 30% of the company's shares. We add the following control variables to the model: return on assets (ROA), company size calculated as the logarithm of total assets, company investment opportunities calculated as the ratio of the company's market value to its book value, and company debt load measured as the ratio of debt to corporate assets [33]. These variables are used in models for studying dividend payments in emerging markets [42; 43].

To test Hypothesis 2, we used the following specifications:

$$PR_{it}^* = \gamma_0^{(4)} + \gamma_1^{(4)}\bullet G_{it} + \sum_{n=1}^{j}\gamma_{n+1}^{(4)}\bullet z_{itn} + \varepsilon_{it}^{(4)} \quad (11)$$

$$PR_{it} = \begin{cases} PR_{it}^*, if\ PR_{it}^* \geq 0 \\ 0, if\ PR_{it}^* < 0 \end{cases}. \quad (12)$$

PR_{it}^*, the ratio of dividends to net profit, may assume negative values; PR_{it} is the payout ratio ($PR_{it} \geq 0$); and G_{it} is a binary variable which takes the value 1 if the government's share in the corporate stock capital exceeds 30% and 0 otherwise. For the purposes of agency cost theory, we assume that $\gamma_1^{(4)}$ is positive.

Results

Signaling theory

To test the first hypothesis, we used linear regression models with fixed effects of the company and year (models 2, 4, 6) and without them (models 1, 3, 5) (Table 1). The threshold value was set at 0.2: if the dividend growth rate exceeds 20% in a given year, we consider it as an increase in dividend payments. Before developing the models, we excluded companies which did not pay any dividends at all within the considered period. It is important to note that a dividend increase entails the growth of the return on assets in certain years (models 1–4); however, the coefficient preceding the variable of interest in model 6 turns out to be insignificant, which excludes the possibility of growth in the average return on assets within a two-year horizon.

Table 1. Regressions of changes in ROA after an increase in dividend payments

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	(2)	(3)	(4)	(5)	(6)
Dividend increase (20%)	0.027**	0.022**	0.023**	0.024**	0.018*	0.008
	(0.013)	(0.011)	(0.011)	(0.010)	(0.010)	(0.007)
Logarithm of total assets	0.001	–0.032	–0.002	–0.061**	–0.008*	–0.051*
	(0.003)	(0.023)	(0.004)	(0.030)	(0.004)	(0.027)
Ratio of liabilities to assets	0.058**	0.323***	0.054**	0.266***	–0.014	0.196**
	(0.025)	(0.065)	(0.026)	(0.080)	(0.037)	(0.084)
P/B	0.019***	0.053**	0.015	–0.013	0.022	0.018
	(0.007)	(0.021)	(0.010)	(0.017)	(0.016)	(0.019)
Constant	–0.073		–0.013		0.114	
	(0.053)		(0.066)		(0.080)	
Number of observations	265	265	236	236	149	149
R^2	0.050		0.040		0.109	
Within R^2		0.124		0.088		0.120
F-statistic	3.400***	7.858***	2.390*	4.691***	4.425***	3.825***

Note: models 1, 3, 5 are pooled regressions while models 2, 4, 6 comprise fixed effects of the company and year. Robust standard errors were employed. The P-value for the test verifying the hypothesis that fixed effects are equal to zero is less than 0.001 for models 2, 4, and 6. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

A similar threshold value is used in models for evaluating the influence of a reduction in dividend payments: if the dividends decrease by more than 20% in a given year, we consider it as a reduction in dividend payments. The results suggest that there is a relationship between a reduction in dividend payments and the return on assets for all three dependent variables (Appendix, Table P2): the coefficients preceding the variable of interest are significant in models 2, 4 and 6. The conclusions reached are consistent with the results of previous studies [44; 45].

To measure the sensitivity of the obtained results to the choice of the cutoff threshold, we developed models for k equal to both 0.1 and 0.3 (Appendix, Tables P3 and P4). The results of the fixed effects models show that the choice of the cutoff threshold does not lead to changes in the conclusions, i.e., the results are stable.

We constructed models using positive and negative dividend growth rates as the variables of interests. In all models with the dividend growth rate, we considered only companies which had paid dividends at least once within the studied period. Moreover, we excluded observations in which the annual dividend growth rate exceeded 500%. A positive dividend growth rate turned out to be positively related to changes in the return on assets in all considered models (Table 2). The coefficient preceding the variable responsible for the negative dividend growth rate is positive in models 1–5, which aligns with signaling theory: a reduction in dividends results in a decrease in the return on assets. However, these coefficients are insignificant, while the significant coefficient in model 6 is negative, which contradicts signaling theory. This result may be due to the fact that the extreme values of the dividend growth rate, which seriously influence the result, were retained in the data. When we exclude companies for which the growth rate exceeded 300%, virtually all the coefficients preceding the variables of interest turn out to be insignificant (except for the coefficient preceding the positive growth rate in model 3) (Appendix, Table P5). These results suggest that there is no stable influence of the dividend growth rate on changes in a company's return on assets.

Table 2. Regressions for changes in ROA depending on the dividend growth rate

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	(2)	(3)	(4)	(5)	(6)
Dividend growth rate$^+$	0.015*	0.018*	0.011*	0.021**	0.014**	0.021***
	(0.009)	(0.010)	(0.006)	(0.009)	(0.007)	(0.004)
Dividend growth rate$^-$	0.040	0.047	0.020	0.003	0.012	–0.042***
	(0.037)	(0.034)	(0.032)	(0.033)	(0.023)	(0.014)
Logarithm of total assets	0.006*	0.003	0.002	–0.001	–0.005	0.001
	(0.003)	(0.006)	(0.004)	(0.004)	(0.004)	(0.011)
Ratio of liabilities to assets	0.063**	0.090*	0.068***	0.111***	–0.007	0.014
	(0.025)	(0.048)	(0.024)	(0.043)	(0.037)	(0.041)
P/B	0.023***	0.049**	0.021*	0.025**	0.031*	0.058***
	(0.007)	(0.020)	(0.011)	(0.010)	(0.018)	(0.009)
Constant	–0.133**		–0.078		0.059	
	(0.059)		(0.065)		(0.081)	
Number of observations	216	216	190	190	119	119
R^2	0.064		0.055		0.161	
Within R^2		0.112		0.074		0.241
F-statistic	2.895**	4.503***	2.144*	2.446**	4.346***	5.150***

Note: models 1, 3, 5 are pooled regressions, while models 2, 4, 6 comprise fixed effects of the company and year. In the models we used observations for which the dividend growth in comparison to the previous period takes on values less than 5. Robust standard errors were employed. The P-value for the test verifying the hypothesis that fixed effects equal zero is < 0.1 for models 2 and 4 and < 0.001 for model 6. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

At the next stage we developed models using the future return on assets as the dependent variable. Information about the dividend growth rate does not enable us to predict the future return on assets: a significant influence of a reduction in dividend payments has been detected only in two models and only for the high threshold value $k = 0$. With threshold values of 0.1 and 0.2, the coefficient preceding the variable of interest differs from zero significantly only in model 2. An increase in dividend payments does not allow to forecast the future return on assets in any of the specifications (Appendix, Table P6).

The modeling results lead to the following conclusions. An increase in dividend payments results in the growth of the return on assets, while a reduction results in the decrease of the return on assets, which confirms the applicability of signaling theory to the Russian market. However, no stable relationship between the dividend growth rate and the size of changes in the return on assets was found: only the information that an increase or reduction in dividend payments exceeds the threshold value has predictive power, while the size of the changes cannot be used to forecast the change in the return on assets in future periods.

Agency cost theory

To test Hypothesis 2, we developed Tobit regression models with fixed industry and year effects (Table 3). The dependent variable – the payout ratio – shows high variance, significantly exceeding 1 for some companies. To decrease the impact of outliers, we limited the sample to values less than 5 in model 1, less than 3 in model 2, and less than 1 in model 3. We developed a separate model 4 in which all values of the payout ratio exceeding 1 are replaced with 1, and we added the limitation that 1 is the maximum value which the independent variable can take in the initial data.

The coefficient preceding the variable responsible for the return on assets in the preceding period turns out to be significant and positive: the growth of the return on assets in the current period has a positive relationship with the payout ratio in the next period. The coefficient preceding the variable of government participation is insignificant in all developed models; furthermore, the result is negative in the majority of models. Thus, Hypothesis 2 is rejected, which may be explained by the fact that the ownership structure of many Russian companies is displaced towards the presence of principal shareholders, and so the government gets no additional advantages from solving agency conflicts.

Table 3. Tobit regression for the relationship between government participation and the dividend payout ratio

	Dependent variable: dividend payout ratio			
	(1)	(2)	(3)	(4)
Constant	–0.443***	–0.541***	–1.127***	–0.776***
	(0.051)	(0.051)	(0.054)	(0.057)
Government participation	–0.146	–0.099	0.064	–0.102
	(0.106)	(0.096)	(0.059)	(0.076)
ROA_{i-1}	1.172	1.237*	1.058**	1.363**
	(0.621)	(0.562)	(0.356)	(0.452)
Logarithm of total assets	0.060	0.058	0.010	0.042
	(0.063)	(0.057)	(0.034)	(0.045)
P/B	–0.068	–0.044	0.004	–0.049
	(0.064)	(0.057)	(0.033)	(0.045)
Ratio of liabilities to assets	0.714**	0.531*	–0.078	0.522**
	(0.273)	(0.248)	(0.156)	(0.195)
Number of observations	285	283	241	291
McFadden R^2	0.099	0.106	0.195	0.142

Note: the observations have a payout ratio of less than 5 in model 1, less than 3 in model 2, and less than 1 in model 3. In model 4, all the values of the payout ratio that exceed 1 are replaced with 1. Models 1, 2 and 3 limit the values of the dependent variable to nonnegative values. Model 4 has a lower limit (≥ 0) and an upper limit (≤ 1) for the dependent variable. Fixed effects of the year and industry are added to all models. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

The obtained results are consistent with research on the Russian market by L. Alekseeva et al., who attribute the insignificant influence to the specific character of accounting within the ownership structure of principal shareholders [45]. A. Novak et al. also found no significant relationship between the amount of dividend payments and the share of government participation; at the same time, they discovered a nonlinear relationship between the share owned by the government and the amount of dividends [46]. Unlike A. Ankudinov and O. Lebedev, who demonstrated the significant impact of government presence in the corporate ownership structure on the payout ratio [47], we have detected no evidence of the applicability of agency cost theory.

Conclusion

In this study, we analyzed the applicability of two main dividend payment theories to the Russian stock market over the period 2010–2021. Our findings partially confirmed the applicability of signaling theory: changes in dividends were related significantly to changes in the return on assets in the three years following dividend changes. Unlike numerous studies [5–8] that indicate the impossibility of forecasting the future return on assets on the basis of dividend payment changes, we showed a significant influence of both the fact of an increase in dividends and the dividend growth rate on the future return on assets.

Nevertheless, stability testing of the results showed that, when companies with a dividend growth rate exceeding 300% are excluded from the analysis, the coefficients preceding the variables of the dividend growth rate become insignificant. At the same time, the relationship between the fact of an increase or reduction in dividends and future changes in the return on assets turns out to be stable. Thus, dividend payments can serve as an information signal of the future profitability of a company.

In regard to agency cost theory, we considered the influence of the presence of principal shareholders – and, in particular, government agencies – on the dividend pay-

ments of companies. We found no significant impact of government participation on the payout ratio, which argues against applying agency cost theory to the Russian market. Our results demonstrate stability in relation to the exclusion of observations with extreme payout ratio values from the sample.

The present study enhances the understanding of the relationship between dividend payments and the future financial performance of companies in the Russian market and casts the foundations for further research. Understanding the consequences of dividend policy implementation will be useful for investors taking investment decisions.

References

1. Pirogov N., Volkova N. Dividend Policy: Evidence From Emerging Markets. *Korporativnye Finansy = Journal of Corporate Finance Research*. 2009;3(4):57-78. (In Russ.) https://doi.org/10.17323/J.JCFR.2073-0438.3.4.2009.57-78
2. Abramov A.E., Radygin A.D., Chernova M.I., et al. The "dividend puzzle" and the Russian stock market. Part 1. *Voprosy Ekonomiki*. 2020;(1):66-92. (In Russ.) https://doi.org/10.32609/0042-8736-2020-1-66-92
3. Abramov A.E., Radygin A.D., Chernova M.I., et al. The "dividend puzzle" and the Russian stock market. Part 2. *Voprosy Ekonomiki*. 2020;(2):59-85. (In Russ.) https://doi.org/10.32609/0042-8736-2020-2-59-85
4. Grullon G., Michaely R., Benartzi S., et al. Dividend changes do not signal changes in future profitability. *The Journal of Business*. 2005;78(5):1659–1682. https://doi.org/10.1086/431438
5. Grullon G, Michaely R, Swaminathan B. Are Dividend Changes a Sign of Firm Maturity? *The Journal of Business*. 2002;75(3):387–424. https://doi.org/10.1086/339889
6. Farre-Mensa J., Michaely R., Schmalz M.C. Payout Policy. *Annual Review of Financial Economics*. 2014;6(1):75-134.
7. Kalay A., Lemmon M. Chapter 10 - Payout Policy. In: *Handbook of Empirical Corporate Finance*. 2008;2:3–57. https://doi.org/10.1016/B978-0-444-53265-7.50002-0
8. Chin C.L., Jais M. Bin, Sahari S. Binti. The Impact of Dividends on Future Earnings: Evidence from Malaysian Public Listed Companies. *International Journal of Academic Research in Business and Social Sciences*. 2023;13(2):1472-1488. https://doi.org/10.6007/ijarbss/v13-i2/16332
9. Miller M., Modigliani F. Dividend Policy, Growth, and the Valuation of Shares. *The Journal of Business*. 1961;34(4):411-433. https://doi.org/10.1086/294442
10. Bhattacharya S. Imperfect Information, Dividend Policy, and "The Bird in the Hand" Fallacy. *The Bell Journal of Economics*. 1979;10(1):259-270. https://doi.org/10.2307/3003330
11. Rozeff M.S. Growth, Beta and Agency Costs as Determinants of Dividend Payout Ratios. *The Journal of Financial Research*. 1982;5(3):249-259. https://doi.org/10.1111/j.1475-6803.1982.tb00299.x
12. La Porta R., Lopez-De-Silanes F., Shleifer A., et al. Investor protection and corporate governance. Journal of Financial Economics, Elsevier, 2000;58(1-2):3–27. https://doi.org/10.1016/S0304-405X(00)00065-9
13. Booth L., Zhou J. Dividend policy: A selective review of results from around the world. *Global Finance Journal*. 2017; 34:1–15. https://doi.org/10.1016/j.gfj.2017.07.002
14. Bozos K., Nikolopoulos K., Ramgandhi G. Dividend signaling under economic adversity: Evidence from the London Stock Exchange. *International Review of Financial Analysis*. 2011;20(5):364–374. https://doi.org/10.1016/J.IRFA.2011.07.003
15. Balachandran B., Krishnamurti C., Theobald M., et al. Dividend reductions, the timing of dividend payments and information content. *Journal of Corporate Finance*. 2012;18(5):1232–1247. https://doi.org/10.1016/J.JCORPFIN.2012.08.002
16. Joliet R, Muller A. Dividends and Foreign Performance Signaling. *Multinational Finance Journal*. 2015;19(2):77-107. https://doi.org/10.17578/19-2-1
17. Ivashkovskaya I., Kukina E. Economic Profit Determinants of Large-scale Russian Companies. *Korporativnye Finansy = Journal of Corporate Finance Research*. 2010;3(4):18-33. (In Russ.) https://doi.org/10.17323/J.JCFR.2073-0438.3.4.2009.18-33
18. Baker HK. Do Changes in Dividends Signal the Future or the Past. *Cfa Digest*. 1998;28:45–47. https://doi.org/10.2469/DIG.V28.N1.219.
19. Teplova T. Stock price reactions to cash dividend announcements: signaling in the Russian market before and after the crisis. *Finansovyj Menedzhment*. 2011;(1):12–30. (In Russ.)
20. Rogova E., Berdnikova G. Price reaction of the Russian stock market to companies' announcements of dividend payments. *Rossijskij Zhurnal Menedzhmenta*. 2014;12(4):3-28. (In Russ.)
21. Berezinets I., Bulatova L., Ilyina Y., et al. Russian stock market reaction to dividend announcements: empirical study. *Vestnik S.-Peterburgskogo un-ta. Menedzhment = Vestnik of Saint Petersburg university. Management*. 2015;(1):44-90. (In Russ.)
22. Berezinets I., Bulatova L., Ilyina Y., et al. Russian stock market reaction to dividend "surprises": an empirical study. *Rossijskij Zhurnal Menedzhmenta*. 2016;14(2):29–48. https://doi.org/10.21638/11701/SPBU18.2016.202
23. Teplova T. Impact of cash dividend payments on Russian companies' market capitalization: Event

study testing for Russian and world stock exchanges. Audit I finansovyj analiz 2008; (2): 1–15. (In Russ.)

24. Berezinets I., Bulatova L., Ilyina Y. Dividends announcements impact on the stock returns: evidence from the emerging market of India. *Vestnik S.-Peterburgskogo un-ta. Menedzhment = Vestnik of Saint Petersburg university. Management.* 2013;(4):3-28. (In Russ.)
25. DeAngelo H., DeAngelo L., Skinner D.J. Are dividends disappearing? Dividend concentration and the consolidation of earnings. *Journal of Financial Economics*. 2004;72(3):425–456. https://doi.org/10.1016/S0304-405X(03)00186-7
26. Denis D.J., Osobov I. Why do firms pay dividends? International evidence on the determinants of dividend policy. *Journal of Financial Economics.* 2008;89(1):62–82. https://doi.org/10.1016/j.jfineco.2007.06.006
27. Al-Malkawi H.-A.N., Rafferty M., Pillai R. Dividend Policy: A Review of Theories and Empirical Evidence. *International Bulletin of Business Administration*. 2010;(9):171-200.
28. Jensen M.C. Agency Costs of Overvalued Equity. *Financial Management.* 2005;34(1):5–19.
29. Alli K.L., Khan A.Q., Ramirez G.G. Determinants of Corporate Dividend Policy: A Factorial Analysis. *Financial Review*. 1993;28(4):523–547. https://doi.org/10.1111/J.1540-6288.1993.TB01361.X
30. Easterbrook F.H. Two Agency-Cost Explanations of Dividends. *The American Economic Review*. 1984;74(4):650–659.
31. Denis D.J., Denis D.K., Sarin A. The Information Content of Dividend Changes: Cash Flow Signaling, Overinvestment, and Dividend Clienteles. *The Journal of Financial and Quantitative Analysis*. 1994;29(4):567-587. https://doi.org/10.2307/2331110
32. Officer S.M. Overinvestment, corporate governance, and dividend initiations. *Journal of Corporate Finance*. 2011;17(3):710–724. https://doi.org/10.1016/j.jcorpfin.2010.06.004
33. Ramli N.M. Ownership Structure and Dividend Policy: Evidence from Malaysian Companies. *International Review of Business Research Papers*. 2010;(6):170-180.
34. Mehrani S., Moradi M., Eskandar H. Ownership structure and dividend policy: Evidence from Iran. *African Journal of Business Management*. 2011;5(17):7516–7525. https://doi.org/10.5897/AJBM11.468
35. Gharaibeh, M. A., Zurigat, Z., & Al-Harahsheh, K. The effect of ownership structure on dividends policy in Jordanian companies. Interdisciplinary Journal of Contemporary Research in Business, 2013; 4(9), 769- 796
36. Fedorova E.A., Komarova E.O. The Impact of Foreign Stockholders on the Dividend Policy of Russian Companies. Digest Finance. 2018;23(1):55–62. https://doi.org/10.24891/df.23.1.55
37. Shleifer A., Vishny R.W. Large Shareholders and Corporate Control. *Journal of Political Economy*. 1986;94(3):461–488. https://doi.org/10.1086/261385
38. Shleifer A., Vishny R.W. A Survey of Corporate Governance. *The Journal of Finance*. 1997;52(2):737–783. https://doi.org/10.1111/J.1540-6261.1997.TB04820.X
39. Renneboog L., Trojanowski G. Control structures and payout policy. *Managerial Finance.* 2007;33(1):43–64. https://doi.org/10.1108/03074350710715809
40. Truong T., Heaney R. Largest shareholder and dividend policy around the world. *The Quarterly Review of Economics and Finance*. 2007;47(5):667–687. https://doi.org/10.1016/J.QREF.2007.09.002
41. Jabbouri I. Determinants of corporate dividend policy in emerging markets: Evidence from MENA stock markets. *Research in International Business and Finance.* 2016;37:283–298. https://doi.org/10.1016/j.ribaf.2016.01.018
42. Elyasiani E., Jia J., Movaghari H. Determinants of dividend payout and dividend propensity in an emerging market, Iran: an application of the LASSO. *Applied Economics.* 2019;51(42):4576–4596. https://doi.org/10.1080/00036846.2019.1593315
43. Ham C.G., Kaplan Z.R., Leary MT. Do dividends convey information about future earnings *Journal of Financial Economics.* 2020;136(2):547–570. https://doi.org/10.1016/J.JFINECO.2019.10.006
44. Nissim D., Ziv A. Dividend Changes and Future Profitability. *The Journal of Finance*. 2001;56(6):2111–2133. https://doi.org/10.1111/0022-1082.00400
45. Alekseeva L., Berezinets I., Ilyina Y. Ownership Concentration and dividend Policy: a Study of Russian joint stock companies. *Vestnik S.-Peterburgskogo un-ta. Menedzhment = Vestnik of Saint Petersburg university. Management*. 2011;(3):3-31. (In Russ.)
46. Novak A.E., Silkina .S., Khvostova I.E. Empirical analysis of Dividend Policy of Public and Private Companies in Russia. *Finansy: teoriya i praktika = Finance: Theory and Practice*. 2018;22(5):90-104. (In Russ.) https://doi.org/10.26794/2587-5671-2018-22-5-90-104
47. Ankudinov A., Lebedev O. Dividend Payouts of Russian Companies against the Backdrop of Financial Crisis. *Korporativnye Finansy = Journal of Corporate Finance Research.* 2016;10(3):38–56. https://doi.org/10.17323/J.JCFR.2073-0438.10.3.2016.38-56

Appendix

Table P1. Descriptive statistics of variables

	Mean value	Standard deviation	Minimum	First quartile	Third quartile	Maximum
Government's participation	0.36	0.48	0.00	0.00	1.00	1.00
Logarithm of total assets	13.34	1.27	10.61	12.58	13.87	17.11
P/B	0.87	0.69	0.02	0.35	1.29	3.81
Ratio of liabilities to assets	0.55	0.23	0.08	0.37	0.74	1.13
ROA	0.08	0.09	-0.21	0.03	0.11	0.47
Payout ratio	0.72	1.71	0.00	0.11	0.81	23.67

Note: the government participation variable is equal to 1 if the share of stocks owned by the government or government-owned companies exceeds 30%. P/B is calculated as the ratio of company capitalization to the book value of assets. ROA is calculated as the ratio of net profits to the book value of assets. The payout ratio is determined as the ratio of dividends paid during the year to annual net profit.

Table P2. Regressions of changes in ROA after a decrease in dividend payments

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	(2)	(3)	(4)	(5)	(6)
Dividend reduction (20%)	−0.026*	−0.035**	−0.019	−0.030*	−0.011	−0.016**
	(0.015)	(0.015)	(0.014)	(0.015)	(0.011)	(0.007)
Logarithm of total assets	0.001	−0.024	−0.002	−0.055*	−0.008*	−0.050*
	(0.002)	(0.024)	(0.004)	(0.030)	(0.004)	(0.027)
Ratio of liabilities to assets	0.057**	0.326***	0.051**	0.269***	−0.017	0.198**
	(0.025)	(0.065)	(0.025)	(0.080)	(0.038)	(0.084)
P/B	0.020***	0.059***	0.016*	−0.006	0.023	0.019
	(0.007)	(0.021)	(0.009)	(0.016)	(0.016)	(0.020)
Constant	−0.054		0.004		0.127	
	(0.046)		(0.066)		(0.083)	
Number of observations	265	265	236	236	149	149
R^2	0.042		0.031		0.097	
Within R^2		0.131		0.087		0.129
F-statistic	2.821**	8.414***	1.827	4.655***	3.848***	4.156***

Note: models 1, 3, 5 are pooled regressions, while models 2, 4, 6 comprise fixed effects of the company and year. Robust standard errors were employed. The P-value for the test verifying the hypothesis that fixed effects are equal to zero is less than 0.001 for models 2, 4, and 6. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

Table P3. Change in ROA after an increase in dividends depending on the threshold value

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Increase in dividends (10%)	0.023*	0.022**	0.022**	0.022*	0.018	0.006
	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.007)
Increase in dividends (20%)	0.027**	0.022**	0.023**	0.024**	0.018*	0.008
	(0.013)	(0.011)	(0.011)	(0.010)	(0.010)	(0.007)
Increase in dividends (30%)	0.030**	0.022*	0.025***	0.022**	0.030***	0.016*
	(0.013)	(0.011)	(0.008)	(0.009)	(0.011)	(0.009)

Note: all models comprise fixed effects of the company and year. The following control variables are used: logarithm of total assets, ratio of liabilities to assets, P/B. Robust standard errors were employed. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

Table P4. Regressions of change in ROA after a reduction in dividends depending on the threshold value

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Reduction in dividends (10%)	–0.023	–0.037**	–0.023	–0.037**	–0.018*	–0.020***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.010)	(0.007)
Reduction in dividends (20%)	–0.026*	–0.035**	–0.019	–0.030*	–0.011	–0.016**
	(0.015)	(0.015)	(0.014)	(0.015)	(0.011)	(0.007)
Reduction in dividends (30%)	–0.029*	–0.027*	–0.042**	–0.043**	–0.018*	–0.016**
	(0.016)	(0.014)	(0.021)	(0.021)	(0.010)	(0.007)

Note: all models comprise fixed effects of the company and year. The following control variables are used: logarithm of total assets, ratio of liabilities to assets, P/B. Robust standard errors were employed. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

Table P5. Regressions of changes in ROA depending on the dividend growth rate

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dividend growth rate$^+$	0.021	0.019	0.012*	0.015	0.007	0.012
	(0.015)	(0.016)	(0.007)	(0.010)	(0.010)	(0.010)
Dividend growth rate$^-$	0.035	0.027	0.020	0.016	0.019	-0.019
	(0.035)	(0.036)	(0.033)	(0.032)	(0.025)	(0.029)
Number of observations	210	210	184	184	117	117
R^2	0.065		0.051		0.132	
Within R^2		0.074		0.063		0.190
F-statistic	2.857**	2.768**	1.916*	1.973*	3.363***	3.763***

Note: models 1, 3, 5 are pooled regressions, while models 2, 4, 6 comprise fixed effects of the company and year. In the models we used the observations for which the dividend growth in comparison to the previous period has values of less than 300%. The following control variables are used: logarithm of total assets, ratio of liabilities to assets, P/B. Robust standard errors were employed. The P-value for the test verifying the hypothesis that fixed effects are equal to zero is < 0.1 for models 2 and 4 and < 0.001 for model 6. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

Table P6. Regressions of ROA depending on changes in dividends

	Dependent variable					
	ΔROA_t^1		ΔROA_t^2		ΔROA_t^3	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Increase in dividends (30%)	0.005		0.009		0.010	
	(0.006)		(0.009)		(0.011)	
Reduction in dividends (30%)		–0.015**		–0.029*		–0.015
		(0.006)		(0.016)		(0.010)
Number of observations	265	265	236	236	207	207
Within R^2	0.273	0.277	0.112	0.128	0.085	0.087
F-statistic	20.904***	21.390***	6.127***	7.126***	3.891***	3.970***

Note: all models comprise fixed effects of the company and year. The following control variables are used: logarithm of total assets, ratio of liabilities to assets, P/B. Robust standard errors were employed. *, ** and *** indicate a 10%, 5% and 1% significance level, respectively.

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.75-92
JEL classification: G30, G32

Risk Premium for Emerging Market Equities Versus Developed Market Equities

Svetlana Menshchikova
Equity Research Associate, Morningstar, Inc, Amsterdam, the Netherlands,
menschikovasve@gmail.com, ORCID

Abstract

The paper provides the most recent view on the difference in ERP (Equity Risk Premiums) across various economic regions, analyzing data sets from the early 2000s to May 2023. The study demonstrates a significant shift in the relationship between ERPs in emerging and developed markets over the past two decades, which runs contrary to the existing research on the matter. The author estimated the average ERPs per country and economic region, analyzed ERPs on the industry level, and conducted the regression analysis using macroeconomic factors and analysis of upside and downside betas. The research established that, following the 2008 economic crisis, developed markets displayed greater resilience to negative economic shocks. Moreover, investing in emerging markets entails higher risks, characterized by elevated negative beta and higher volatility, but also increased upside beta. The regression analysis revealed negative associations between ERP and higher GDP growth and local interest rates, while a positive correlation emerged with a higher unemployment rate. Additionally, the paper incorporates the Democracy Index, indicating that less democratic countries tend to exhibit higher ERPs.

Keywords: ERP, emerging markets, developed markets, composite index, macroeconomic factors, democracy index, upside beta, downside beta, volatility, return

For citation: Menshchikova S. (2024) Risk Premium for Emerging Market Equities Versus Developed Market Equities. *Journal of Corporate Finance Research.* 18(1): 75-92. https://doi.org/10.17323/j. jcfr.2073-0438.18.1.2024.75-92

Introduction

Investors from all over the world know that one of the key fundamentals which they should seek is diversification. Diversification does not only entail holding various asset classes but also a distribution of the portfolio by geography and industry. The most difficult part here is investing in countries other than the investors' country of domicile due to the existing preference towards domestic investment. Among the biases are greater understanding and trust in the local market, easier access to information, local currency, interest rates, etc. However, A. Arnott [1] shows that the correlation of emerging markets with the United States (US) is less than for developed markets, which provides the reason for international diversification. Diversification through emerging markets could provide benefits, but this paper attempts to analyse the historical performance of Equity Risk Premium (ERP) in emerging and developed markets and its potential as a suitable strategy for investors to use their capital in emerging markets. The existing literature on the ERP puzzle and the difference between emerging and developed markets is quite exhaustive, however, most of the widely cited papers examine market performance from its origin to the early 2000s. The above-mentioned paper states that emerging markets on average outperform developed markets, although there are more risks associated with the former. Since the early 2000s, financial markets have been changing rapidly, experiencing market crashes, transitioning to different stages, undergoing structural changes, facing natural disasters. pandemics, and information technology revolution. From the beginning of the 21st century until 2023, the top performing and biggest companies have transformed completely. Thus, an update of the research is needed, and new means of analysis are required.

Hereinafter, the research focuses on finding the differences between emerging and developed markets' ERP in 2001–2023 and providing empirical evidence for the possible future strategies for investment in emerging markets. The research uses statistical and econometric tools to examine the returns and ERPs. Firstly, monthly ERP is calculated for the aggregated indices by economic region and by individual country, taking into account the structural market changes over the last twenty-two years. After that, the research tests the hypothesis of the unequal magnitude of positive and negative market movements in emerging and developed countries, and provides a possible explanation of the recent atypical performance of emerging markets and suggests a strategy for future investors. Having split the data by the timeframes, i.e., market downturns and ascents. the analysis demonstrates a particular market's performance in the past and suggests future implications. Moreover, the analysis focuses on the main local macroeconomic factors which may influence ERP dynamics and serve as a sign to advance for international investors. Political events, integrated into the analysis by using the Democracy index, are also considered an additional factor in the regression model. As a third point in the research, sector composition is analysed. Some cited papers suggested that prior to the 21st century markets focused on geographical factors more than on industry factors, however, the situation had changed in the developed markets in the early 2000s. It is suggested that due to the major changes in the leading industries, as well as to overall globalisation, emerging markets could also be influenced more significantly by industry-specific factors, rather than by local economic factors. It logically refers to the Information Technology sector, which is the best-performing sector over the last decade in every market in the world.

Literature review

ERP is considered a puzzle in the global economy since it brings questions and challenges for investors who try to pursue investment strategies with geographical diversification. Traditional modern financial theories, such as the Capital Asset Pricing Model (CAPM) and Efficient Market Hypothesis (EMH) are used to explain ERP, but the magnitude of differences across different markets remains unclear. The very first appearance of ERPs in literature is usually dated to 1924 and E. Smith [2], who analysed the returns and concluded that the equity is expected to yield higher returns compared to other asset classes. Afterwards, J. Williams [3] and his followers M. Gordon and E. Shapiro [4] established and expanded the perspective on risk premiums as a discounting element in the discounted cash flow formula, serving as compensation for the risks undertaken by investors. At the same time, other research studies by the Cowels Foundation examined S&P returns, provided monthly estimates of stock returns back to 1871 and opened up opportunities for future research on stock prices and ERPs in particular [5]. The exploration of historical long-term ERP in the US market in the late 20th century was done by several notable researchers who estimated historic average ERPs. This research was conducted by R. Ibbotson and R. Sinquefield [6], who were the first to split the returns into risk-free and risky parts and analyse the returns for equity and debt over the period from 1926 to 1974. The researchers found that the average yearly return for stocks was 10.9% over the examined period and 8.8% after adjusting for risk and inflation. They also noted that stocks outperformed all other assets in the study Moreover, they suggested that stocks are rather volatile, using the example that while most of the time equity stayed positive, in 1974 there was a period of –26.4% yearly average return, whereas bonds showed the minimum at –2.1% in 1965–1969. Notably, right after the above-mentioned study, Ibbotson and Sinquefield published an extension, where they provide the forecast of the returns for 1976–2000. Using risk premium assessment models, they forecast inflation-adjusted equity returns to be lower than government bonds returns due to high volatility of equities [6]. Among other famous research studies that provided an estimation of historical ERPs in the US market is J. Siegel [7], who reported an average real equity return from 5.7% in 1802–1870, 6.6% in 1871–1925 and 5.7% in 1926–1990., while noting that short-term government bond returns dropped 5.1, 3.1 and 0.5% in the same respective periods confirming the view of expanding ERP. R. Shiller in 1989 reported the average ERP of 5.75% for the period from 1871 to 1999 [8], R. Mehra-Prescott – 6.92% for the

1889–2000 [9]. For other developed markets apart from the US, the research was not that extensive, however, in 1991 [7] offered an extensive study on ERP, which included the average ERP for the UK as 4.6% during 1947–1999. J. Campbell [10] conducted research for other leading economies, such as Japan, estimating the ERP at 3.3% in 1970–1999 and Germany, with the ERP of 6.6% in 1978–1997. R. Mehra and E. Prescott [11] provided the evidence for France, estimating the ERP for 1973–1998 at 6.3%. E. Dimson et al. [12] reviewed the ERP for the US, the UK and Italy in 1900–2002 and reported them on average as 5.3%, 4.2% and –2.1% respectively. O. Blanchard et al. [13] performed the dynamic analysis for 1930–1990 and concluded that equity premiums were decreasing steadily from the 1950s and in the 1980s, constituting around 2–3% for the US data. Most of the research studies used the difference between stock returns and returns on selected risk-free assets, which are usually Treasury Bills for the US and short-term government bonds for other countries. After researchers calculated and compared the ERP, they started to look for an answer to why the ERP exists. The first to raise a question regarding the ERP puzzle were [14] R. Mehra and E. Prescott, authors showed that standard consumption models failed to explain the equity premium given that models suggest high levels of risk aversion (from concept of risk-aversion coefficients [15]), which is certainly not the case in actual observed equity risk premiums. For the research authors used Standard & Poor's Composite Index, real dividends for the index for equity returns calculation and ninety-day Treasury Bills with an explored period of 1889–1978 annualised data and consumption deflator and later calculated the difference between equities and Treasury Bills. In 2003 the same researchers went further [11], analysing the puzzle and suggesting that the explanation may lie in specific market frictions, borrowing constraints, and the role of uncertainty. J. Siegel and R. Thaler [16] suggested a view that the equity premia puzzle might be not a puzzle, but high ERP could be explained by investors' aversion to small negative shocks and could be considered a fair price for that. Almost simultaneously, G. Bekaert et al. [17] explored the development of emerging markets and the transformation of equity premiums there. Authors found that more advanced economic development positively affects the risk profile of the assets on the market, however, emerging markets experience higher returns, which are explained by higher risks and greater opportunities for investors to exploit mispricing and other market inefficiencies. Other researchers examined the determinants of country-level equity beta for developed and emerging markets, comparing equity risk premiums and factors that may drive equity returns. Among the factors studied are macroeconomic variables (Gross Domestic Product (GDP) growth, interest rates, exchange rates), financial market factors (market liquidity, market volatility, and stock market size), country-specific factors (legal and regulatory frameworks, political stability, investor protection, and corporate governance practices), industry exposure of a particular market [18]. Another interesting conclusion is reached by G. Bekaert et al. [19]. It states that emerging markets indeed have higher equity premiums, but when a market becomes more liberalized (transparent, accessible, and efficient), equity premiums converge. The research was developing extensively by exploring various economic factors explaining the equity premiums, and W. Ferson and C. Harvey [20] used GDP growth, inflation, interest rates, and exchange rates to explain the differences in equity returns across the countries and to predict future returns. This offers hope that the equity premium puzzle may be solved using an extensive model that includes macroeconomic variables and country specifics.

In support of the importance of ERP studies, European Central Bank published ERP research for the Euro zone [21] for France, Germany, Italy, Spain and the Netherlands, providing ERP dynamics through an intertemporal CAPM using returns dependent on market risk and the risk of changing investment opportunities. The results of the research provide that the Euro zone market is highly integrated, and the incorporated risks are significantly priced in.

The differences between emerging and developing markets in terms of returns are widely studied, and most of the researchers agree that emerging markets provide higher equity returns, but it is true only prior to risk adjustment. S. Claessens et al. [22] were one of the first studies indicating the specifics in equity returns in emerging markets. There some anomalies noted: short-time series of available information, many small companies, tax policies, economic and political regime changes. All the above-mentioned factors might contribute to ERP that appeared to be less correlated with developed markets than developed markets among themselves. Another commonly accepted idea is that emerging markets are in constant transformation, and some sorts of frictions, despite the vagaries, may provide higher premiums for investors. The main idea for the current paper is taken mostly from the [23], where emerging market premiums are studied through the prism of timeframes, economic cycles, and structural shifts. The main outcome of the paper is that the authors advise focusing on high uncertainty associated with emerging markets, and equity returns in emerging markets, which exceed those in developed markets, are highly dependent on the specific timeframe chosen for analysis. Studies in the field of investigation and prediction of equity premiums in emerging markets were gaining momentum in 2010s as increasingly more papers explored the role of economic cycles and investor behaviour. discovering that these factors led to higher equity premiums. However, not only macroeconomic factors may explain the differences in equity premiums in emerging and developed markets. M.A. Hooker in 2004 suggested enriching the model developed by M. Cremers [24] with financial variables: Price-to-book, Price-to-earnings, size, in addition to traditional macroeconomic variables, GDP growth, local interest rate, local currency exchange rate, local inflation rate and equity beta. Through the model's framework, the author concluded that macro variables are insignificant except for exchange rate, while financial variables (except for equity beta) play a bigger role in explaining emerging markets equity returns [25]. Some papers also tried to focus on a particular economic sphere to get to the truth. In addition to economic conditions, which

should be considered while assessing equity premiums, industry-specific factors might be incorporated in the models as well as firm-level factors (financial performance, management quality, growth prospects) [26]. Some authors segregate the returns by particular industry to compare between countries and market types. In 2021, a group of researchers presented a multifactor model to study the equity returns of the banking industry in Pakistan, and M. Donadelli and L. Persha [27] studied 19 emerging countries to calculate the contribution of industrial stocks to equity premia paid between 1995 and 2014. The paper studies the country-level and industry-by-industry level of ERPs, separating the timeframes of the crisis period (1995–2002) and the post-crisis period (2003–2012). The authors found that during the examined period the biggest premia creators for Asian countries are the healthcare and the utilities sectors and for Latin and East European markets the consumer services sector. Moreover, the paper shows that industrial stock markets significantly correlated within and across countries, which may cause struggles in investor diversification strategies.

For the current research, the focus will be on estimating ERPs in emerging and developed markets for the purpose of comparison of recent data with previous research and providing the updated view on ex-ante ERPs, indicating potential future trends. Moreover, the analysis of the ways in which macroeconomic factors can contribute to the ERPs, given the recent market events such as the 2008–2009 crisis and the 2020–2021 COVID-19 pandemic. In addition, a comparison of the each industry's ERPs will be examined in order to observe which industries drive the index returns.

Data and sources

Most of the studies in the ERPs sphere use Morgan Stanley Capital International (MSCI), as it provides various indices for emerging and developed markets. In the current research, MSCI indices are used for one part of the analysis. Monthly returns including companies with large and medium capitalisation in selected developed and emerging countries' indices are used together with MSCI's proprietary indices: G7, World, and Emerging Markets (EM). All indices include large and medium-capitalisation companies across various industries. The datasets for all countries are available for the whole explored timeframe except for the United Arab Emirates index, which was established in 2005 and the Saudi Arabia index, which was established only in 2014. Thus, for the whole studied data frame of monthly data, the analysis has 106 observations for Saudi Arabia, 217 for the United Arab Emirates and 270 observations for all other countries.

For the second part of the analysis, Standard and Poor's (S&P) indices will be used, as the company provides the emerging and developed markets indices for specified sectors/industries. In particular, S&P offers information on the following industry segments: communication services, consumer discretionary, consumer staples, energy, financials, health care, industrials, information technologies, materials, utilities and real estate (Table 1).

Table 1. S&P indices constituents (countries). As of June 2023

Indices emerging countries			Indices developed countries	
Brazil	Saudi Arabia	Kuwait	Canada	Australia
Chile	South Africa	Poland	France	South Korea
China	Taiwan	Philippines	Germany	Belgium
Colombia	Turkey	Greece	Italy	Sweden
India	The UAE	Hungary	Japan	Ireland
Malaysia	Indonesia	Czech Republic	The UK	Netherlands
Mexico	Thailand	Egypt	The US	New Zealand
Peru	Qatar	Pakistan	Switzerland	Israel
			Denmark	

All S&P indices are compiled using a float-adjusted market cap weighted method and rebalanced annually with additional adjustments for IPOs.

To calculate the ERP, the standard historical method is used by deriving the difference between total monthly index returns and 13-week Treasury Bills.

$$ERP_t = Return_t - Tbill_t .$$

For macroeconomic information, datasets from the Organisation for Economic Co-operation and Development (OECD) and International Monetary Fund (IMF) were used. Despite the fact that the OECD provides plenty of macroeconomic data, and main indicators are available on a monthly basis, some emerging markets countries lack this basic statistic, so the analysis will be conducted for the following countries (Table 2).

Table 2. List of countries for the macroeconomic analysis

GDP growth	CPI	Unemployment	Industrial production	Overnight local rate	Long-term local rate	Local currency rate to USD
Brazil	Brazil		Brazil		Brazil	Brazil
Chile	Chile	Chile		Chile		Chile
China	China				China	China
Colombia	Colombia	Colombia	Colombia	Colombia	Colombia	Colombia
France	France	France	France	France	France	France
G7	G7		G7			
Germany	Germany	Germany	Germany	Germany	Germany	Germany
India	India		India		India	India
Italy	Italy	Italy	Italy	Italy	Italy	Italy
Japan	Japan	Japan		Japan	Japan	Japan
Mexico	Mexico	Mexico	Mexico	Mexico	Mexico	Mexico
Saudi Arabia	Saudi Arabia					
South Africa	South Africa				South Africa	South Africa
Turkey	Turkey	Turkey	Turkey	Turkey		Turkey
United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom	United Kingdom
United States	United States	United States	United States	United States	United States	

The macroeconomic parameters used further in the research were downloaded on a monthly basis, except for GDP growth, which was taken on a quarterly basis and extrapolated.

In order to test the market influence of political regimes on the magnitude of ERP Democracy index from Economist Intelligence Unit (EIU) is used for 2006–2022 years.

It is also important to note that further analysis will be conducted based on historical data and to list possible biases. In his literature review on ERP for CFA Institute, J. Siegel delineated three possible biases in historical data for ERP [7]. Survival bias for the US stocks as this market tends to be the **most** successful throughout the entire history, however, this bias dates back to a long time ago in 1995. Since then the other markets grew substantially and there were also several turbulent periods in the world which showed that the other countries' performance could be comparable to that of the United States [28]. Another bias defined is the presence of transaction costs, regulation, and taxes (especially given the analysis of different countries, each with its specifics). The third bias is the unanticipated repricing of equities which states that historical returns may be overpriced given the changed preferences of the investors [29].

Hypothesis

After a review of literature, it remains unclear whether investing in emerging markets can still provide investors with what they are looking for: diversification and returns that are higher than in developed markets (as stated in earlier research); it could be tested by simply following the correlation between emerging and developed markets indices for the beginning of the tested period and the end. However, the correlation may not be sufficient to make a conclusion about investment strategies in emerging and developed markets. The ERP may be a good indication for a certain period, but the economic cycles and structural changes in the two recent decades have challenged both market types, so the question arises: are emerging or developed markets more resilient? Do the ERPs remain high for a longer period, and which countries are the winners? In the times of the great market turbulence in 2008–2009 and 2020, which markets were the best for providing positive returns for investors? All these questions open up a field for additional research, and the following hypothesis will be tested.

1) In [23], the average ERP for emerging markets was 0.65% higher than for developed markets during the analysis of pre-2001 data. Presumably, the same holds for the 2001–2023 timeframe.
   - The average ERP prior to 2008 was higher than the average ERP after 2008.
   - The average ERP prior to 2020 was higher than the average ERP after 2020.
2) In terms of the CAPM model, the upside beta for emerging markets is lower than the downside beta (which drives the average ERP for emerging markets

down) in absolute values. The hypothesis is tested with the regression analysis comparing upside and downside betas.

3) Weaker local currency rate, higher local interest rate, higher inflation rate and higher unemployment could explain higher the ERP on a country-specific level [25]. The test uses the regression model with the countries' ERP as the dependent variable and macroeconomic variables as independent variables.
4) Increasing political risks and autocratic regimes could explain the higher ERP. The hypothesis is tested using the regression analysis with the countries' ERP as the dependent variable, and the Democracy index as the independent variable.
5) Industry composition could play an explanatory role in the higher ERP in developed markets [27]. The hypothesis is tested with a comparison of mean standard deviation and the Sharpe ratio for emerging and developed markets' industries.
6) The emerging markets are better priced according to P/E (Price-to-earnings) ratio in 2023 than in 2001. The hypothesis is tested comparing the P/E ratio for the World index and the EM index in 2001 and 2003.

ERP research

Emerging and developed markets, ERP comparison

In the first part of the empirical analysis, the average ERP was calculated for the two groups of countries and composite indices of the World (top 25 the biggest world economies), G7 and Emerging markets for the period from 2001 to May 2023 using monthly returns in US dollars and T-bills. Over the last twenty-two years there were several financial market events that were clearly reflected in the analysis below. Firstly, 2001 was a difficult year for the US market due to the September 11 attacks, following which the market was closed for four days and major indices fell after re-opening. Some markets outside of the US also suffered issues due to the difficulties with US dollar transaction settlements, resulting in a 12% decline of the MSCI World Index. However, the recovery went smoothly and before the end of 2001 the markets almost gained back the previous losses [30]. Another event that should be taken into consideration is the Katrina and Rita hurricanes in 2005 in the US, which influenced investors' behaviour and hence the equity returns. P. Gangopadhyay et al. [31] showed in their research that Katrina caused a negative response from the market. The 2007–2009 crisis in the US had a major impact on every economy in the world with an almost 40% drop to 2006 values in world indices. Researchers note that the emerging markets suffered greater value destruction than developed ones [32]. Another major event to be taken into account is the Fukushima Daiichi accident in Japan in 2011, which had a negative impact on the returns of nuclear energy firms all around the world [33]. The Sovereign Debt Crisis in Europe in 2010–2011 could have also been a disturbance point for equity returns at that time. In 2020 the world was struck with the COVID-19 pandemic, which was a great disruption for equity returns in all markets with the highest levels of market volatility [34].

Considering all the above-mentioned events in the course of the last twenty-two years, we would expect changes in the ERPs for emerging and developed markets. Many 20th-century studies offer the evidence that emerging markets demonstrate a more dramatic decline in returns (from historical maximums) during the crises than developed markets and also are slower to recover [35]. This evidence might be a guide for the current research as risk-adjusted ERP could be seen as a proxy for market performance over a sample period. In the beginning, ERPs are analysed over the entire twenty-two-year period, and it is clearly seen that standard deviations for the **emerging** markets (for the composite index as well as for individual country-indices) are 2.5% higher than for the **developed** markets on average, and the EM index is 1.64% more volatile than World index and G7 index (Table 3) (the average is not the same as composite because the countries have different weights in the composite index). However, the average monthly ERP in USD is 0.10% lower for emerging markets than for World and G7. Although, if averaging ERP across analysed individual countries, it reaches 0.84% for emerging countries, but only 0.42% for developed ones. These results are partly consistent with the examined literature and specifically with the research conducted by R. Salomons and H. Grootveld [23] in regard to ERPs prior to 2001. It therefore partly supports out first hypothesis, namely, that ERP in emerging markets stays higher than in developed markets on average, however, in recent years it decreased in absolute terms compared to previous research, and the composite index for emerging markets performs poorer than developed countries' indices. The difference between the research results for years prior to 2001, and the current research for the twenty-two years prior to 2021 is clearly seen in the changed magnitude of the standard deviation for both emerging and developed market groups. The results obtained by R. Salomons and H. Grootveld [23] demonstrate a 0.3% higher average standard deviation for developed countries and indices, and an almost 4% higher one for emerging countries and indices. This could be a sign of emerging markets' development over the last twenty-two years in terms of lower volatility and hence lower risk. The ERPs decreased by 0.08% during the sample period (2001–2023) for developed markets and almost 0.4% lower for emerging. This result is logical given the lower risk calculated using a lower standard deviation. The most significant contributors to the standard deviation in R. Salomons and H. Grootveld paper [23] paper were Argentina (25.13%), Brazil (15.72%) and Venezuela (13.49%), however in later years in the current research we observe that Brazil remained the main contributor with 10.25%, which is still much lower than the research data (Argentina and Venezuela were excluded from the list of emerging market countries by MSCI in 2021 and 2006, respectively). Nevertheless, individual emerging markets continue to earn high

ERPs above 1% (Brazil, Columbia, Peru, India), while in developed countries the maximum ERP is only 0.6% and is that of the US. In terms of the Sharpe ratio, Peru, Columbia and India have the best profiles, followed by the US. This provides an indication that emerging markets could be considered as reasonable investment even after the two extremely volatile decades, however, investors are advised to be scrupulous when allocating their capital to emerging markets and focus on the specific country's performance.

The main market crashes of the last two decades were already mentioned; subsequently the ERP analysis is divided into four periods. Firstly, the period prior to September 2008 is analysed to study the ERPs prior to the greatest market crash in latest history. Secondly, the period from September 2008 to the end of 2010 is examined to see how ERPs performed during the crisis and recovery period. Thirdly, the timeframe from 2011 to March 2020 is analysed to compare the recovered returns after 2008 but before the COVID-19 pandemic. Lastly, the last three turbulent years are explored.

Contrary to the results of the above-mentioned analysis, in 2001-2008 ERPs of developed markets represented by the World and G7 indices were scoring negative numbers, whereas the EM index stayed positive. Moreover, on average, emerging countries reached an ERP of 1.6%, while developed ones were only at 0.25%. Volatility also did not differ significantly between EM, World and G7 indices (5.4%, 3.9% and 3.8% respectively). The best Sharpe ratios are also those of emerging countries, with an average 0.2, and maximum values of 0.4 in Columbia and Peru, whilst in developed countries the average Sharpe is 0.03, with a maximum of 0.08 in Germany (Table 3). This evidence supports the views presented in [23] and can be explained by the potential held by emerging markets before the 2008 market crash.

The second analysed period refers to the time during the market crash in 2008 and up until 2010 (market recovery). In general, the picture is more or less the same if we observe individual countries' returns, with emerging markets scoring an average of 1.65% ERP, while developed countries – only 0.08%. However, the composite EM index is negative for that period, while World and G7 stayed positive (the ERP of the composite index differs from that of the average because of the weights of each country). Volatility increased significantly (twofold on average compared to the previous analysed period). Sharpe ratios are the best for Chile (0.3), Columbia (0.3) and Malaysia (0.3), while for developed markets Sharpe is around 0.01 (Table 3).

The period after market recovery from the 2008 crisis is characterised by major changes in ERP configuration across analysed markets. All volatility decreased, and surprisingly, developed markets start to gain higher ERPs for the first time since Salomons and Grootveld's research timeframe [23] and for the current research starting 2010. The developed countries now have an average 0.54% ERP and emerging countries – only 0.12%, while the average volatility for developed markets is 4.6%, and emerging ones – 6.4%. Hence it is clear that after the 2008 market crash emerging markets lost their privilege of scoring higher returns and offering a decent risk profile. Since 2010, Sharpe ratios equaled 0.02 for emerging and 0.13 for developed countries, with the US at 0.3. These results might indicate that due to weaker institutes, emerging markets did not endure the pressure of the 2008 market crash and stopped providing diversification opportunities to the investors (Table 4).

The results for the period between March 2020 and June 2023 are quite puzzling. Over these three years, developed and emerging markets indices performed similarly – with an average ERP of 0.86% for the EM, 0.93% for the World and 0.96% for the G7 indices. However, looking at the ERP of individual developed countries, the US was in the lead with a 1.2% average monthly ERP and a 0.2 Sharpe ratio. Among the emerging countries the same pattern with highest Sharpe ratio of 0.21 was demonstrated by Saudi Arabia, which performed poorly in the previous analysed period (it should be noted that the Saudi Arabia index was launched only in 2014). The second-best emerging countries were Mexico, Taiwan and India with a 0.18 Sharpe ration, but higher ERPs of 1.52%, 1.23% and 1.44% respectively (Table 4).

Summing up the above-described research, the results suggest that emerging markets used to outperform the developed markets. This tendency was suggested by previous research for the historical data before the early 2000s. However, after the market crash in 2008 only certain emerging countries continue to outperform developed ones. After 2010, when developed markets recovered from the downturn, emerging markets lost their positions, and in the most recent three years developed markets showed much better risk-adjusted returns than emerging markets. Considering all the above-mentioned dynamics, it is difficult to say whether investors should continue to invest in emerging markets, as there are some countries that significantly outperformed developed markets as well as some of the emerging markets' countries, but there are still some markets which significantly underperformed. Given that developed markets proved themselves as faster in recovery after market crashes, the strategy of sticking to only developed markets is still reasonable and can earn decent returns. Thus, investors might use this evidence while building their portfolios nowadays, taking into account the market conditions and analyzing which markets are expected to perform better in such conditions. If the market is rising, emerging markets could gain higher ERPs than developed countries, but diversity might be the key as while the market crash emerging markets might suffer more than developed ones.

Moreover, the above-mentioned correlation as an additional measure of possible diversification benefits of investing in emerging and developed markets demonstrates interesting results. The correlation between the emerging market MSCI index and the G7 MSCI index appeared to be 67% on the dataset prior to 2002 and 93% from 2002 to 2023. This could be a good indication that diversification benefits have deteriorated during recent years. Such deterioration could be caused by globalization and integration trends between worldwide markets.

Table 3. Developed & emerging market ERPs

	2001–2023			2001–2008			2008–2010		
Industry	**Mean (%)**	**StDev (%)**	**Sharpe**	**Mean (%)**	**StDev (%)**	**Sharpe (%)**	**Mean (%)**	**StDev (%)**	**Sharpe**
Developed:									
World	0.3	4.5	0.07	0.0	3.9	−0.01	0.1	7.5	0.01
G7	0.3	4.5	0.07	−0.1	3.8	−0.03	0.1	7.2	0.01
US	0.6	4.5	0.13	0.0	3.9	−0.01	0.4	6.9	0.05
UK	0.3	4.9	0.07	0.3	3.9	0.06	0.2	8.1	0.03
Japan	0.3	4.5	0.06	0.0	4.6	0.00	0.2	6.3	0.03
Italy	0.3	7.0	0.05	0.3	5.1	0.06	−0.6	11.0	−0.05
France	0.5	6.1	0.08	0.3	5.3	0.07	0.0	10.0	0.00
Germany	0.5	6.8	0.07	0.6	6.7	0.08	0.3	10.3	0.03
Emerging:									
Emerging index	0.2	6.17	0.03	0.2	5.4	0.03	−0.4	10.3	−0.04
Chile	0.6	6.9	0.09	1.3	5.9	0.22	2.4	8.0	0.30
Brazil	1.1	10.3	0.11	2.4	10.8	0.22	1.3	11.8	0.11
Colombia	1.4	9.0	0.16	3.5	8.9	0.39	2.9	10.3	0.28
Mexico	0.9	6.8	0.13	1.6	6.1	0.26	1.3	10.3	0.13
Peru	1.4	8.2	0.17	2.7	7.8	0.35	3.2	13.0	0.24
China	0.7	7.5	0.10	1.4	8.3	0.16	1.1	9.2	0.12
UAE	0.3	9.0	0.04	-0.2	11.8	−0.02	−1.7	13.7	−0.13
South Africa	0.8	7.4	0.10	1.4	7.3	0.20	2.0	10.3	0.19
India	1.0	7.7	0.14	1.6	7.9	0.21	1.9	12.4	0.16
Malaysia	0.4	4.9	0.08	0.8	5.2	0.16	2.0	6.4	0.31
Saudi Arabia	0.5	6.1	0.08	–	–	–	–	–	–
Taiwan	0.8	7.0	0.12	0.6	7.9	0.08	1.6	10.1	0.16
Turkey	0.9	12.3	0.07	2.0	15.5	0.13	1.8	13.6	0.13

Table 4. Developed & emerging market ERPs

	2010–2020			2020–2023		
Industry	**Mean %**	**StDev %**	**Sharpe**	**Mean %**	**StDev %**	**Sharpe**
Developed:						
World	0.5	3.6	0.15	0.9	5.6	0.16
G7	0.6	3.5	0.17	1.0	5.7	0.17
US	1.0	3.5	0.29	1.2	5.9	0.20
UK	0.3	4.3	0.08	0.7	5.8	0.12
Japan	0.5	3.8	0.12	0.5	4.8	0.11
Italy	0.4	6.6	0.06	1.1	8.3	0.13
France	0.6	5.0	0.12	1.1	7.1	0.16
Germany	0.5	5.5	0.09	0.7	7.4	0.10

Industry	2010–2020 Mean %	2010–2020 StDev %	2010–2020 Sharpe	2020–2023 Mean %	2020–2023 StDev %	2020–2023 Sharpe
Emerging:						
Emerging index	0.2	5.1	0.05	0.9	6.9	0.13
Chile	–0.5	6.3	–0.08	1.1	9.2	0.12
Brazil	0.1	9.0	0.01	0.8	11.2	0.07
Colombia	–0.1	7.0	–0.02	0.0	12.2	0.00
Mexico	0.0	5.6	–0.01	1.5	8.4	0.18
Peru	0.1	6.2	0.02	0.7	9.6	0.08
China	0.5	5.9	0.09	-0.4	8.4	–0.05
UAE	0.8	6.7	0.12	1.0	6.9	0.15
South Africa	0.1	6.4	0.02	0.6	8.3	0.07
India	0.3	6.1	0.05	1.2	6.9	0.18
Malaysia	0.0	4.2	–0.01	-0.3	4.9	–0.05
Saudi Arabia	0.0	6.2	0.01	1.2	5.9	0.21
Taiwan	0.7	4.6	0.16	1.4	7.9	0.18
Turkey	–0.4	9.0	–0.04	0.9	10.8	0.08

Research on upside and downside betas for emerging and developed markets

It is widely believed that investors treat negative and positive returns differently even if they have the same magnitude. R. Salomons and H. Grootveld [23] notice that ERP distribution is neither symmetrical nor normal, so it is not fair to look only at the standard deviations, as positive and negative returns contribute differently to the overall ERP. The current research undertakes to check whether the market risk for individual countries is different. The data suggests that emerging markets have a higher positive ERP than developed markets, but at the same time – a significantly higher negative ERP during the "only-negative" return time (Table 5). To further understand the nature of the differences in ERP for emerging and developed countries and to outline possible future developments for the investors, market betas are estimated. The International Capital-Asset-Pricing-Model (CAPM) is the extension of the regular CAPM. The original CAPM was introduced and developed in 1961–1962 by Treynor, Sharpe, Lintner and Mossin, and was widely used in financial research [36], however, it was not factoring market integration. In 1983 ICAPM was suggested assuming complete market integration [37], finally in 2012 ICAPM for partially integrated markets was suggested, and in their research, authors derived that local factors are crucial for ERP in emerging markets; meanwhile, in developed markets ERP mostly depends on global factors [38]. Inspired by the above-mentioned research, our second hypothesis states that emerging markets may perform at their lowest during turbulent times due to higher local market risk estimated through the beta. At the same time, higher ERP of emerging markets compared to developed markets when financial markets in a state of growth could also be driven by the local factors reflected in local beta. The estimation relies on performing regressions of country-specific indices on the World index, with all data provided by MSCI. The regressions allow to estimate the upside and downside betas to estimate the risk level associated with positive and negative index movements. The following regressions were run [39]:

$$Return_{country} = \alpha + \beta_{upside} \cdot Return_{world} + \varepsilon, if\ Return_{world} > 0$$

$$Return_{country} = \alpha + \beta_{downside} \cdot Return_{world} + \varepsilon, if\ Return_{world} < 0.$$

Table 5. Developed & emerging market ERPs (2001–2023), only positive or negative returns

Industry	Only positive Mean %	Only positive StDev %	Only negative Mean %	Only negative StDev %
Developed:				
World	3.2	2.5	–3.9	3.5
G7	3.1	2.5	–3.9	3.4

	Only positive		Only negative	
Industry	**Mean %**	**StDev %**	**Mean %**	**StDev %**
Developed:				
UK	3.5	3.0	–3.9	3.4
Japan	3.4	2.8	–3.6	3.0
Italy	5.1	4.4	–5.6	4.8
France	4.6	3.6	–4.9	4.2
Germany	5.0	4.0	–5.5	4.8
Emerging:				
Emerging	4.4	3.6	–5.1	4.4
Chile	5.7	4.2	–5.1	4.5
Brazil	8.3	6.3	–7.6	6.7
Colombia	7.0	5.5	–7.0	6.4
Mexico	5.1	4.0	–5.3	5.1
Peru	6.6	5.2	–6.1	5.5
China	5.5	4.7	–6.2	5.2
UAE	6.4	6.4	–6.3	6.2
South Africa	5.8	4.2	–6.0	5.1
India	6.0	5.1	–5.5	5.2
Malaysia	3.8	3.0	–3.8	3.3
Saudi Arabia	4.5	3.7	–5.1	4.0
Taiwan	5.5	4.8	–5.1	4.3
Turkey	9.6	8.1	–9.3	7.5

Table 6. Estimation of market betas for 2001–2023

	Beta	Upside beta	Downside beta		Beta	Upside beta	Downside beta
Developed:				**Emerging:**			
G7	0.98	0.98	0.98	Emerging index	1.27	1.36	1.19
US	0.96	0.95	0.97	Chile	0.92	1.14	1.08
UK	0.97	1.04	0.92	Brazil	1.48	1.55	1.60
Japan	0.73	0.60	0.80	Colombia	1.09	1.19	1.28
Italy	1.27	1.45	1.13	Mexico	1.15	1.10	1.32
France	1.22	1.31	1.12	Peru	0.98	1.09	1.09
Germany	1.36	1.47	1.30	China	1.01	0.92	1.10
				UAE	0.92	0.81	1.29
				South Africa	1.15	1.18	1.14
				India	1.10	0.94	1.09
				Malaysia	0.63	0.77	0.73
				Saudi Arabia	0.65	0.59	0.73
				Taiwan	1.03	0.88	1.12
				Turkey	1.49	1.81	1.24

Based on the analysis of the proposed hypothesis of emerging markets having a higher magnitude of negative returns than positive, this hypothesis is only partly confirmed. Nevertheless, most of the individual emerging countries, i.e., Brazil, Columbia, Mexico, China, the UAE, India, Saudi Arabia and Taiwan (eight out of thirteen analysed) indeed have a higher downside than upside beta (and most of them have a higher downside beta than regular beta). However, the emerging index (EM) generally shows a higher upside beta in contrast with most of the analysed individual countries (Table 6). Additionally, it is important to note that not only most of emerging countries and the EM have a beta above one, but so do Italy, France and Germany, although the upside beta for these countries is higher than the downside. In general, the result of the empirical analysis of the beta suggest that investing in emerging markets could potentially bring higher returns and that the magnitude of positive returns could be higher than that of the negative returns. However, diversification is the key here given the performance of individual emerging countries that could bring more negative than positive returns to one's portfolio. To illustrate the result clearly, Figure 1 demonstrates the expected returns per country (calculated using the Security Market Line formula) with estimated regular, upside and downside betas, which are calculated using the CAPM formula. For the expected returns, the latest monthly risk-free rate and world return are used. The highest return is achieved by Turkey with downside beta. Moreover, it is clearly seen that emerging markets have higher dispersion between estimated betas, whereas in developed markets downside and upside beta values are close to each other.

Figure 1. Monthly expected returns (vertical axis) per country (area) using estimated betas

Moreover, to assess whether the average returns are aligned with betas. Realised return on the vertical axis and upside (downside) beta on the horizontal axis show the dependent relationship between these variables. Additionally, the orange line is the Security Market Line (SML) calculated using the CAPM formula. The yellow dots are countries, however, for the sake of simplicity they were divided into only emerging (E) and developed (D). For the upside beta is known from the theory that the portfolios (markets) above the SML line are undervalued, earning returns above market with the same risk level, while those below are undervalued. It is apparent that developed markets tend to be closer to the line, which can be explained by fairer valuation, whereas emerging markets are greater distances from each other and the SML (Figure 2).

Constructing the same chart for the downside beta (Figure 3), the same tendency is observed: developed markets are less dispersed across the chart than emerging markets and the downside beta chart looks denser than the one for upside beta. The main outcome provided by the charts is that for both downside and upside betas the developed markets showed results that are closer to the theoretical market line, while the emerging markets deviated.

Figure 2. The graph presenting realised monthly return and Security Market Line using upside betas. "E" – emerging countries, "D" – developed countries

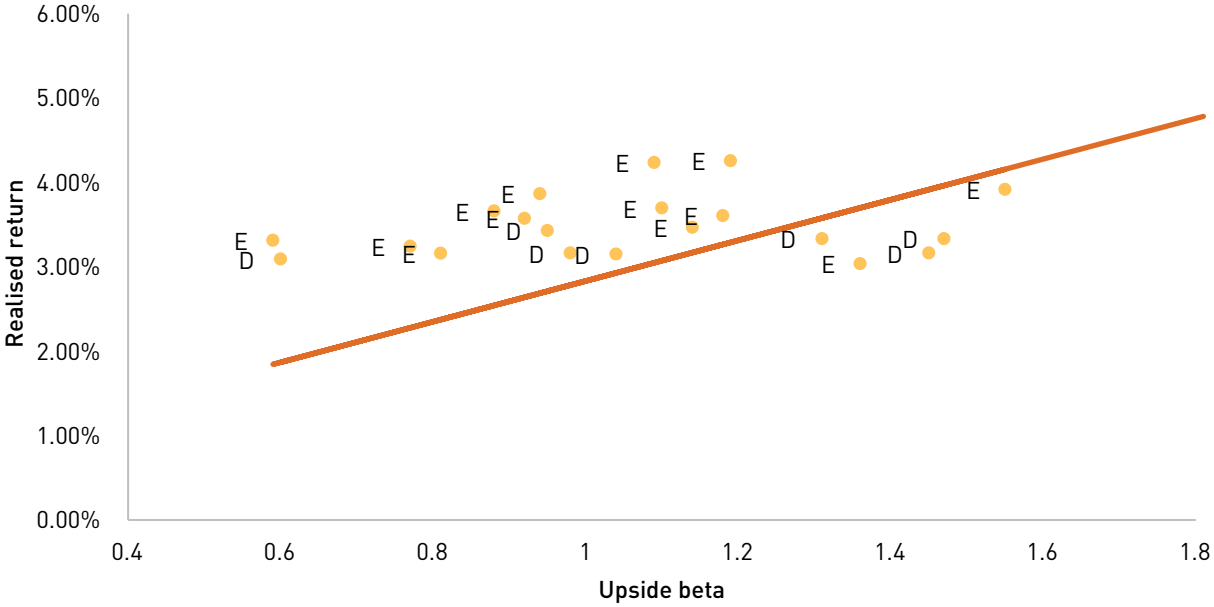
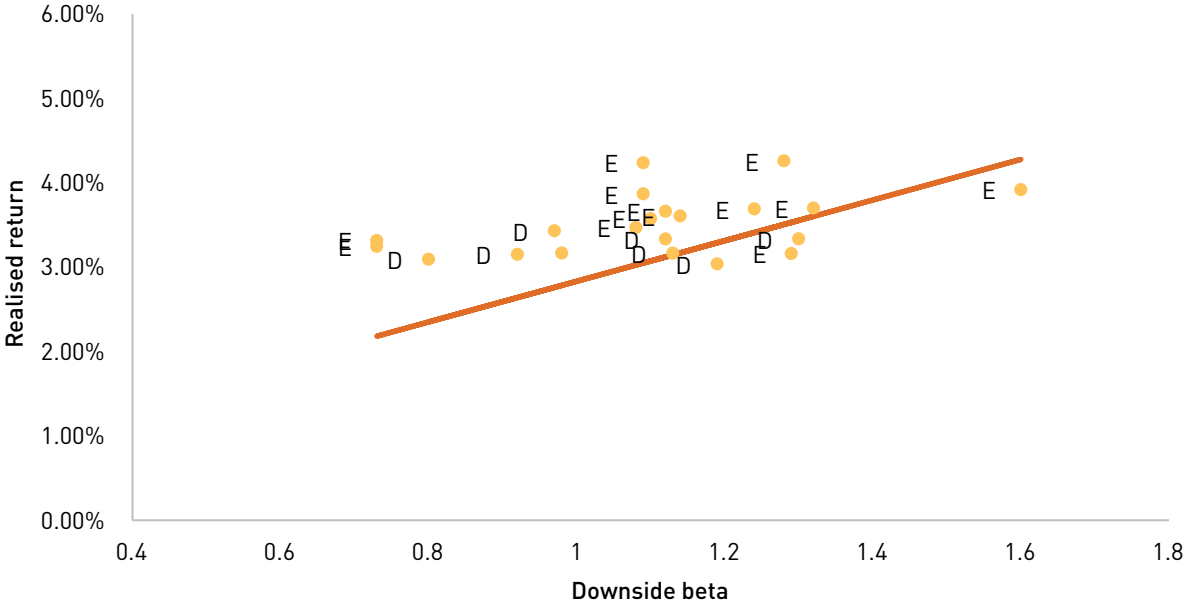


Figure 3. The graph presenting realised monthly return and Security Market Line using downside betas. "E" – emerging countries, "D" – developed countries



Emerging and developed markets and macroeconomic factors affecting ERPs

Macroeconomic variables are not often factored into the ERP analysis probably due to the commonly considered gap between macroeconomic and financial data. Most of the widely used macroeconomic factors are published on a yearly basis, usually in the end of 1st quarter of the year following the reporting year. This may not be useful in the analysis of financial market data such as returns or ERPs, as they change much quicker and macro variables could not be explanatory in this case. However, some macro variables are published on a monthly basis and could be taken into consideration in ERP research over a longer timeframe (twenty-two years). In this case, macroeconomic variables could be used to explain structural market changes. In the current research we consider commonly used variables: GDP growth, local long-term interest rate, local inflation rate, industrial production in a share of GDP, and unemployment rate. These factors aim to reflect the state of the local economy, capturing all major economic indicators which are used to assess if the economy is in distress or in recovery. Panel data regression analysis is performed with the dependent variable of the country's ERP for the period and above-mentioned independent variables of macroeconomic factors for the same period. Moreover, in some regression model specifications, such as Arellano Bond lagged ERP for the preceding period, are added to the independent variables. The analysed timeframe is from 2001 to 2023

with monthly data consisting of 1,587 country-months. Panel data always includes unobserved effects that could be captured by using random or fixed effect regression models. It is presumed that the chosen dataset would have fixed effects expressed through country-specific factors that are not captured by included variables. These factors could include political state, trade conditions, fiscal policy, local currency rate changes, and other market-specific factors in every country. The fixed effect method is suitable for smaller number of countries and controls for country heterogeneity. Moreover, time effects might be present as there's a high probability of having autocorrelation in ERPs, so the regression equation in this case would be:

$$ERP_{i,t} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{i,t}^k + Z_i + W_t + U_{i,t}.$$

Where $ERP_{i,t}$ is the ERP of country i in month t, β_0 is a constant in the regression equation, $_k$ is a vector of regression coefficients, $X_{i,t}^k$ – vector of k independent macroeconomic variables (GDP growth, local inflation rate, local long-term interest rate, industrial production in share of GDP, unemployment rate) over i countries and t months, Z_i – unobserved country-fixed effects, W_i – unobserved time effects and $U_{i,t}$ the vector of regression errors. To determine whether the proposition of fixed effect model setup is suitable for the dataset, the following tests are conducted:

Firstly, F-test with H_o: fixed effects are not significant ($Z_i = 0$). The hypothesis is tested by including all countries in the model as dummies and getting F-statistics = 1.09 of and P-value = 0.37 > 0.05. For the dataset, the hypothesis is rejected, which means $Z_i \neq 0$ and fixed effect are present.

Secondly, Breusch-Pagan LM test H_o: random effects are not significant (Variance of $Z_i = 0$). The hypothesis is tested; χ^2 is close to 0 and P-value = 1, which means the hypothesis is not rejected, $Var(Z_i) = 0$ and this supports the hypothesis that unobserved effects are fixed.

Thirdly, F-test with H_o: time effects are not significant ($W_i = 0$). The hypothesis is tested by including all time periods in the model as dummies and obtaining F-statistics = 0.67 of and P-value = 0.73 > 0.05. For the current dataset the hypothesis is rejected, which means that $W \neq 0$ and time effect are present.

Additionally, heteroskedasticity and autocorrelation magnitude are tested. Wald test with H_o: variations for all countries are the same. The hypothesis is rejected (and $\chi^2 = 338$ and P-value = 0, which supports the presence of heteroskedasticity across country observations; robust standard errors are used to overcome this issue. Arellano-bond test for autocorrelation is used with H_o: no autocorrelation. The hypothesis is rejected due to the presence of 1st order autocorrelation. To manage this issue, the lags of 1 period will be used.

Using the results of the test mentioned above, a dynamic Arellano-bond panel regression model with fixed effects, lags of one, and robust errors are used.

Table 7. Regression results for macroeconomic factors

	Arellano-Bond		Arellano-Bond, robust		Arellano-Bond, robust	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
ERP (lag-1)	–0.199	0.000*	–0.199	0.000*	–0.199	0.000*
Inflation	0.006	0.056*	0.006	0.212	–	–
GDP growth	–0.005	0.000*	–0.005	0.000*	–0.005	0.000*
Industrial production	–0.002	0.031*	–0.002	0.105	–	–
Long-term rate	–0.046	0.000*	–0.046	0.016*	–0.040	0.034*
Unemployment	0.021	0.000*	0.021	0.000*	0.025	0.000*
Constant	–0.445	0.209	–0.445	0.367	–0.025	0.798

In the regression analysis it is apparent that the biggest significant influence on the ERPs is a long-term local interest rate with a negative coefficient of –0.046 and unemployment rate with a positive coefficient of 0.02. This result is somewhat puzzling and could suggest that the growth of local long-term interest rate by 1% would be reflected in local monthly ERPs by a decrease of 0.05%, which may be explained by the rising risks associated with higher long-term rates. The small magnitude, in turn, may be explained by the currency difference given that the ERP is in the US dollars, and local interest rate is in the local currencies. However, higher unemployment could bring additional ERP of 0.02% which may be driven by higher risks associated with labour market instability and a decrease in production. The local inflation rate is not significant for ERP variance in the chosen model setup. Moreover, GDP growth negatively affects ERP with a 1% increase in GDP growth could decrease ERP by an average of 0.006% (Table 7). This empirical evidence supports the third hypothesis, but contradicts (Hooker, 2004), which claims that macroeconomic factors do not significantly affect ERPs.

Rising political risks and autocratic regimes could explain higher ERP

To examine the hypothesis that political regime could influence ERP, this research uses the Democracy index for 2006–2022, provided by the EIU. The index is calculated by the researchers using a score from 0 to 10. The five categories are "electoral process and pluralism, functioning of government, political participation, political culture, and civil liberties," and they are translated into four political regime types: "full democracy", "flawed democracy", "hybrid regime" or "authoritarian regime" [40]. Some papers suggested using the index of estimated political risks [41], however, the Democracy index suggested by EIU accounts for a wide range of factors when attributed, so it might be a sufficient alternative measure of political risks.

Panel regression is used to determine the influence of the higher democracy score on the ERP in examined countries, returns are adjusted on a yearly basis as the index is adjusted yearly. The examined dataset comprises 209 country-years.

$$ERP_{i,t} = \beta_0 + \beta_1 X + Z_i + W_i + U_{i,t}.$$

Where $ERP_{i,t}$ is the ERP of country i in month t, β_0 is a constant in the regression equation, β_1 is a regression coefficient, X – independent variable (Democracy index) for i countries and t months, $\varepsilon_{i,t}$ the vector of regression errors. Z_i – unobserved country-fixed effects, W_i – unobserved time effects, and $U_{i,t}$ – the vector of regression errors. The results of all the above-mentioned tests for the macroeconomic regression allow to conclude that the Arellano-Bond regression should be used with fixed and time effects prerequisites.

Table 8. Regression results for the Democracy index

	Coefficient	P-value
ERP (lag-1)	–0.045	> 10
Democracy index	–0.029	< 10
Constant	0.209	< 5

Regression results suggest higher Democracy index negatively affects ERP levels decreasing yearly ERP by 0.02% when the index increases by 1 (Table 8). Such an event could be explained by the lower risks associated with investing in the countries a with higher Democracy index. The regression result supports the stated hypothesis, namely, that political risks could explain higher ERP.

To form an integrated conclusion, a regression of ERP and macroeconomic and political factors was conducted. The Democracy index was added to the model of macroeconomic factors like inflation, GDP growth, industrial production, long-term interest rate and unemployment, which was already reviewed above. However, the time frame was reduced to 2006–2022 due to data restrictions of the Democracy index. The tests for such a model pointed to using the Arellano-bond regression model with fixed and time effects. The results suggest that signs of the coefficients for macroeconomic factors remained the same as in the individual model (Table 7), however industrial production is no longer significant. The Democracy index also preserved the negative sign, although its absolute value is now higher, which may point to the fact that, combined with macroeconomic factors, the Democracy index as a political factor has higher explanatory power of ERP variance. The results support the results of the previous analysis, namely, that a higher Democracy index decreases the ERP, but the an increase of 1 in the index decreases the ERP by almost 0.1% (Table 9).

Table 9. Regression results for combination of macroeconomic factors and Democracy index

	Coefficient	P-value
ERP (lag-1)	–0.267	<5
Inflation	0.007	>10
GDP growth	–0.006	<5
Industrial production	–0.001	>10
Long-term rate	–0.046	<5
Unemployment	0.022	<5
Democracy index	–0.078	<10

The intuition behind the hypothesis is that the countries that are moving towards higher democracy levels might experience the lowering of their indices' ERPs, however, in fact, for most of the countries the Democracy index has decreased over the last sixteen years. Together with the negative sign of the regression coefficient, this leads us to conclude that a lowering Democracy index increases ERP due to higher risks. This conclusion is supported by the analysis of the latest ERPs in developed countries compared to emerging that due to poorer performance during a crisis on the financial markets developed countries (which are assumed to have a higher Democracy index: the average index for emerging countries was 5.9 in 2006 and 8.2 for developed, in 2022 the average was 5.7 for emerging, and 8.2 for developed) earned higher ERPs on average, even though during the times of positive returns the ERP for emerging was higher.

Sector composition difference and its influence on ERPs

A different economic sector composition might be a factor explaining the differences in ERP across emerging and developed countries. The paper by Donadelli and Persha [27] mentioned in the literature review tries to find industries that contribute the most to ERP in different markets, but the paper analysis is based on the time frame up until 2002 since at that time there was a major change in industries' performance across the world [27]. Another research study suggests that in the late 20th century there was a prevalence of country-related factors that drove returns in developed countries, however, in in the year 2000 it changed, and sec-

tor-related factors became more important for investment strategies due to greater globalisation. However, for emerging markets, the results of the paper suggested a higher importance of country-related factors [42]. In the current research economic sector composition is assessed using S&P sector-split indices.

The last ten-year monthly ERP (based on total returns) constructed from S&P indices demonstrates that the financial sector occupies the largest share (20%), whilst the second-largest sector is Energy (14%), and Information Technology (IT) has only the third largest share in the emerging markets index (12%). In terms of performance, the top industry is IT with 1.2% ERP, while Financials and Energy shows only around 0.3% ERP. In developed markets' performance, IT sector is the best-performing throughout the last decade with 1.46% ERP, and the developed market index has the greatest exposure to this sector at 20%. According to S&P global data, Information Technology was the best-performing industry over the last 10 years, outperforming the global index as a whole and the closest competitor (Health Care with 0.8% ERP) twice, scoring an average of 1.43% ERP over the last decade, The exposure to the IT sector is the biggest for the global index and for developed markets. Hence, it could be considered the possible explanation of the difference in ERP between emerging and developed markets. It could also suggest the reason why ERP in the examined period in the emerging markets is more than two times lower than ERP for developed and global markets. Emerging markets have a smaller exposure to the IT sector; however, it has been the best-performing sector over the last decade.

Another possible explanation of emerging markets' underperformance could be their higher exposure to the Energy sector with a 14% share of the total, whereas developed markets are exposed only by 4%, and the global index – by 7%. The energy sector is the one of the worst performers over the last decade for all three index groups; the only sectors that demonstrated worse performance are the Real Estate sector in developed (0.37% ERP) and global markets (0.30% ERP). while Communication Services (–0.17% ERP) and Consumer Staples (–0.20% ERP) performed worse in emerging markets. Moreover, the Energy Sector is the most volatile sector for emerging, developed, and global indices with the highest standard deviation across other sectors.

The hypothesis in the current analysis suggests that sector exposure could explain the differences in ERP for emerging and developed markets. The tables above allowed us to prove that higher exposure to the IT sector for developed markets could have brought higher returns over the last decade, and the otherwise higher exposure of emerging markets to the energy industry could negatively affect the emerging markets' ERP. Thus, it could be possible that with the same industry composition (i.e., same sector weights) the ERP should be similar for emerging and developed markets. To test this hypothesis, the sector weights for developed countries are applied to emerging countries, subsequently, the mean ERP for emerging markets reaches 0.4%, which is higher than 0.3% that results from using the sectors' actual weights in emerging countries. This result can suggest a conclusion that it is not only industry composition which plays its role in emerging markets' ERP, but also the performance of specific companies, although sector composition weight could bring up to 0.1% additional ERP.

Comparison of market pricing based on Price-to-Earnings analysis

The analysis above does not indicate a clear strategy towards investing in emerging markets because the performance was different through analysed timeframes and across countries. However, there is one more tool that can help to identify possible future strategies for investors. Price-to-earnings (P/E) multiple is well known for its simplicity and quickest approach to comparing assets and evaluating future opportunities. The average P/E for MSCI World index in 2001 was around 25x, 14x – for MSCI EM (emerging markets), and in 2023 the numbers have changed to 18x for the World index and 12x for the EM. The valuation might be an indication of the relatively low price of emerging markets requested by the market compared to the price of the World index. However, in twenty-two years the World index lost more value than the EM even given the results above, and in recent turbulent years developed markets showed higher returns. Summing up, this analysis could be a good indication for a future investor's strategies given the extensive comparison of developed and emerging markets and presenting a possible explanation of the ERPs. Emerging markets outperformed before 2008, when the first worldwide financial crisis hit after the technological rise of the early 2000s. After the shock, emerging markets were recovering much slower than developed markets, and even providing with a higher magnitude of positive returns for investors, negative periods contributed massively to driving down the average estimates. Investing in developed countries could be a good strategy for a long-term investment horizon, which could be considered relatively safe, and it could be expected that every new market turbulence would be survived by the developed countries. The emerging markets can be a potential investment direction, but the analysis suggests that certain emerging countries could perform very differently from others, so in order to pursue investing it is reasonable to carefully choose the specific country considering the macroeconomic, political and financial factors and the industry specification.

Conclusion

The research pursued the aim of providing a refreshed analysis of the ERP matter and examining existing differences in historical ERP in emerging and developed markets. Firstly, the research covered the existing international literature related to ERP studies and reviewed the timeframes, approaches, and results suggested by widely cited papers. The main outcome of the literature review is that most of the papers demonstrate the results for the historical time frame prior to the early 2000s, which leads

to conclude that the market has changed dramatically, and the research might not reflect recent market conditions. The outcomes of most of the papers suggest that emerging markets earn higher ERP than developed markets. Analysing datasets for indices' ERPs by country and aggregated by region, the research focused on providing up-to-date information for the last twenty-two years of financial markets' performance. Examination of six hypotheses by means of statistical analysis yielded the following results: emerging markets were outperforming developed ones until the 2008 market crisis. After 2010, when the developed market showed strong recovery signs, emerging markets were still earning negative ERPs with high levels of volatility, making investing in emerging indices unfavorable. However, country-level indices for certain countries, such as Columbia, Peru, and Mexico, performed decently over the entire analysed period and demonstrated one of the highest ERPs throughout the whole analysed sample of emerging and developed markets. Nonetheless, an analysis of beta supported the idea of emerging markets being riskier investment because of higher downside beta than upside. Additionally, upside and downside betas showed that most emerging countries have a higher downside than upside beta, which points out to investors that during distressed times emerging markets decline lower than they increase over developed markets during the market boom.

Industry composition analysis suggested that a higher exposure to the Information Technology sector of developed markets compared to emerging provides better ERPs since this sector performs better than any other (using the average ERP over the last ten years). And having a higher share of the Energy sector of emerging markets compared to developed ones drives ERPs down, with the Energy companies performing the worst in the last decade across the globe.

Macroeconomic factors certainly influence country-specific ERPs which were tested using an econometric dynamic regression with fixed effects. The results are puzzling given the negative effect of higher GDP growth and the positive effect of a higher unemployment rate on ERP. Moreover, higher local interest rates negatively affect ERPs. Having linked the Democracy index to the regression model, the authors concluded that the average democracy levels in the developed countries remain the same over the examined period, however, for the emerging countries they are slightly lowered. Given the reverse dependency between the ERP and democracy levels, it might be expected that the ERP in emerging markets could increase in the future if democracy levels are lowered.

For the concluding remarks on the research and providing the possible forecast for investment strategies, P/E ratios were compared for the World index and the Emerging markets index. The ratios suggest that both developed or emerging markets are better priced nowadays than twenty-two years ago, however, the World index dropped significantly lower than EM index relative to 2001 ratios. The research supports the idea that emerging markets cannot be considered a perfect strategy for yielding higher returns, since developed markets perform usually perform better and recover faster during turbulent times, however in financial markets undergoing the growth stage, emerging markets could provide higher ERPs.

References

1. Arnott A. *Is International Diversification Necessary?* Morningstar; 2022. URL: https://www.morningstar.com/portfolios/is-international-diversification-necessary (accessed on 03.09.2023)
2. Smith E. L. *Common Stocks as Long Term Investments.* New York: Macmillan; 1924. 129 p.
3. Williams J. B. *The Theory of Investment Value.* Cambridge MA: Harvard University Press; 1938. 613 p.
4. Gordon M.J., Shapiro E. Capital Equipment Analysis: The Required Rate of Profit. *Management Science.* 1956;3(1):102-110.
5. Cowles A. *Common Stock Indexes 1871-1937.* Bloomington, Ind: Principia Press; 1938. 499 p.
6. Ibbotson R.G., Sinquefield R.A. Stocks, Bonds, Bills, and Inflation: Simulations of the Future (1976-2000). *The Journal of Business.* 1976;49(3):313-338.
7. Siegel J.J. The Equity Premium: Stock and Bond Returns Since 1802. *Financial Analysts Journal.* 1992;48(1):28-38.
8. Shiller R. J. *Market Volatility.* London: The MIT Press; 1989. 478 p.
9. Mehra R., Prescott E.C. The equity risk premium: A solution? *Journal of Monetary Economics.* 1988;22(1):133-136.
10. Campbell J.Y. Asset prices, consumption, and the business cycle. In: *Handbook of Macroeconomics.* 1999;1(C):1231-1303.
11. Mehra R., Prescott E.C. The equity premium in retrospect. In: *Handbook of the Economics of Finance.* Vol. 1. Elsevier Science; 2003. pp 889-938.
12. Dimson E., Marsh P., Staunton M. *Triumph of the Optimists: 101 Years of Global Investment Returns.* Princeton: Princeton University Press; 2002. https://doi.org/10.1515/9781400829477
13. Blanchard O.J., Shiller R., Siegel J.J. Movements in the Equity Premium. *Brookings Papers on Economic Activity.* 1993;(2):75-138. https://doi.org/10.2307/2534565
14. Mehra R., Prescott E.C. The equity premium: A puzzle. *Journal of Monetary Economics.* 1985;15:145-161.
15. Friend I., Blume M.E. The Demand for Risky Assets. *The American Economic Review.* 1975;65(5):900-922.

16. Siegel J.J., Thaler R.H. Anomalies: The Equity Premium Puzzle. *The Journal of Economic Perspectives*. 1997;11(1):191-200. https://doi.org/10.1257/jep.11.1.191

17. Bekaert G., Harvey C.R., Lundblad C.T. Emerging Equity Markets and Economic Development. *Journal of Development Economics*. 2001;66(2):465-504.

18. Yartey C.A. The Determinants of Stock Market Development in Emerging Economies: Is South Africa. *IMF Working Paper*. 2008: 2008/032.

19. Bekaert G., Harvey C.R., Lundblad C.T. Equity Market Liberalization in Emerging Markets. *Journal of Financial Research*. 2003;26(3):275-299.

20. Ferson W.E., Harvey C.R. The Risk and Predictability of International Equity Returns. *Review of Financial Studies, Society for Financial Studies*. 1993;6(3):527-566.

21. Cappiello L., Maddaloni A., Lo Duca M. Country and industry equity risk premia in the euro area: an intertemporal approach. Working Paper Series 913, European Central Bank. 2008. https://doi.org/10.2139/ssrn.1108311

22. Claessens S., Dasgupta S., Glen J. Return Behavior in Emerging Stock Markets. *The World Bank Economic Review*. 1995;9(1):131–151. https://doi.org/10.1093/wber/9.1.131

23. Salomons R., Grootveld H. The equity risk premium: emerging vs. developed. *Emerging Markets Review*. 2003;4(2):121-144. https://doi.org/10.1016/S1566-0141(03)00024-4

24. Cremers M.K. Stock Return Predictability: A Bayesian Model Selection Perspective. *The Review of Financial Studies*. 2002;15(4):1223-1249.

25. Hooker M.A. Macroeconomic factors and emerging market equity returns: a Bayesian model selection approach. *Emerging Markets Review*. 2004;5(4):379-387. https://doi.org/10.1016/j.ememar.2004.09.001

26. Klapper L.F., Love I. Corporate governance, investor protection, and performance in emerging markets. *Journal of Corporate Finance*. 2004;10(5):703-728. https://doi.org/10.1016/S0929-1199(03)00046-4

27. Donadelli M., Persha L. Understanding emerging market equity risk premia: Industries, governance and macroeconomic policy uncertainty. *Research in International Business and Finance*. 2014;30:284-309. https://doi.org/10.1016/j.ribaf.2013.09.008

28. Dimson E., Marsh P., Staunton M. Worldwide equity premium: a smaller puzzle. In: Mehra R., ed. *Handbook of the equity risk premium*. Elsevier; 2008. pp. 467-514

29. Siegel L.B. The Equity Risk Premium: A Contextual Literature Review. *Capital Markets: Asset Pricing & Valuation eJournal*. 2017:158258339. https://doi.org/10.2139/ssrn.3088820

30. Cohen B.H., Remolona E.M. Overview: financial markets prove resilient. *BIS Quarterly Review*. 2001. URL: https://www.bis.org/publ/r_qt0112a.pdf (accessed on 03.09.2023)

31. Gangopadhyay P., Haley J.D., Zhang L. An Examination of Share Price Behavior Surrounding the 2005 Hurricanes Katrina and Rita. *Journal of Insurance Issues,* 2010;33(2):132-151.

32. Bartram S.M., Bodnar G.M. No place to hide: The global crisis in equity markets in 2008/2009. *Journal of International Money and Finance*. 2009;28(8):1246-1292. https://doi.org/10.1016/j.jimonfin.2009.08.005

33. Lopatta K., Kaspereit T. The cross-section of returns, benchmark model parameters, and idiosyncratic volatility of nuclear energy firms after Fukushima Daiichi. *Energy Economics*. 2014;41:125-136. https://doi.org/10.1016/j.eneco.2013.10.006

34. Shaikh I. Impact of COVID-19 pandemic disease outbreak on the global equity markets. *Economic Research-Ekonomska Istraživanja*. 2021;34(1):2317-2336. https://doi.org/10.1080/1331677X.2020.1863245

35. Patel S.A., Sarkar A. Crises in Developed and Emerging Stock Markets. *Financial Analysts Journal*. 1998;54(6):50-61.

36. French C.W. The Treynor Capital Asset Pricing Model. *Journal of Investment Management*. 2003;1(2):60-72.

37. Adler M., Dumas B. International Portfolio Choice and Corporation Finance: A Synthesis. *The Journal of Finance*. 1983;38(3):925-984. https://doi.org/10.1111/j.1540-6261.1983.tb02511.x

38. Hedi Arouri M.E., Nguyen D.K., Pukthuanthong K. An international CAPM for partially integrated markets: Theory and empirical evidence. *Journal of Banking & Finance*. 2012;36(9):2473-2493. https://doi.org/10.1016/j.jbankfin.2012.05.004

39. Guy A. Upside and Downside Beta Portfolio Construction: A Different Approach to Risk Mesurement and Portfolio Construction. *Risk Governance and Control Financial Markets & Institutions*. 2015;5(4):263-270. https://doi.org/10.22495/rgcv5i4c1art13

40. *Democracy Index 2022. Frontline democracy and the battle for Ukraine*. The Economist Intelligence Unit

Limited; 2023. URL: https://www.eiu.com/n/wp-content/uploads/2023/02/Democracy-Index-2022_FV2.pdf?li_fat_id=f1fbad7e-a282-4b9e-9f8f-6a6d5a9fe6b8 (accessed on 03.09.2023)

41. Duyvesteyn J., Martens M., Verwijmeren,P. Poilitical Risk and Expacted Goverment Bond Returns. *Journal of Empirical Finance.* 2016;38(Part A):498-512. https://doi.org/10.1016/j.jempfin.2016.01.016

42. Chen J., Bennett A., Zheng T. Sector Effects in Developed vs. Emerging Markets. *Financial Analysts Journal.* 2006;62(6):40-51. https://doi.org/10.2469/faj.v62.n6.435

The article **was submitted** 11.01.2024; **approved after reviewing** 12.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.93-106
JEL classification: D15, D25, G3, O32

Determinants of Sustainable Innovation Expansion Strategy: the Case Study of Companies from a Declining Industry

Nikita Tolstov
PhD Student, Moscow Academy of Finance and Law, Moscow, Russia,
nickita.tolstov@yandex.ru, ORCID

Abstract

Stimulation and improvement of innovative development is an extremely important component of economic growth in an economy, along with the companies' competitiveness in stagnating industries, which is especially relevant for companies at the maturity stage of the life cycle, where the risk of transition to the decline stage is highest. Without new developments and a sustainable innovation strategy, a company loses its leading position in the industry and misses new opportunities, leading it to the stage of stability and decline. Thus, it is important to study the factors that contribute to R&D intensity and encourage innovations in detail. This study investigates the impact of high level and quality of companies' patent activity on their financial potential in order to maintain stable innovation performance in the medium term. The sample comprises companies from the printer and camera sector between 2007 and 2020. The determinants of innovation expansion that characterize the technological readiness and market potential of firms to maintain their leading position in a highly competitive market are identified, using a case study method using the example of Canon and its competitor Xerox. The data are collected from Bloomberg and Orbis Patent Database. The results show that while high innovation activity is an important driver of growth, it does not always lead to better financial performance in the earlier stages of the life cycle. The study contributes to the literature by examining different characteristics of innovation activity and life cycle stages through the lens of external economic changes, which brings transparency and clarity in understanding the possible problems that may result from using already disclosed innovations of competitors as well as disclosing one's own intellectual property rights. The study proves that the greatest effect of innovation activity is observed in companies whose R&D expenditures are close to the industry average values along with diversification of revenue. The results of the study can help policy makers, managers and shareholders to build effective corporate governance to achieve strategic goals and minimize the risks of making wrong management decisions in R&D investments.

Keywords: life cycle, R&D, innovation intensity, investments, financial performance

For citation: Tolstov N. (2024) Determinants of Sustainable Innovation Expansion Strategy: the Case Study of Companies from a Declining Industry. *Journal of Corporate Finance Research.* 18(1): 93-106. https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.93-106

Introduction

The market for printing devices continues to transform, with a huge variety of document management systems and multifunctional devices (hereinafter referred to as MFPs) on the market in 2021, but their compatibility is a pressing issue. The need for simultaneous access from several users to the same device functions, taking into account the correctness of their fulfillment remains an urgent task in supporting the innovative development of MFPs [1], laser printing equipment and inkjet products. The acquisition of printing equipment is driven by the systematic replacement of end-of-life and obsolete devices, and as a result, like any dynamic business, printing and copying companies are interested in IT transformation to further improve customer service, accelerate business processes, and drive innovation. Successful innovators quickly adapt to the new reality. Setting qualitatively new goals and prioritizing all key areas of innovation, taking into account the long-term horizon when selecting strategy, allocating investments, and planning are all important factors of companies' success in the modern world. The relevance of the research question is related to the prospects for the development of companies in the R&D sphere. This is confirmed by the study of E. Naumova and G. Silkin, whose paper examines inclusive growth practices used in metallurgical companies and assesses their impact on financial results and value. An analysis of data showed that diversification of innovation directions has a positive impact on its financial results and value [2]. Utilizing all opportunities to take into account the latest achievements in related industries, as well as using the already disclosed innovations of competitors and disclosing their own intellectual property rights by formalizing their claims accordingly allows mature companies to maintain a position of leadership in innovation. As a result, those companies in the maturity stage whose citation rate is higher than the industry average [3], as well as those companies that are interested in innovative development, are more resistant to external economic changes and can maintain their potential for a long time.

In the context of economic crises, as well as unstable situations in the industry, companies show similarities and differences in their reactions to innovative development, while reducing or increasing flows from investment activities [4]. Against this backdrop, some companies improve the quality of financing while reducing investment, while others increase investment in the face of economic downturns. For example, D. Podukhovich in his study "CEO Investment Horizon Problem and Possible Ways to Solve It" notes that companies, that tend to make short-term investments have lower economic fundamentals and performance results performance [5]. As a consequence, counterintuitive actions may contribute to different events in the short and long term, leaving some or other consequences for firms. In order to identify the impact of a company's innovation activity on its future economic potential, it is necessary to consider its activities at different stages of the life cycle, including in the short and long term. To answer the research question posed, it is necessary to consider this problem using a case study, which focuses on the following factors:

- Historical analysis of financial performance;
- Patent activity of companies at different life cycle stages;
- Innovation activity of companies at the maturity stage;
- Methodological research aimed at identifying economic potential in companies;
- Analysis of non-financial metrics of Canon and Xerox.

Innovation is necessary for economic growth and development in a globalized economy. In order to consider a certain effect of innovation, it is necessary to trace the dynamics and all stages of the print industry formation using the example of specific companies [6].

Such authors as S. Gyedu et al., L. Fuentelsaz et al., M. Bianconi and C. Tan analyzed companies based not only on the difference in the performance of companies before and after any market events, but also on their effectiveness in achieving their goals. Suppose that a company increases the output of technologies that have been developed throughout the company life cycle, and in the future the investment is expected to generate a certain return over a certain period. However, how many companies have managed to achieve this, and are the selected companies performing better in the face of rapidly changing realities? Are the achieved results sustainable? These are the questions the authors answer in their research [7–9]. These papers contribute new evidence to the studies of corporate cash holding, focusing specifically on innovative companies. However, there are many research gaps in these papers, which are related to the lack of analysis of non-financial and innovation metrics, industry specifics, and the rather significant Life Cycle Stage indicator

The main purpose of this paper is to examine how innovation activity affects companies in a stagnant industry. In a growing industry high innovation activity has a positive effect on revenue, but whether it can stop the decline in revenue and help a company to grow further in an industry that has been in decline for over 5 years is a relevant question at the moment. This theory was tested by M. Zarva using the panel regression method. They selected about 3000 innovative companies of growing industry, as the GDP growth rate increased, the cash ratio of innovative companies decreased. The authors also reveal the insignificance of R&D expenditures for innovative companies and prove that ranking companies by the R&D expenditure amount and using this variable as innovation proxy was inexpedient [10].

Also, this paper raises the question of how the intensity of innovation and patent creation affects the ability of companies to stay in earlier stages without transitioning to the aging stage. In order to identify the relationship of innovation activity at different stages of the LCA, Apple was analyzed, which had a significant negative impact on the industry

with Canon and Xerox. Apple has been in the growth stage for a long time, and as a result, it is scientifically interesting to study how the company has been able to change its R&D expenditure policy in other stages and also in comparison to companies in a stagnant industry.

Literature Review and Development

Research issue

In order to maintain the current stage of the life cycle, a company must constantly work to improve its operations, adapt to changing market conditions and be ready for innovation. Innovation is a key factor in the development of the company that ensures its competitiveness in the market. The novelty of this study is that different innovation practices were analyzed simultaneously, and Canon's innovation expansion strategy was proven to be sustainable in the long term. However, the greatest effect of innovation activity is observed for those companies whose R&D expenditure was close to the industry average and was not inflated, while maintaining high quality and a relatively low number of patents. The advantage of these companies over their competitors is primarily inherent in the ability to move from the maturity stage to the growth stage, contributing to the decision to further increase economic potential and strengthen market position, which is the novelty of this research paper [11; 12]. This trend to improve business processes is addressed by A. Santos in her case study in order to improve the efficiency of the company's operations. The author's results clearly show the company's ability to achieve planned goals and the sustainability of the results achieved in the process of innovative development [13].

Innovative development promotes the creation of conditions and activities aimed at stimulating and supporting innovative processes in the economy and society. This may include financing scientific research, creating incubators and gas pedals for start-ups, organizing conferences and exhibitions, conducting courses and trainings on innovation and technology, and establishing legal and organizational frameworks for innovation activities. Promoting innovative development helps to increase the competitiveness of the economy, improve the quality of life of people and solve social and environmental problems. This is evidenced by S. Kwon and A. Marco in their study "Can antitrust law enforcement spur innovation? Antitrust regulation of patent consolidation and its impact on follow-on innovations", where with the case of the US Department of Justice's regulation of Novell's software patent transfers to four large proprietary software companies (i.e., Microsoft, Oracle, EMC, and Apple) in 2011. The paper confirms the fact that patent consolidation by patent transfer can restrict access to upstream technology and is thus a deterrent to monopolistic market power. The analyses using patent citation, copyright, and trademark data show the positive effect of the antitrust regulation of Novell's patent transfers on the development of follow-on software innovations by the patent-consolidating firms' competitors [14].

The main objects of the study are Xerox and Canon companies. Canon and Xerox image processing systems use technologies developed throughout the history of the development in companies. These are foundational technologies that are still used in all of Canon's current devices however, once the company began supplying its low-cost products to the U.S. market, Xerox was displaced from its first place as the leader in copying technology. The supply of Xerox devices continues to narrow, and the selection of devices themselves is limited to entry-level models that haven't been improved in a long time [15–17]. From a technological point of view, modern fax machines, replacing analog, are the same MFPs, as well as devices that allow you to connect to computers, are also inferior in their performance, quality of printing and scanning. As a result, the use of such devices manufactured by Xerox in the role of printer or printing is possible, but not optimal in pragmatic terms. Given the decline in demand, due to the lack of new promising areas of development, as well as the inability to adapt to the new market realities throughout all life cycles stages have prompted companies such as Xerox and Canon to restructure their businesses. This raises the need for comparative analysis at different life cycles of companies, where M. Cucculelli and V. Peruzzi conduct this assessment in their paper "Innovation over the industry life-cycle. Does ownership matter?" [18]. The case method confirms the fact that companies focus on product-oriented innovation during the growth stage of the industry life-cycle, and on process-oriented innovation during the maturity stage. This paper identifies different economic potential and innovation intensity at the growth and maturity life cycle stages.

Innovation activity

In this study, different innovation parameters were used. In addition to innovation intensity (ratio of R&D to revenue) and patent creation, indicators such as innovation efficiency (ratio of patents to R&D) and patent citation were used [19].

Expenditures on qualitatively new patents developed by companies mostly contribute to the accumulation of competencies to form a platform for further development. Systemic work with innovations requires the adjustment of the operating model, including the improvement of the organizational structure, tools and resources to ensure the necessary speed and flexibility in their implementation.

Innovation is essential for sustainable growth and economic development of both individual firms and industries, therefore, the relationship between economic growth and innovation is of great interest to researchers. Innovation measures such as R&D expenditures, R&D to revenue ratio, patents and trademarks can be found in various literature sources. For example, in the 2021 study "The impact of innovation on economic growth among G7 and BRICS countries", a group of scholars used R&D expenditures as an innovation measure. The paper examined the impact of R&D per capita in BRICS countries. The results showed that R&D expenditures increase the level of innovation and the latter leads to a constant growth in GDP per capita. The results suggest that innovation has a positive impact on GDP per capita for both developed and developing countries.

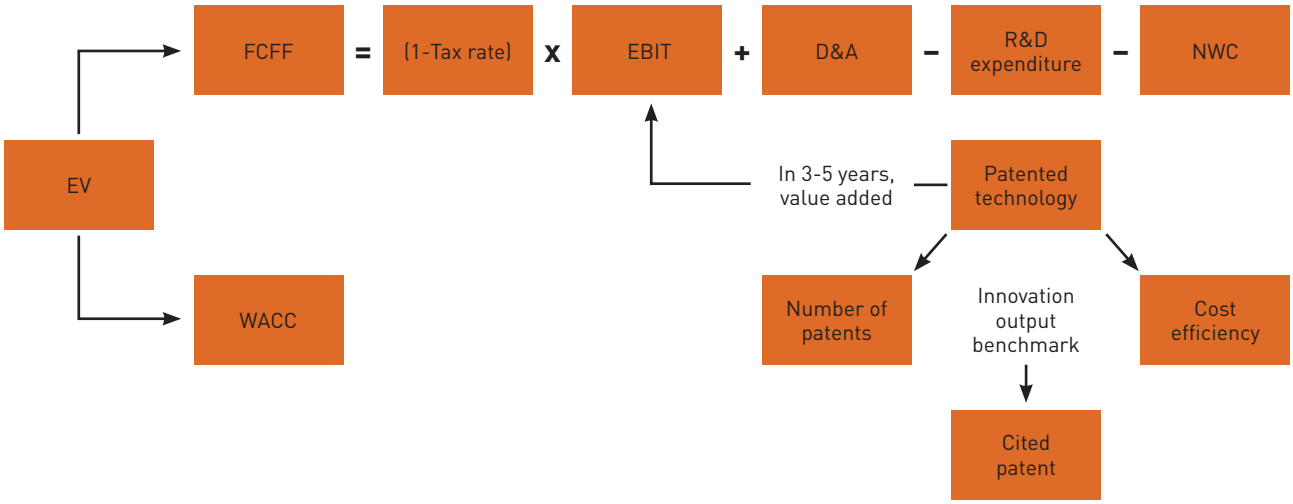
Innovation policy should take into account the complexity of the economic growth process, including indicators other than R&D expenditures. Thus, in the work of G. Valacchi et al. [20] entitled "Impact of outward foreign direct investments on patent activity of Greenfield multinationals" the number of patents is used as innovation, and in the study of S. Ling et al. "The Effects of Financing Channels on Enterprise Innovation and Life Cycle in Chinese A-Share Listed Companies: An Empirical Analysis" uses the ratio of R&D to revenue [21]. In the study of T. Tang "Hedge fund activism and corporate innovation" companies were classified into different cash flow-based LCRs, and the main financing channels were analyzed [22]. As a result, it was determined that government subsidies, tax preferences, equity financing and equity financing can significantly stimulate innovation of company activities, while bank loans can significantly restrain their innovation development. Financing channels have a non-linear relationship (U-shape) with firms' innovation, and the life cycle has a moderating effect on the incentive effect of innovation financing channels, subsequently, the incentive effect of financing channels represented by government subsidies and tax incentives weakens with the advancement of life cycle stages [23].

In the paper "Do the innovative MNEs generate added value in emerging economy?" [24] researchers such as P. Szklarz et al. investigated the impact of innovation on the competitiveness and profitability of a company. The dependent variables were such indicators as EVA, EV, ROA and ROE. The explanatory variable was R&D expenditures in different sectors of the economy. The results of the study revealed that companies from developed economies with a strong innovation base achieve a higher return on invested capital than companies from emerging economies. As a consequence, the companies described demonstrate better financial performance, as well as generate higher economic profits and receive sufficient financial incentive for further innovation.

Researchers point out that during the growth stage, unstable consumer preferences and rising demand continue to drive the intensity of product innovation. During the transition to the maturity stage, products become more standardized and companies compete on performance or efficiency. Innovation in product solutions is replaced by innovation in firm processes, focusing on managerial best practices that are investigated by N. Bloom and J. Van Reenen [25]. Nevertheless, the empirical work of F. Shahzad et al. does not yet convincingly prove that innovation activity is less in the maturity stage than in the growth stage [26]. However, the fact that with the transition to later life cycle stages, innovation shifts from product to process innovation is rather supported by different works of J. Bos et al. and E. Huergo, J. Jaumandreu [27; 28]. The papers hypothesize that the degree of innovation intensity increases during the transition to later stages and depends largely on sector affiliation.

Innovation activity and its impact on market valuation, financial performance, and consequently company cash flows, which determine a company's life cycle stage, according to V. Dickinson [29] can be illustrated by the example of the classical discounted cash flow model (DCF – discounted cash flow) in Figure 1. The peculiarity of innovative companies is the creation of intangible assets (patents, trademark, IT support) within the investment cycle, so many companies classify R&D costs as capital expenditures, in other words, capitalize R&D according to the IFRS standard and the company's accounting policy. Special personal characteristics and experience are required from the company's management given the high risk of the investment, the uncertainty of future cash flows from the patented technology and the long payback period on the invested capital. In particular, whether the efficiency of patent costs (cost efficiency) and high level of patent activity (number of patents) are justified in terms of their significance for the market – cited patent, as well as competitive advantage in the short-term period of 3 years and long-term 3–5 years on revenue, EBITDA and net income [30–34].

Figure 1. Correlation of innovation activity and financial indicators using the example of the DCF model

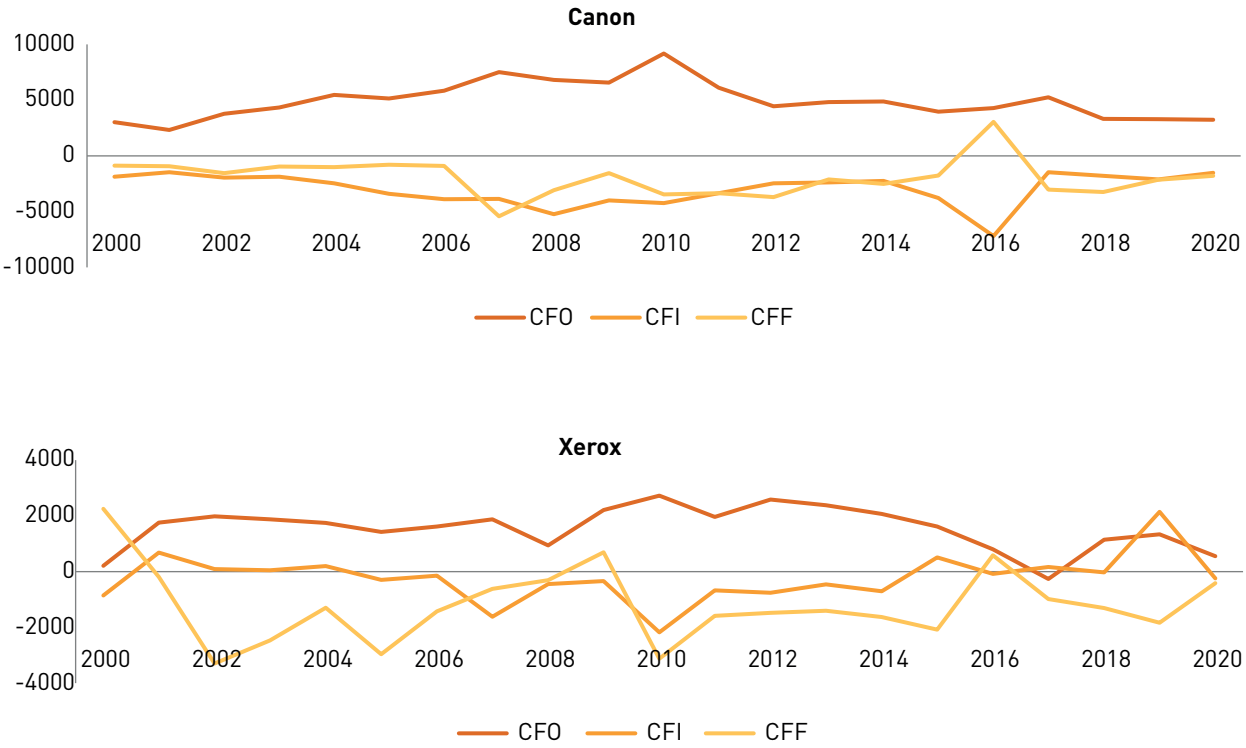


Source: Prepared by authors.

Identification of the life cycle stage of companies in the industry.

The Figure 2 shows the cash flow dynamics of companies such as Canon and Xerox with the definition of the stage of the life cycle according to V. Dickinson [29].

Figure 2. Cash flows of Canon and Xerox (USD, mln)



Source: Prepared by authors.

As can be seen from the Figure 2, all companies are from the same industry and are at the maturity stage, so this sample can be analyzed using certain economic and innovation activity indicators.

Hypotheses

1. *High intensity of innovation relative to competitors in the industry in the long term 3–5 years has a positive impact on the revenue growth rate.*

One of the main metrics of innovation activity in research is innovation intensity, calculated as R&D expenditure to revenue ratio. The indicator allows us to compare Canon and Xerox, which are different in size, in relation to the camera and office printing equipment industries. It is hypothesized that Canon's high innovation intensity allows it to adapt faster to the changing environment and remain a leader by creating value through higher sales of its innovative products. The hypotheses are tested from 2007 to 2020 in an industry transformation, and revenue growth rates are measured from the base year of 2007 [10].

2. *A high level and quality of patent activity above the industry average has a positive impact on the company's financial performance and business margins.*

Significant investment in R&D does not imply a higher level and quality of patenting activity, so one of the issues that the study reveals is how successfully Canon patents its technologies and whether high patent quality (patent citation by other researchers) means higher revenue rates and EBITDA margin relative to competitors [14].

3. *Stable efficiency of innovation spending in the medium term has a positive impact on the EBITDA margin.*

In addition to the quality of patent activity, it is important to analyze the efficiency of innovation spending, in other words, how many patents a company generates on average, all else being equal, per 1 million dollars in R&D investments. This is how we measure the R&D capacity of Canon and its weaker competitor Xerox. The higher this indicator, the more the company maximizes its return on investment [13].

4. *The intensity, quantity, and quality of patents allow companies to remain in the early maturity (prime) stage and not move into late maturity (stability) or the aging stage.*

It is assumed that the results of high innovation intensity – a stable level and quality of patent activity – should increase a company's cash flow in the medium and long term, and as a consequence – the company's market capitalization. Diversification of intellectual capital into other segments, as well as the creation of new products that allow the company to stay longer at the prosperity stage or move to the growth stage can become drivers of growth in difficult conditions [14].

5. *Companies in the growth stage have higher innovation intensity than those in the maturity stage.*

A comparison will be made between Apple's innovation and life cycle performance and that of companies in the printer and camera industry. It is hypothesized that companies in the growth stage should spend more on innovation to ensure revenue and market share growth, while mature companies should be interested in cost reduction, so as to spend less on innovation [18].

Data and Method

For the case study, financial and non-financial data were taken for two main companies: Canon and Xerox. To study industry dynamics, data on the following companies were used: Sharp, Ricoh, Nikon, Apple and HP. Statistical financial data were generated using Bloomberg's information database for 2007–2020, while the other information was gathered from each company's annual reports. Patent information was uploaded from the Orbis Patent Database. Financial and quantitative variables were used to test the hypotheses. The descriptive statistics for each variable are presented in Table 1.

Table 1. Descriptive statistics of variables

Variable	Number of observations	Average	Median	Standard deviation	Coefficient of variation	Minimum	Maximum
R&D to Revenue	95	1.01	0.98	0.16	0.16	0.63	1.53
Revenue growth	97	0.05	0.05	0.01	0.28	0.02	0.09
EBITDA margin	89	0.12	0.11	0.03	0.28	0.03	0.31
Citation per Patent	98	8.88	7.88	0.35	0.04	2.00	19.76
Patent growth	97	1.03	1.01	0.32	0.31	0.41	3.04
Patent to Revenue	98	0.16	0.16	0.03	0.17	0.01	0.57

Source: Calculated by authors.

Descriptive statistics characterize the total sample of balanced data without glaring omissions, the number of observations for which ranges from 89 to 98. Statistics represent relative indicators that are used to prove the hypotheses being tested. It is worth noting that the values of the variation coefficient for such indicators as R&D to Revenue, Citation per Patent and Patent to Revenue are within the normal range from 4 to 20%. However, a relatively greater scatter and lower equalization of the studied values for individual indicators arise due to indicators for individual companies that are distinctive from the industry average. For example, a greater scatter of the revenue dynamics is due to Canon, which has large R&D expenditures compared to the industry average, which were not successful, as clearly seen in the Figure 4. For EBITDA margin, the variation is significant due to Apple's higher margins, which are 30% higher than the industry average, causing right-sided asymmetry. The inflated variation coefficient also indicates the different level of companies' innovation activity, where Xerox causes asymmetry due to the increased number of patents, but their citation and effect on financial results leaves much to be desired. Median and mean values for all indicators are roughly equal, the sample is without obvious omissions. For almost all indicators, the standard deviation is close to zero, which characterizes the lower data **scatter**. All of the above allows us to conclude that the sample is homogeneous.

The first indicator is calculated according to the formula:

$$R\ \&\ D\ to\ Revenue = \frac{R\ \&\ D_{i,t}}{Revenue_{i,t}} \cdot 100\%, \quad (1)$$

where R&D is the amount of money spent by the company on research and development in millions of USD in a particular year, Revenue is the amount of total sales spent by the company in millions of USD in a particular year. This indicator shows how much the company is interested in Innovation Input.

The second indicator shows the level of company's interest in Innovation Output and is calculated according to the formula:

$$\text{Patent to Revenue} = \frac{Patent_{i,t}}{Revenue_{i,t}} \cdot 100\%, \quad (2)$$

where Patent is the number of registered patents held by the company for the current year, Revenue is the amount of total sales spent by the company in millions of USD in a particular year.

The indicator characterizing the degree of income efficiency is calculated according to the formula:

$$\text{Revenue Growth} = \frac{Revenue_{i,t=1}}{Revenue_{i,t=0}} \cdot 100\%. \quad (3)$$

Expenditures on quality new patents developed by companies mostly contribute to the accumulation of competencies to form a platform for further development. Systemic work with innovations requires an adjustment of the operating model, including the improvement of the organizational structure, tools and resources to ensure the necessary speed and flexibility in their implementation. A similar indicator characterizing innovation intensity is calculated using formula:

$$\text{Patent Growth} = \frac{\text{Patent}_{i,t=1}}{\text{Patent}_{i,t=0}} \cdot 100\%. \quad (4)$$

EBITDA margin is defined as the percentage of revenue retained by the company on a pre-tax basis and calculated using formula:

$$\text{EBITDA margin} = \frac{\text{EBITDA}_{i,t}}{\text{Revenue}_{i,t}} g100\%. \quad (5)$$

Patented technologies and a long period of return on invested capital should be justified in terms of their significance for the market and show a high level of patent activity, namely patent citation:

$$\text{Citation per Patent} = \frac{\text{Citation}_{i,t}}{\text{Patent}_{i,t}}, \quad (6)$$

where Patent is the number of registered patents held by the company for the current year and Citation is the number of times the patent has been cited by other researchers.

Table 2 presents the correlation matrix of the variables.

Table 2. Correlation matrix

	R&D to Revenue	Revenue growth	EBITDA margin	Citation per Patent	Patent growth	Patent to Revenue
R&D to Revenue	1.00					
Revenue growth	–0.03	1.00				
EBITDA margin	0.39	0.14	1.00			
Citation per Patent	–0.43	0.20	–0.20	1.00		
Patent growth	0.11	0.05	0.02	0.15	1.00	
Patent to Revenue	0.54	–0.07	0.07	–0.11	0.08	1.00

Source: Calculated by authors.

There is no significant relationship between the variables (the correlation does not exceed 60%), however, the positive relationship between two indicators: Patent to Revenue and R&D to Revenue (0.54) is close to the threshold value. These indicators are compared separately from each other across companies and characterize R&D expenditures as Innovation Output and Innovation Input in order to assess the efficiency of their implementation. Thus, there is no correlation below the threshold value of 60%, which allows us to reject the problem of multicollinearity between the variables.

In 2009, the leaders in the inkjet and laser printer market included Hewlett Packard, Canon, Samsung and Xerox, which accounted for 65–70% of the global market in 2009. The total share held by the leaders in 2000–2010 remained relatively stable, which is explained by the main factors: the image of the supplying company, a good price/quality ratio for each laser or inkjet printer model, as well as a well-thought-out marketing policy, well-developed infrastructure and dealer network. By the end of 2010, the sales performance of printer, desktop MFP, and flatbed and document scanner companies had stagnated. The beginning of the year was not the best in terms of purchasing activity, due to the sharp downturn in 2009 and the slow recovery of demand. In the first half of 2011 there were no significant changes in the market. Showing only token growth, stagnation subsequently turned to decline in 2012 and the market for printing devices contracted in the face of unfavorable economic conditions. Companies needed to upgrade their entire production base in order to expand their product range.

In the high-end copier market, Canon managed to overtake Xerox by continuing its cooperation with HP. Canon increased the production of its own laser printers, controlling about 5% of the market. In the middle of 2012, it became known that due to unfavorable profit forecast, Canon President Uchida would step down and Mitarai would become president again. The news was received positively, but sparked discussions about Canon's dependence on Mitarai. Uchida was given a position as an advisor to the company [35]. Canon continued to operate in its standard segments of camera, optics, and office equipment, and also introduce new technologies and developments. Despite the change in leadership, financial performance in 2011 and 2012 was almost identical. In 2014 alone, the company received more than 4,000 patents in the field of printing, and despite the decline in camera sales Canon managed to increase financial performance with the sale of office devices and printers. Operating income grew by 7.8% to $3 billion and net income by 10.3% to $3.17 billion. By the end of

2015, the company's net income had fallen to $1.8 billion, which prompted another change in management, with Mitarai stepping down as president and Masaya Maeda taking his place. The board of directors decided to downsize from 17 to 6 management members and shift its focus to new industries, taking on new patents in surveillance cameras and commercial printers. The company's sales declined again in 2016, with operating income of $1.9 billion and net income of $1.2 billion.

When considering Xerox, it is worth noting the historical fact that as early as 1985, the inventor of "electrophoto" Chester Carlson assigned the license rights to his patents to the Battelle Institute and Haloid, which used time-limited patent activity to prevent competitors (such as IBM) from making analogs and copiers and securing market dominance. For several decades, Xerox carefully protected its patents from license infringement by competitors. The company owned the most advanced solutions and could have become a market monopolist, but due to the lack of engineers' vision of the final product amid intellectual property restrictions, it could not reach this position [36]. All patented technologies contributed to the infringement of other intellectual property by copying or borrowing original sources. This was the beginning of the deterioration of Xerox's economic potential.

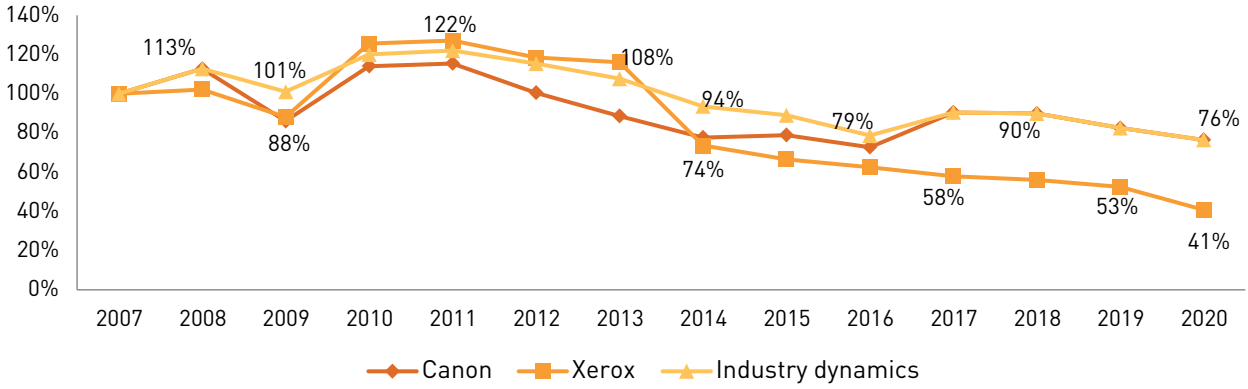
Results

Impact of innovation intensity on revenue dynamics of the companies.

The Figures 3 show that revenue growth in the industry stopped in 2011. Canon's revenue decreased by 23% over 13 years, while Xerox lost 60% of its revenue over 13 years.

Of all the companies, Canon had the highest innovation intensity. The worse the revenue dynamics were, the more Canon invested in innovation. Xerox, on the other hand, reduced its innovation intensity as its revenue decreased, which resulted in the company preserving only 40% of its 2007 revenue in 2020. Comparing Canon with its competitors, we cannot say that its high level of innovation intensity had a positive impact on revenue, but Xerox's low innovation intensity may have had an impact on revenue decline. Since no definite conclusions can be drawn, Hypothesis 1 is rejected.

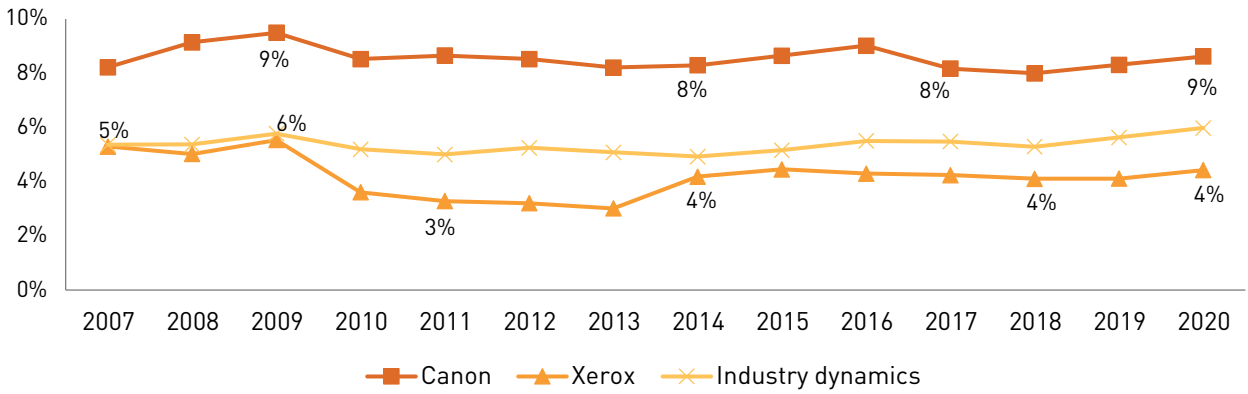
Figure 3. Revenue growth dynamics in 2007–2020



Source: Prepared by authors.

Analyzing the revenue dynamics, it is worth noting that the sharp growth of Xerox's revenue from 2009 to 2012 was caused by a new direction taken up by the company – electronic document management services. In 2009 their share amounted to 3.5 billion dollars, in 2010 it grew to 10 billion, but by 2014 it fell to 4 billion. Most likely, Xerox lost this segment to other, more technologically advanced companies. This indicator is calculated according to formula (3).

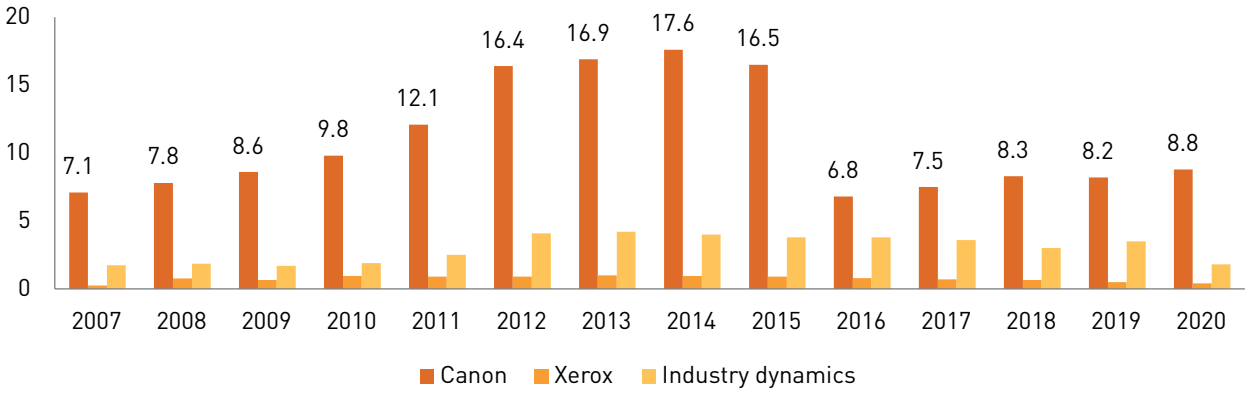
Figure 4. R&D to revenue ratio from 2007 to 2020



Source: Prepared by authors.

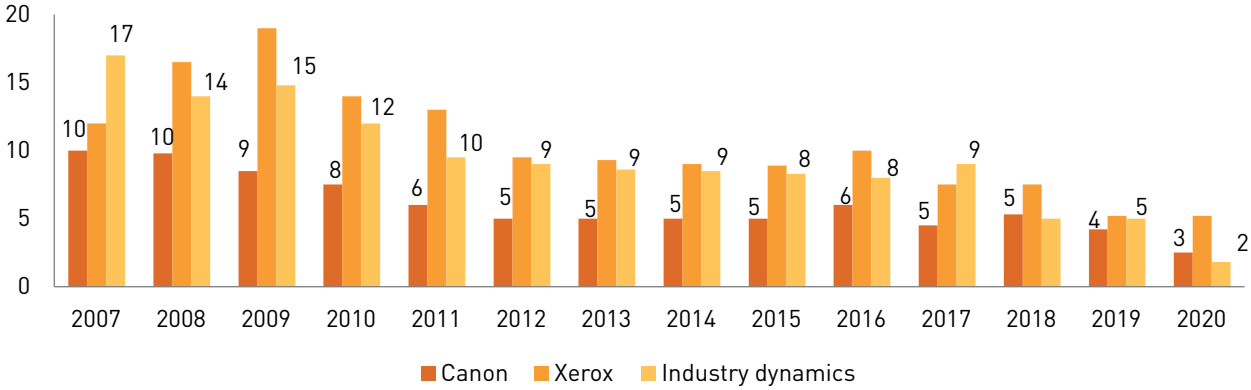
High R&D spending has helped Canon to create new business units, without which, the company would have lost half of its revenue over 13 years. This is characterized by Figures 4. As a result, it is difficult to determine how Canon's high innovation intensity has affected revenue compared to other companies, but it is worth noting that without it, Canon could have ended up in Xerox's shoes. This indicator is calculated according to formula (1).

Figure 5. Patent growth dynamics in 2007–2020



Source: Prepared by authors.

Figure 6. Average citation per patent in 2007–2020 (1000 per patent)



Source: Prepared by authors.

Impact of patent activity on the company's financial results

An analysis of the results of innovation intensity of Xerox and Canon allowed to show that the latter's indicator is significantly above the level in the industry and comparable companies, but the revenue is growing at a comparable rate with its peers. Therefore, it becomes an important task to compare the patent activity metrics – numbers and citations. Figure 5 shows that Canon is well ahead of Xerox and the industry average in terms of the number of patents. This has allowed the company to remain one of the market leaders in the camera[1] и printer[2] sectors. This is partly a consequence of high innovation intensity. The number of patents grew steadily until 2015, while the pace slowed down in subsequent periods. Since 2016 the number of patents has halved, which is probably due to the fact that new discoveries in the optical devices and office printing equipment industry were not yielding results, and in 2015–2017 the company invested part of its R&D potential in the new segments – semiconductors and medical devices. On the contrary, Xerox exhibited low patent activity below the industry average, even with regard to the difference in company size (on average, Canon's revenue was 2.7 times higher than Xerox's, and the number of patents was 13 times higher during the period in question). As a result, the company lost 58% of its revenue by 2020, losing the competition and failing to follow a strategy of entering new markets.

The indicator illustrating the quality of patents is the citation of existing inventions by other researchers. Meanwhile, given the different levels of patent activity, a relative indicator – the average citation rate per patent – was calculated. Figure 6 shows that Canon's citation rate is significantly lower than Xerox's and the overall industry dynam-

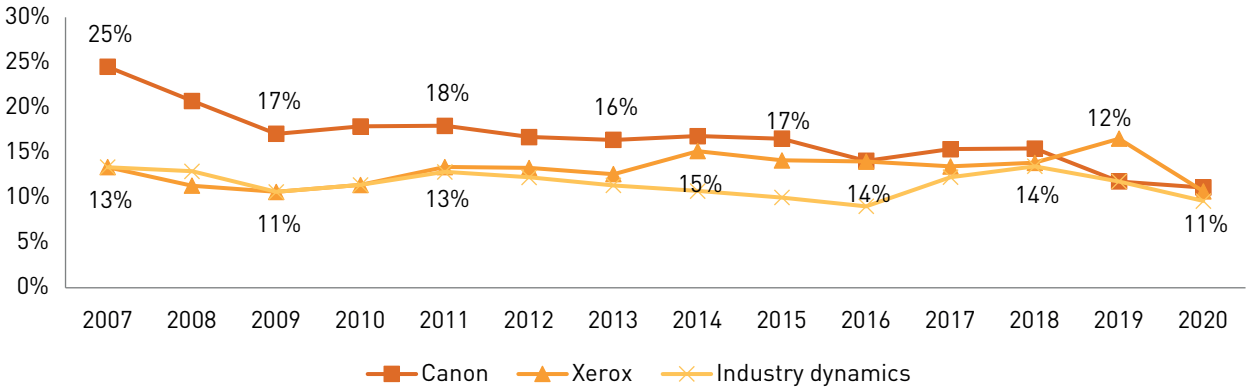
[1] URL: https://www.digitalcameraworld.com/news/camera-market-share-canon-owns-48-sony-22-nikon-drops-to-14

[2] URL: https://www.statista.com/statistics/541347/worldwide-printer-market-vendor-shares/

ics, which to some extent may explain the weak revenue growth despite high patent activity. This indicator is calculated according to formula (4).

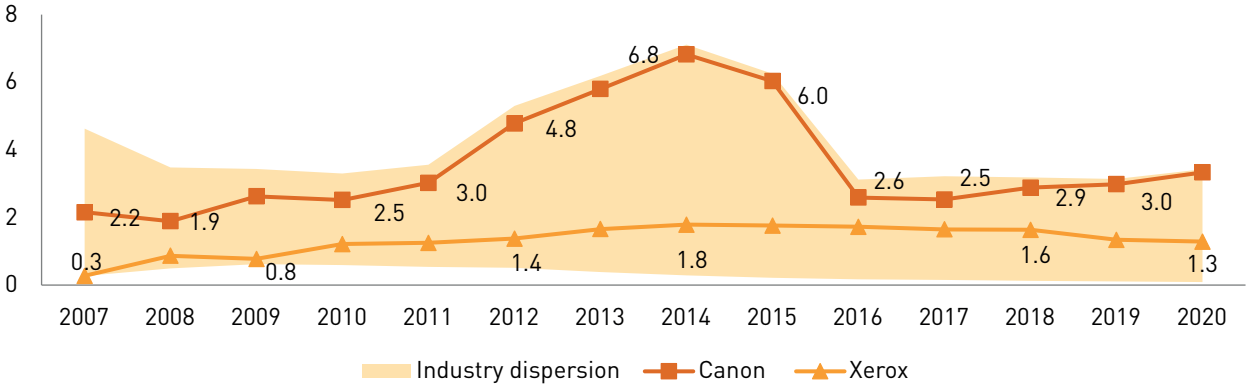
Innovative development requires a potentially different amount of investment to build a strong and sustainable competitive advantage in the market. It should be noted that the main effect of innovation is achieved through productivity growth, which further promotes the introduction of advanced technologies and approaches to the organization of internal processes, which in turn generate profits from sales of new products. However, the period from the initial research to commercialization can take 10 to 20 years, therefore, all scientific innovations require long-term efforts, which are stimulated by long-term investments in R&D [37]. This indicator is calculated according to formula (6).

Figure 7. EBITDA margin in 2007–2020



Source: Prepared by authors.

Figure 8. Impact of patent cost efficiency on revenue of Xerox and Canon (Patents/USD mln)



Source: Prepared by authors.

As seen in Figure 7 above, high patent activity leads to lower EBITDA margin in the mid-term assessment period. In the case of Canon and Xerox, Canon viewed R&D and patents as a way to increase sales and revenue solely from a long-term development perspective, leading to a EBITDA decrease from 25 to 11%. Xerox viewed R&D as an expense to create new value chains, and as a result shifted short-term profitability zones, whereby the company was able to grow the net margin by 3.5% over 3 years, but deprived itself of revenue. Unlike operating businesses, innovation activities have a fundamentally different risk profile and less predictable performance. Therefore, it is necessary to use special methods such as portfolio management and adaptation of corporate culture, as well as a certain motivation system within companies. As a result, we can conclude that **Hypothesis 2** is rejected. This indicator is calculated according to formula (5).

Canon vs Xerox innovation cost efficiency

Analysis of the efficiency of innovation spending as a ratio of the total number of patents to R&D expenditures in Figure 8 showed that Canon's ratio was more volatile than Xerox's, although to some extent it followed the spread of minimum and maximum values in the sector. Given the stable R&D expenses to revenue ratio in the range of 8–9% over the past decades, their efficiency has been declining markedly since 2014–2016 amid the restructuring of the company's business model through M&A deals and the development of new promising business lines – commercial printing, IP cameras, medical and industrial equipment. At the same time, Xerox followed a conservative strategy and tried to strengthen its potential in a stagnant market without seeking to improve the efficiency of R&D spending. As a result, Canon is largely maximizing its re-

turn on investment compared to Xerox, but not exceeding the industry average. However, the EBITDA margin dynamics does not allow us to draw unambiguous conclusions regarding this indicator, and therefore **Hypothesis 3** is rejected. This indicator is calculated according to formula (2).

Impact of innovation intensity on the life cycle.

As shown in Table 3 below, over 20 years, Canon was in a predominantly flourishing stage (CFO>0; CFI <0; CFF <0), while Xerox had periods of stability (CFO>0; CFI>0; CFF <0) and aging. This suggests that Canon's high innovation intensity allowed the company to remain at an earlier stage than Xerox.

Table 3. Change in the life cycle stages of Canon and Xerox in 2000–2021

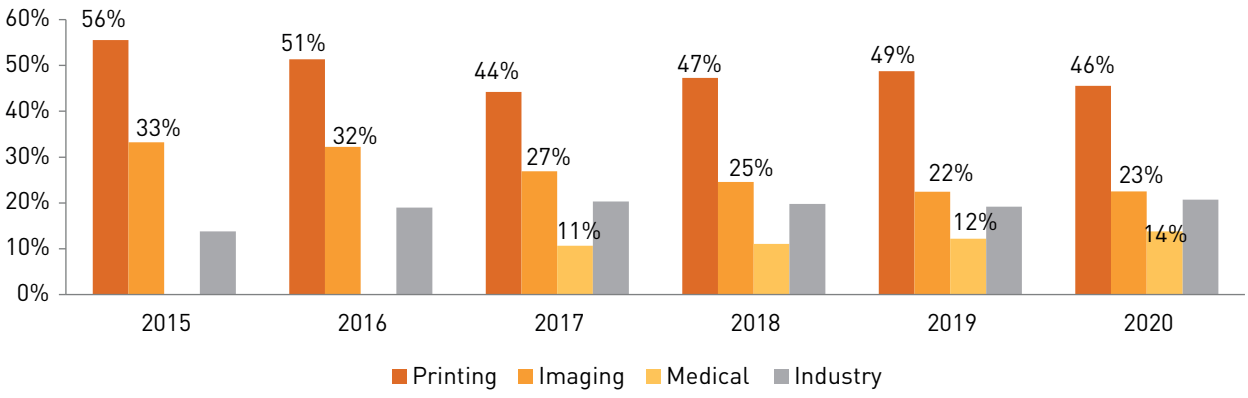
Canon						Xerox					
Year	Stage	Year	Stage	Year	Stage	Year	Stage	Year	Stage	Year	Stage
2000	Prime	2007	Prime	2014	Prime	2000	Growth	2007	Prime	2014	Prime
2001	Prime	2008	Prime	2015	Prime	2001	Stable	2008	Prime	2015	Stable
2002	Prime	2009	Prime	2016	Growth	2002	Stable	2009	Growth	2016	Growth
2003	Prime	2010	Prime	2017	Prime	2003	Stable	2010	Prime	2017	Decline
2004	Prime	2011	Prime	2018	Prime	2004	Stable	2011	Prime	2018	Prime
2005	Prime	2012	Prime	2019	Prime	2005	Prime	2012	Prime	2019	Stable
2006	Prime	2013	Prime	2020	Prime	2006	Prime	2013	Prime	2020	Prime

Source: Calculated by authors.

It is worth noting that in 2016 both companies were at the growth stage. This was facilitated by the increased innovation intensity in the previous 3 years. Xerox moved into the aging stage in the following year, and even its spending on innovation could not help the company's growth and product creation. Meanwhile, Canon entered new markets with increased innovation intensity, thereby diversifying its revenue. It entered the semiconductor manufacturing market in 2015 and the medical device market in 2017. The share of revenue from semiconductor manufacturing has increased from 13% in 2015 to 20% in 2020, and the share from medical devices – from 10% in 2017 to 13% in 2020. Canon thus has a better chance of staying in its prime than Xerox, which has never been able to enter new markets.

Hypothesis 4 is not rejected.

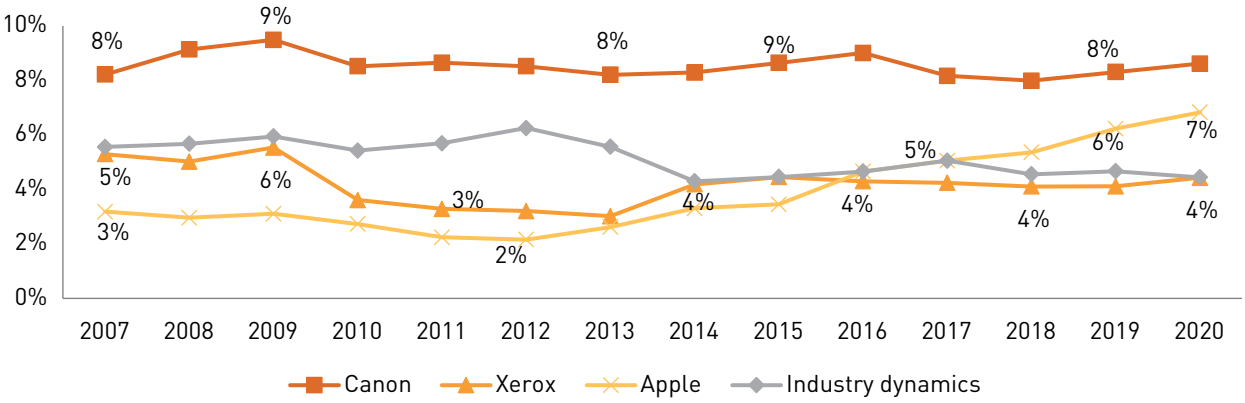
Figure 9. Canon's revenue structure in 2000–2020 (USD)



Source: Prepared by authors.

As shown in Figure 9, the printing and imaging industries accounted for the bulk of revenue, with a share consistently exceeding 40% for 5 years for printing.

Figure 10. Comparative characteristic of innovation activity of companies in the industry of IT at different life cycle stages



Source: Prepared by authors.

Table 4. Changes in the stages of Apple's Life Cycle in 2000–2020

Year	Stage	Year	Stage	Year	Stage
2000	Prime	2007	Growth	2014	Prime
2001	Prime	2008	Growth	2015	Prime
2002	Growth	2009	Growth	2016	Prime
2003	Prime	2010	Growth	2017	Prime
2004	Prime	2011	Growth	2018	Stable
2005	Growth	2012	Prime	2019	Stable
2006	Prime	2013	Prime	2020	Prime

Source: Calculated by authors.

This indicator is calculated according to formula (4). As can be seen in Figure 10 above, Apple's innovation intensity has long been lower than Canon's and the printer market as a whole. This is especially evident when Apple was in the growth or blossoming stage, the stages of the life cycle of which are summarized in Table 4.

However, from 2013 onwards, the company began to increase innovation intensity, and by 2020, it has maximized the gap with Canon. One explanation for this phenomenon is that after the 2007–2011 period, the company entered the maturity stage, and in 2018-2019 it entered the aging stage. The increase in innovation intensity may indicate that Apple is trying to move out of the maturity and aging stage into the growth stage.

Hypothesis 5 is rejected. Innovation intensity increases when companies in later stages reenter the growth stage.

Conclusion

The analysis of the impact of innovation activity on the financial performance of Canon and Xerox in comparison with competitors showed that exceeding the industry average in terms of the number of patents and innovation intensity does not always lead to higher financial results in the short and medium term. Nevertheless, a small effect on the company's revenues and cash flows was observed in the long-term horizon, which confirms the conclusions in research conducted by Anabela S. In particular, the company's high intensity of innovation and Canon's innovation expansion strategy help diversify its revenue into other knowledge-intensive industries, keeping the company at an earlier maturity stage. Nevertheless, it has not been able to significantly outperform its competitors, probably due to weak patent quality and average innovation spending efficiency. This observation refutes the conclusions from the research evidenced by S. Kwon and A. Marco [14]. Meanwhile, Xerox will probably be unable to maintain its stable position in the market, gravitating towards the life cycle stage of decline. The company's current strategy of optimizing costs through innovation in business processes allows it to preserve its EBITDA margin at a high level, but the slowing revenue and low innovation intensity is rather distancing it from its competitors. Apple was also studied for comparison. According to the results of the analysis, it appeared that this company demonstrated a low innovation intensity during the growth stage, but when it started to transition to the stage of prosperity and stability, it significantly increased its innovation intensity. This can be explained by the fact that Apple realizes that without new innovations the company will lose its leading industry position and miss new opportunities, which will lead it to the aging and stability stage. The results of the study

can be used by financial analysts and academics to analyze the probability of making the right choice of the company's development strategy under conditions of uncertainty and declining economic potential. It's worth noting that industry growth is slowing down as investment in research and development becomes less efficient, external controls increase, and companies become increasingly forced to collaborate with each other on innovation, creating more complex management and control structures. This trend negates the need for new products, however, companies should focus on the diversification of their products, as well as the variety of services provided, not limiting themselves to just one specification. A company should have a clear financial plan, control its expenses, and invest in marketing campaigns and promotion of products and services in the market, which will help increase brand awareness and attract new customers. Moreover, it will promote innovation in stagnant industries and increase the likelihood of moving to a higher and more stable stage of growth.

References

1. Bernstein S., Dev A., Lerner J. The creation and evolution of entrepreneurial public markets. *Journal of Financial Economics.* 2020;136(2):307-329. https://doi.org/10.1016/j.jfineco.2019.10.002
2. Naumova E., Silkin G. How Do Inclusive Growth Practices Affect Financial Performance and the Value of Metallurgy Companies? *Korporativnye Finansy = Journal of Corporate Finance Research*. 2023;17(4):78-92. https://doi.org/10.17323/j.jcfr.2073-0438.17.4.2023.78-92
3. Szopik-Depczyńska K., Cheba K., Wiśniewska J. Innovation, R&D and User-driven Innovation Activity in R&D Departments in Poland. The Multi-Criteria Analysis. *Procedia Computer Science.* 2020;176:2705-2713. https://doi.org/10.1016/j.procs.2020.09.290
4. Nagler M., Sorg S. The disciplinary effect of post-grant review – Causal evidence from European patent opposition. *Research Policy*. 2020;49(3): 103915. https://doi.org/10.1016/j.respol.2019.103915
5. Podukhovich D. Determinants of CEO Investment Horizon. A Literature Review. *Korporativnye Finansy = Journal of Corporate Finance Research*. 2023;17(2):95-109. https://doi.org/10.17323/j.jcfr.2073-0438.17.2.2023.95-109
6. Kim J. Economic hard times: Impact on innovation and innovation potential: Introduction to the Special Section. *Technological Forecasting and Social Change*. 2011;78(8):1285. https://doi.org/10.1016/j.techfore.2011.07.012
7. Gyedu S., Heng T., Ntarmah A.H., et al. The impact of innovation on economic growth among G7 and BRICS countries: A GMM style panel vector autoregressive approach. *Technological Forecasting and Social Change.* 2021;173:121169. https://doi.org/10.1016/j.techfore.2021.121169
8. Fuentelsaz L., Garrido E., González M. Ownership in cross-border acquisitions and entry timing of the target firm. *Journal of World Business.* 2020;55(2):101046. https://doi.org/10.1016/j.jwb.2019.101046
9. Bianconi M, Tan C.M. Evaluating the instantaneous and medium-run impact of mergers and acquisitions on firm values. *International Review of Economics & Finance.* 2019;59:71-87. https://doi.org/10.1016/j.iref.2018.08.005
10. Zarva M. Cash Balance Management in Innovative Companies. Korporativnye Finansy = Journal of Corporate Finance Research. 2022;16(1):113-135. https://doi.org/10.17323/j.jcfr.2073-0438.16.1.2022.14-37
11. Veganzones D., Séverin E., Chlibi S. Influence of earnings management on forecasting corporate failure. *International Journal of Forecasting.* 2023;39(1):123-143. https://doi.org/10.1016/j.ijforecast.2021.09.006
12. Ding W., Levine R., Lin C., et al. Corporate immunity to the COVID-19 pandemic. *Journal of Financial Economics*. 2021;141(2):802-830. https://doi.org/10.1016/j.jfineco.2021.03.005
13. Santos A. Do selected firms show higher performance? The case of Portugal's innovation subsidy. *Structural Change and Economic Dynamics*. 2019;50:39-50. https://doi.org/10.1016/j.strueco.2019.04.003
14. Kwon S., Marco A.C. Can antitrust law enforcement spur innovation? Antitrust regulation of patent consolidation and its impact on follow-on innovations. *Research Policy.* 2021;50(9):104295. https://doi.org/10.1016/j.respol.2021.104295
15. Liang Q., Gan C., Li Z. Institutional environment and financing costs: Evidence from venture capital backed transactions. *Finance Research Letters.* 2019;31. https://doi.org/10.1016/j.frl.2018.11.018
16. Li X., Wu X., Tan Y. Impact of special economic zones on firm performance. *Research in International Business and Finance*. 2021;58:101463. https://doi.org/10.1016/j.ribaf.2021.101463
17. Root A., Yung K. Resolving agency and product market views of cash holdings. *Research in International Business and Finance.* 2022;59: 101518. https://doi.org/10.1016/j.ribaf.2021.101518
18. Cucculelli M., Peruzzi V. Innovation over the industry life-cycle. Does ownership matter? *Research Policy.* 2020;49(1):103878. https://doi.org/10.1016/j.respol.2019.103878

19. D'Inverno G., Carosi L., Romano G.. Environmental sustainability and service quality beyond economic and financial indicators: A performance evaluation of Italian water utilities. *Socio-Economic Planning Sciences.* 2021;75:100852. https://doi.org/10.1016/j.seps.2020.100852
20. Valacchi G., Doytch N., Yonzan N. Impact of outward foreign direct investments on patent activity of Greenfield multinationals. *Technological Forecasting and Social Change.* 2021;173:121168. https://doi.org/10.1016/j.techfore.2021.121168
21. Ling S., Han G., An D., et al. The Effects of Financing Channels on Enterprise Innovation and Life Cycle in Chinese A-Share Listed Companies: An Empirical Analysis. *Sustainability*. 2020;12(17):6704. https://doi.org/10.3390/su12176704
22. Tang T. Hedge fund activism and corporate innovation. *Economic Modelling.* 2020;85:335-348. https://doi.org/10.1016/j.econmod.2019.11.004
23. Eaton G.W., Guo F., Liu T., et al. Officer. Peer selection and valuation in mergers and acquisitions. *Journal of Financial Economics.* 2022;146(1):230-255. https://doi.org/10.1016/j.jfineco.2021.09.006
24. Szklarz P., Klóska R., Czyżycki R., et al. Do the innovative MNEs generate an added value in emerging economy? Evidence from Scandinavian enterprises in Poland. *Procedia Computer Science.* 2021;192:2180-2189. https://doi.org/10.1016/j.procs.2021.08.231
25. Bloom N., Van Reenen J. Why do management practices differ across firms and countries? *Journal of economic perspectives*. 2010;24(1):203-204. https://doi.org/10.2139/ssrn.1533440
26. Shahzad F., Ahmad M., Fareed Z., et al. Innovation decisions through firm life cycle: A new evidence from emerging markets. *International Review of Economics & Finance*. 2022;78:51-67. https://doi.org/10.1016/j.iref.2021.11.009
27. Bos J.W.B., Economidou C., Sanders M.W.J.L. Innovation over the industry life-cycle: Evidence from EU manufacturing. *Journal of Economic Behavior & Organization.* 2013;86:78-91. https://doi.org/10.1016/j.jebo.2012.12.025
28. Huergo E., Jaumandreu J. How Does Probability of Innovation Change with Firm Age? *Small Business Economics.* 2004;22:193–207. https://doi.org/10.1023/B:SBEJ.0000022220.07366.b5
29. Dickinson V. Cash Flow Patterns as a Proxy for Firm Life Cycle. *The Accounting Review*. 2011;86(6):1969–1994. http://dx.doi.org/10.2139/ssrn.1268509
30. Magni C.A., Marchioni A., Baschieri D. Impact of financing and payout policy on the economic profitability of solar photovoltaic plants. *International Journal of Production Economics.* 2022;244:108338. https://doi.org/10.1016/j.ijpe.2021.108338
31. González M., Guzmán A., Tellez-Falla D.F., et al. Determinants of corporate tone in an initial public offering: Powerful CEOs versus well-functioning boards. *Research in International Business and Finance.* 2021;58:101481. https://doi.org/10.1016/j.ribaf.2021.101481
32. Ang T.C.C., Azad A.S.M.S., Pham T.A.T., et al. Firm efficiency and stock returns: Australian evidence. *International Review of Financial Analysis*. 2021;78:101935. https://doi.org/10.1016/j.irfa.2021.101935
33. Howell A., Lin J., Worack S. Going out to innovate more at home: Impacts of outward direct investments on Chinese firms' domestic innovation performance. *China Economic Review*. 2020;60:101404. https://doi.org/10.1016/j.chieco.2020.101404
34. Didier T., Levine R., Montanes R.L., et al. Capital market financing and firm growth. *Journal of International Money and Finance*. 2021;118:102459. https://doi.org/10.1016/j.jimonfin.2021.102459
35. Martínek S.A. The impact of Sovereign Wealth Funds on their investees: Methodology limitations. *Research in Globalization.* 2021;3:100072. https://doi.org/10.1016/j.resglo.2021.100072
36. Cao Y., Dong Y., Ma D., et al. Customer concentration and corporate risk-taking. *Journal of Financial Stability*. 2021;54:100890. https://doi.org/10.1016/j.jfs.2021.100890
37. Butticè V., Caviggioli F., Franzoni C., et al. Counterfeiting in digital technologies: An empirical analysis of the economic performance and innovative activities of affected companies. *Research Policy.* 2020;49(5):103959. https://doi.org/10.1016/j.respol.2020.103959

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.

DOI: https://doi.org/10.17323/j.jcfr.2073-0438.18.1.2024.107-117
JEL classification: G15, G32, G38

Using Derivatives to Hedge Foreign Exchange Exposure in Russia: Academic Research Review

Valeriy Dudko
Executive Director, Sberbank, Global Markets Department, Moscow, Russia,
valeriy9106@mail.ru, ORCID

Svetlana Avrutskaya ✉
Ph.D., Associate professor,
Department of Management and Marketing, Mendeleev University of Chemical Technology of Russia,
Department of Quantitative Methods in Management, Institute of Business Studies,
The Russian Presidential Academy of National Economy and Public Administration, Moscow, Russia,
avrutskaya-sg@ranepa.ru, ORCID

Abstract

The review analyzes Russian academic publications from the early 2000s to the present on financial derivatives and their use by Russian non-financial companies to hedge foreign exchange exposure. During this period, studies have made significant progress, from discussing general issues, like the concept of FX exposure, the types of derivatives and the basics of hedging, to original research of hedging effects on company value or cost of equity using generally accepted quantitative methods, such as VaR evaluation. The research demonstrates that hedging practices vary by industry and by the firm size; the 2008 and 2014 financial crises followed by increased FX volatility had a twofold effect on these practices, with some companies starting to apply hedging on a larger scale, and others abandoning it at all. The general opinion is that the use of derivatives to hedge foreign exchange exposure, specifically the transaction one, in Russia is much lower than in developed markets due to the market immaturity, regulatory and accounting difficulties, low demand for hedging instruments because of underdeveloped corporate treasury function, high hedging costs, etc. Instead, companies adhere to natural hedging, use non-financial techniques, or accept foreign exchange exposure. Still, most authors agree that to manage FX exposure, companies need to develop a comprehensive strategy; however, commercial flows reorientation due to the current political and economic situation requires developing new FX derivatives and a market for them. Overall, it can be concluded that the studies of Russian practices of using financial derivatives to hedge foreign exchange exposure are relatively small in number compared to foreign ones; data availability limits their factual base to information disclosed by public companies and model examples and does not allow to consider mid-sized and private firms' practices.

Keywords: foreign exchange risk, transaction exposure, risk management, foreign exchange derivatives, derivatives market, hedging factors, hedging strategy, natural hedging, company value

For citation: Dudko V., Avrutskaya S. (2024) Using Derivatives to Hedge Foreign Exchange Exposure in Russia: Academic Research Review. *Journal of Corporate Finance Research.* 18(1): 107-117. https://doi. org/10.17323/j. jcfr.2073-0438.18.1.2024.107-117

Introduction

Using financial derivative instruments to hedge foreign exchange (FX) exposure is quite common among foreign non-financial companies involved in international operations. Academic research in this area is extensive and dates back to the 1970s. The existence of three types of foreign exchange exposure – transaction, translation, and economic exposure – has long been universally recognized; it is believed that transaction exposure should be hedged in the first place, and forwards (futures) and options are the major types of contracts being used for this purpose. Current international research mainly focuses on reasons behind companies' decisions to hedge and discusses the impact of hedging on company value directly or via different factors such as firm size, corporate structure, dividend policy, etc.

Foreign exchange exposure hedging is especially relevant for Russia because the financial results and financial position of many non-financial companies are affected by the volatility of the Russian ruble exchange rate. The contracts include exports, mostly of natural resources and low value-added products; imports of machinery and technologies, as well as food products and consumer goods; and loans in foreign currency. While it is ordinary practice to hedge such transactions in the international market, many issues remain unresolved in Russia due to its short market history. The fact that Russian practice in this area hardly takes international research and practice into account only adds to the problem.

The goal of the present paper is to review Russian academic studies on foreign exchange hedging practices using derivatives by Russian non-financial (corporate) companies and to highlight the state and main issues of this research. We do not analyze the use of derivatives by financial institutions such as banks or hedge funds, as these are professional market participants with specific regulatory requirements, and their practices require a separate discussion. Our review focuses on Russian literature on the subject, does not consider foreign research and its methodology, and does not intend to make any specific cross-market comparisons.

Derivatives Market in Russia

A remarkable feature of this market, as noted by V. Lialin [1], is that it began forming simultaneously with the market of underlying assets. Foreign exchange futures and options were the first derivatives in Russia: the first USD/RUB futures contracts began to be traded on MOEX in October 1992. However, the literature on derivatives of that period is limited to academic books and does not contain any publications on the use of FX derivatives to hedge FX exposure, as we see from the comprehensive bibliographic index "Securities market and derivative financial instruments" for 1993–2003 [2].

The first original research on foreign exchange derivatives and their use to hedge FX exposure of non-financial companies dates back to the early 2000s. D. Piskulov [3] attributes this to the following:

- The Russian economy recovered from the 1998 financial crisis and began to experience stable development supported by high oil prices.
- The currency basket regime increased the ruble exchange rate uncertainty and volatility.
- Russian banks recovered from the 1998 crisis and regained access to international capital markets, while Russian interbank market activity increased.
- The demand for financial derivatives to hedge interest rate risks began to grow, and the first interest rate and cross-currency swap deals were concluded.
- Legal obstacles to the development of the derivatives market were removed, starting with legal protection for settlement deals concluded by qualified market participants.
- Professional organizations of market participants, such as the National Foreign Exchange Association and the Association of Russian Banks, were founded to identify and solve market problems.

However, results of a bank survey by the National Foreign Exchange Association cited by D. Piskulov [3] show that, in the early 2000s, FX derivatives transactions were carried out exclusively in the interbank market. Some scholars [4–8] argue that one of the biggest obstacles to hedging development in Russia was legislation stipulating that non-deliverable instruments were considered bets rather than financial instruments, and therefore not subject to legal protection. This issue was resolved only in 2007 by special amendments to article 1062 of the Civil Code of the Russian Federation.

According to a 2016 survey by the National Financial Association, the share of client transactions amounted to 33% of the total volume of bank transactions with FX derivatives at that time [9]. Thus, transactions involving non-financial companies represent a significant share of the market. Most authors agree that export-import transactions and foreign currency denominated liabilities are the main sources of exchange rate exposure [5; 10], with foreign exchange volatility and open foreign exchange positions being key risk factors (96 percent and 40 percent, respectively) [5]. A. Efimov [10] states that companies involved in import substitution are also exposed to foreign exchange risk.

Different publications consider the history [1; 3; 11], structure and dynamics [3; 9; 11–20] of the Russian FX derivatives market or make international comparisons [5–6; 14–15; 21]. However, they are mostly based on secondary data drawn from market research and reports by the Bank for International Settlements, PJSC Moscow Exchange, Russian Central Bank, and SRO National Financial Association (D. Piskulov [9]) and surveys conducted by consulting companies such as PwC and KPMG. The best among them are probably the original study by Yu. Danilov [7], containing the most complete information on the development of the derivatives market in 2001–2017, including its volume, structure, liquidity, dynamics, comparisons with foreign markets, regula-

tory problems, and obstacles to and proposals for further market development, and the fundamental research by M. Dmitrieva [5]. These papers show that the derivatives market in Russia is developing, with FX derivatives prevailing over interest rate derivatives, unlike the situation in other countries.

Some papers are devoted to issues that have long been discussed and resolved in international research, such as:

- The nature of derivatives [22].
- The different types of derivatives and the purposes of their use [5; 6; 10; 11; 16; 18; 22–26], including three strategies: hedging, speculation and arbitrage [11; 18; 27].
- The concept of FX exposure [10; 28] and its three types – transaction, translation, and economic exposure [4; 5; 21; 29–31] – as well as unobvious (hidden) exposure [10; 32], and the different approaches used to mitigate them [31–32].
- The nature of hedging [33] and analysis of international hedging practices [22; 34].

For the theoretical background, most authors use the fundamental books on financial derivatives by A. B. Feldman, V. A. Galanov, A. N. Burenin [5; 16; 19; 23; 25–27; 33; 35–36], as well as the Russian translation of *Options, Futures, and other Derivatives* by John C. Hull [5; 6; 12; 13; 19–21].

Most authors acknowledge that the Russian market of derivatives is immature [11; 13; 15], which, along with the impact of the 1998 financial crisis [3], explains some of its problems, such as:

- The high ruble exchange rate volatility that makes it difficult to develop long-term hedging strategies [16; 17].
- Underdeveloped infrastructure [15; 17; 36].
- Numerous gaps and contradictions in the legislation [9; 11; 17; 22; 36–37].
- Little or no support from the government [15].
- Difficulties in financial and tax accounting of transactions involving derivatives [9; 16–17; 22; 36].
- Low control over transactions, enabling price manipulation based on the use of insider information [34–35] and creating potential counterparty risks and conflicts of interest [18].
- Low demand for derivatives due to underdeveloped corporate planning and treasury functions, low financial literacy and low risk tolerance of treasury employees [9; 15; 18; 38], and lack of support from top management [22].
- High hedging costs, including the costs of legal support [17; 36; 38].

Most of these problems are specific to or more pronounced for the Russian market, as shown by M. Dmitrieva [5]. As a result, the use of derivatives to hedge foreign exchange exposure is much lower than that in developed markets.

Factors Affecting Hedging Practices

Based on a 2011 PwC study, I. Khmelev [4] and V. Okulov, V. Skripyuk [24] state that 30 percent of companies do not hedge their exchange rate risks, because in the majority of cases they are not directly exposed to them (or do not have open foreign currency positions). According to a 2015 PwC study [39], only 11 percent of analyzed Russian companies were not exposed to foreign exchange volatility, while 43 percent of companies regarded their foreign exchange risks as material. At the same time, the share of companies not managing their foreign exchange exposure decreased to 25 percent, yet only 19 percent actively managed it. However, unlike developed markets where "active management" means the use of derivatives, Russian companies understand it to include natural hedging, which is the dominant approach (56 percent), with the percentage of those using derivatives being much lower than in international markets.

T. Polteva and E. Luk'ianova [22] explain this situation by the low financial literacy of treasury employees, difficulties in assessing initial and residual risk, as well as poor hedging results and lack of understanding and support from top management. Dmitrieva's findings [5] that on average (depending on the industry) 60 percent of analyzed companies use financial hedging, while 90 percent of non-financial companies use at least some kind of hedging, are probably due to her sample specifics. However, she recognizes that most companies hedge less than 40 percent of their open foreign exchange positions.

When risks materialize, companies mostly try to revise the terms of current agreements – increase prices to compensate for higher costs in the case of importers and for national currency appreciation in the case of exporters [36], reduce costs, use reserves, and even reduce capital investments [40].

A. Efimov [10] states that companies sometimes deliberately refrain from using hedging instruments as they expect exchange rates to be stable or change in a favorable direction. Such enterprises deliberately speculate and, if their expectations turn out to be wrong, incur losses. G. Mazin [40] analyzes the annual reports of companies for 2019 to show that exchange rate losses amounted up to 24% of revenues due to the significant volatility of exchange rates. Companies explicitly admitting in their reporting that risks can significantly affect their position yet showing reluctance in using derivatives include Tatneft and the Alrosa Group [40–41]. Other companies such as Transneft, Aeroflot, and PhosAgro have abandoned the use of derivatives because of past massive losses [13; 34].

Many authors note that the most popular approach to managing foreign exchange exposure in Russia is natural hedging [4; 17; 24; 32; 34; 40; 42]. The most widespread natural hedging techniques include matching the currency structure of revenues/expenses and assets/liabilities and using foreign currency nominated loans [33; 43–45]. This observation is confirmed by surveys of the corporate treasury function by PwC [39] and KPMG [46]. This trend per-

sists today, as confirmed by a 2020 KPMG study [45]. Alrosa Group, PJSC NOVATEK and PJSC Gazprom are among companies committed to natural hedging [43].

However, these studies do not examine other potential non-financial techniques mentioned, such as transferring exchange rate risks by concluding all contracts in national currency or in different currencies that have opposite exchange rate trends; using risk sharing agreements; using leads and lags; employing international diversification of revenues and costs and using subsidiaries to balance cash flows in different currencies (currency netting) [5; 29; 32; 43]; and applying money market instruments [23]. The only exception is exchange rate clauses widely used before the 2014 crisis, in which contracted prices are made to depend on the exchange rate [4; 32; 42; 45].

Researchers' opinions on the use of derivatives differ. According to A. Kokosh [38], the scope of hedging transactions should be very limited in Russia – companies should rather use natural hedging by matching revenues and expenses, assets and liabilities, and diversifying their business. K. Kurilov [43] justly argues that only net or open currency positions deserve hedging. However, M. Kiseliov [36] states that hedging an open currency position only with the use of derivatives makes for effective foreign exchange exposure management.

E. Fedosov [45] makes the general conclusion that derivatives as a means of managing FX exposure evokes limited interest among Russian companies – in part, due to the significant losses incurred by some of the largest companies as a result of ruble devaluation in 2014 – and do not fully meet the requirements of the Russian economy. This contrasts with international practice, where derivatives are the most common tools to manage FX exposure.

Several articles show that *exposure to FX risk and hedging practices vary by industry*.

Analyzing corporate annual reports, G. Mazin [40] observes that the impact of foreign exchange exposure is high in oil and gas production, machinery and manufacturing, industrial and commercial services; medium in electric power generation and the chemical industry; and low in food processing.

E. Kayasheva [32] considers real estate investments in a foreign market and shows that initial investments, the periodic (lease) payments, and the liquidation value are all subject to FX exposure. As the first two flows are predetermined, they can be hedged with swap contracts. However, it can be difficult to find the right contract, and hedging incurs additional costs. As for the cash flow from the sale of real estate, it is hard to forecast, and its hedging effectiveness depends largely on its liquidity.

A. Kurilova [23] and K. Kurilov [43] state that Russian automakers are affected both by ruble depreciation that increases material (i.e. steel) and component costs and by ruble appreciation that decreases export revenues. The cyclical character of the industry normally aggravates each scenario. Therefore, when hedging commodity and currency risks, it is necessary to determine the optimal moment to enter the market to avoid losses (A. Kurilova [23]). Thus, automakers are advised to develop a holistic hedging system integrated with planning to make decisions on the use of foreign exchange as well as commodity and interest rate derivatives [43].

D. Balaburkina [44] shows that, in a telecommunication company, exchange rate exposure affects operating cash flows, as some of the company's revenues and expenses are nominated in foreign currency. However, the effect on financial cash flows from foreign currency nominated loans and interest payments is much more profound. The author suggests hedging them with foreign exchange options. S. Shvets and A. Sobolev [48] state that importing innovative equipment and hardware components is the major cause of FX exposure for telecom companies; however, they do not specify whether operating or financing cash flows are affected, nor do they suggest any hedging strategies.

V. Cherkasova [29] demonstrates that oil and gas companies have both FX nominated export revenues and costs stemming from investments in equipment and participation in international projects, so the total effect is uncertain, explaining why natural hedging is so popular. However, using derivatives can help stabilize operating cash flows.

V. Zaernyuk and N. Snitko [28] mention the importance of FX risks for Russian gold mining companies; however, they do not explore methods for minimizing them or optimal management techniques.

P. Pankov [34] analyzed hedging practices by PJSC NLMK and noted that, in the metallurgical industry, commodity price and FX risks need to be assessed jointly due to their strong statistical correlation. In 2012–2014, the company used forward contracts to mitigate the FX exposure, while, in 2015–2019, it used "natural" hedging by maintaining optimal long-term open positions in major currencies. Currently, the company hedges revenues in US dollars with Eurobonds and related coupons in US dollars. The author notes that three more Russian companies mention using foreign debt for hedging purposes in their reporting.

JSC Uralkali, producer of fertilizers, hedged its bonds using cross-currency interest rate swaps [22].

G. Mazin [40] claims that Russian non-financial companies, mostly importers, but also exporters, face two factors contributing to future cash flow uncertainties: exchange rate volatility and commodity price volatility; Pankov finds that their statistical correlation is strong [34]. Analysis demonstrates that, on the whole, commodity derivatives used to hedge price risks are much more popular than FX derivatives among Russian companies.

Thus, many authors do not distinguish between the three types of FX exposure and their hedging techniques. Only V. Yurchenko [21] argues that, in Russian hedging theory and practice, translation exposure is not considered separately, as the number of public companies is small, and they are less concerned with their balance sheet values than economic or operating exposures originating from significant changes in business conditions, including regulatory changes. At the same time, risks relating to the market

(commodity prices), FX exchange (transaction exposures) and interest rates are the most relevant for hedging decisions in Russia, according to the author.

Another factor affecting corporate hedging practices is *company size*. I. Khmelev [4] observes that large companies (with revenues of more than 100 billion rubles) tend to hedge operating profits (40%) and cash flows (30%). Overall, large companies (Aeroflot, Novolipetsk Metallurgical Plant, Rosneft, X5 Retail Group, Gazprom Neft, VimpelCom) pay much more attention to FX exposure management and mainly use exchange-traded derivatives – options and futures – due to their reliability, despite limited currency pairs and maturities. At the same time, such instruments can be complex and costly for mid-sized companies. S. Shvets and A. Sobolev [48] state that higher risk exposure is typical for small companies, while large corporations are usually more conservative and risk-averse: for them, higher risk levels must be accompanied by higher compensation.

Research shows that corporate hedging practices were strongly affected by the *2008 and 2014 financial crises*. M. Kiseliov [36] mentions that the 2008 crisis demonstrated the inability of Russian businesses to effectively protect themselves from adverse foreign exchange fluctuations.

E. Kayasheva [32] observes that, according to experts, adjustments due to exchange rate volatility accounted for 30–40% of total revenues in 2008, so companies started applying hedging strategies on a larger scale. However, they faced increased counterparty risk and low liquidity and high costs in the derivatives market.

N. Krasovskij [25] mentions that, after 2008, increased volatility in the foreign exchange market has forced many Russian banks to require clients involved in export and/or import transactions to hedge foreign exchange exposure. However, using derivatives is extremely costly in the conditions of exchange rate volatility, and hedging loses its economic sense [36]. Still, I. Khmelev [4] shows that the crisis made companies pay more attention to financial risks management, and the interest in hedging instruments increased. Research by P. Pankov [34] demonstrates Russian blue chips using derivatives for both speculation and hedging after 2008. According to V. Lialin [1], the weakening of the ruble against major currencies since 2013 has contributed to a demand for FX futures among non-financial companies for both FX risk hedging and speculation.

The trend has been ambivalent after the 2014 crisis. On the one hand, research by M. Dmitrieva [5] shows that the percentage of companies recognizing the importance of FX risks has increased, while O. Okorokova and A. Pisetskaja [12] make use of Central Bank statistics to demonstrate an increasing demand for hedging instruments such as currency swaps and options. On the other, P. Pankov [34] observes that the 2014 ruble devaluation and subsequent market volatility made companies revise their hedging practices. For example, PJSC Transneft and others abandoned the use of derivatives and hedging, while other companies started using foreign currency nominated loans for hedging purposes.

Qualitative and Quantitative Studies

Different examples of the use of FX derivatives to hedge FX exposure are described in publications.

E. Kayasheva [32] discusses the use of FX derivatives to hedge transaction exposure. A. Efimov [10] presents accounts receivable and accounts payable hedging strategies employing forward contracts and put and call options. I. Khmelev [4] considers different hedging options available to companies in the Russian market, including exchange-traded (futures) and OTC (forwards and options) contracts, together with their advantages and disadvantages and with examples of hedging deals and their costs.

N. Krasovskij [35] identifies factors limiting the use of futures as hedging instruments, including additional cash needed to pay initial and maintenance margins, potential losses and margin calls, and the limited ability to manage the hedged position. He advocates using OTC currency options due to their flexibility and limited losses; at the same time, he recognizes that their liquidity is lower, leading to an increase in hedging costs.

V. Cherkasova [29] compares the results of using forward and option contracts to hedge operating cash flows and shows that forwards have preference over options because of lower costs.

K. Kurilov [43] proposes hedging USD nominated loans using exchange traded FX options.

D. Balaburkina [44] suggests using delivery futures contracts to hedge long-term foreign currency loans and compares hedging costs with losses from national currency depreciation.

A. D'yachkov [6] discusses using futures contracts to hedge revenues and costs in foreign currencies.

E. Fedosov [45] considers employing put options to hedge revenues; forward contracts and call options to hedge accounts receivable; and currency swaps to hedge foreign currency nominated loans.

However, the survey by M. Dmitrieva [5] shows that FX forward and swap contracts prevail as FX hedging instruments, being used by 74 and 69 percent of respondents, respectively, while only 35 percent of companies use futures contracts. Still, S. Shvets [42] examines FX options for hedging a foreign currency nominated loan and its interest payments.

V. Yurchenko [20] claims that non-financial companies are interested in delivery contracts: for them, exchange traded derivatives are convenient in terms of maturities and expiration dates, while commissions can be as low as 0.1 percent of the contract.

Unlike numerous articles published abroad, Russian research of the effect of hedging *on company value* is limited and fragmented. However, analyzing the foreign literature, M. Dmitrieva [5] states that hedging positively affects company value.

M. Bobrovskaya [8] discusses two existing approaches to account for exchange rate exposure in company valu-

ation: adjusting the discount rate and incorporating the exchange rate factor in the cash flow forecast. She identifies the shortcomings of the first approach and asserts that the cash flow forecast is more methodologically correct as the exchange rates it uses reflect the FX exposure estimate. She employs imitation modelling to forecast expected cash flows and shows that the international diversification of sales increases the company value while augmenting its volatility because of exchange rate risks.

V. Okulov and V. Skripyuk [24] applied imitation modelling to analyze the returns of two portfolios consisting of shares of companies that, according to their reports, used or did not use hedges. The authors demonstrated that the differences in portfolio performance were not statistically significant before 2008, while hedging companies performed better on average during the 2008–2009 crisis. However, during the market recovery, shares of companies that did not use hedges had higher returns. They conclude that investors in the Russian stock market regard hedging as a means to protect their value during a crisis, and in this respect, their behavior is the same as that of investors in developed markets.

G. Mazin [41] states that risk management has a significant impact on the market value of Russian public companies. He analyzes the annual reports of 136 public nonfinancial companies for 2014–2018 to determine whether their market capitalization and stock returns were affected by hedging using derivatives. By applying the Tobin coefficient to compare companies and time-series analysis to test the Fama-French three-factor model, the author demonstrates that public companies using hedging to reduce the volatility of forecast cash flows are traded at a conditional positive premium.

I. Kuchin et al. [49] investigate the impact of currency risk on the cost of equity in BRICS countries, including Russia, by adding currency-risk factors to the Fama-French three factor model. They show that the currency risk premium is positive and significant for companies positively exposed to the depreciation of national currency (exporters) and negative for companies with negative exposure to the national currency depreciation (importers or debtors). Risk premiums for exposure to unfavorable exchange rate movements are negative.

P. Pankov [34] draws on foreign research to argue that there is limited and contradictive empirical data supporting the positive effect of hedging on company value and its investment attractiveness. This is partly due to the ineffective management of hedging, including the suboptimal choice of hedging strategies and excessive hedging costs.

Hedging Costs and Hedging Strategy

Some of the aforementioned publications with hedging examples calculate *hedging costs*.

I. Khmelev [4] discusses different hedging options available to companies in the Russian market, including exchange-traded (futures) and OTC (forwards and options) contracts, their advantages and disadvantages, and provides examples of hedging deals and their costs. D. Balaburkina [44] estimates the cost of hedging foreign currency nominated loans and interest payments using delivery futures contracts as compared to foreign exchange losses (for different levels of depreciation).

The articles [36; 38] state that the costs of foreign exchange exposure hedging are extremely high in Russia due to FX volatility, non-competitive pricing in the OTC market and high transaction costs, amounting to as much as 20 percent of the hedged transaction.

All these examples are based on accounting data; O. Okorokova and A. Pisetskaja [12] outline a procedure to account for hedging costs. However, Pankov [50] reasonably argues that the use of accounting information (financial statements) to assess the effect of hedging is limited to the hedged positions and corresponding derivatives and does not account for other costs and risks associated with the use of derivatives. He suggests an "economic" approach to assess the effectiveness of risk hedging by comparing internal and external benefits, on the one hand, and associated costs and risks, on the other. Internal benefits include profit predictability, improved liquidity, more reliable cash flow forecasting, procurement and sales stabilization, tax optimization; among the external benefits are a better corporate image and higher investment attractiveness due to cash flow stability. Internal costs include high wages of hedging professionals, contract transaction and legal expenses, software, increased financial and tax accounting costs, management monitoring and control, while external costs comprise the value of the hedging instruments, including option premiums and OTC derivative spreads, brokerage and exchange commissions, subscriptions to information sources, and opportunity costs of funds diversion (margins, loans to maintain a position).

As for FX *hedging strategy*, its discussion breaks down into several topics.

The first is whether to use total hedging, i.e. hedging the entire amount of the transaction, which completely eliminates both possible losses and possible additional profits, or selective hedging to mitigate some of the risks [10; 26; 32]. According to I. Kiseleva and N. Simonovich [30], the objective of an effective hedging strategy is not to eliminate risk, but to achieve an optimal risk structure, that is, the relationship between the benefits of hedging and its costs. Another option is to apply hedging when the exchange rate passes some predetermined acceptable level [10].

The second topic, discussed by M. Dmitrieva [5] and E. Afendikova, V. Malyar [17], relates to static and dynamic hedging strategies. M. Dmitrieva [5] states that companies normally use forward contracts for static hedging and futures contracts for dynamic hedging. At the same time, she mentions that exchange traded derivatives are not popular among non-financial companies, which aligns with conclusions by N. Krasovskij [35].

Most authors admit that FX hedging as part of a general risk management practice requires a consistent strategic approach – from risk identification and classification to accounting policy and monitoring. Hedging policies are usually developed by companies, which specify the steps and procedures, responsible employees and decision levels. A. Kurilova [23] suggests a general algorithm that can be used to select financial engineering tools in order to decrease FX, price, interest rate and other potential risks and costs, while increasing company liquidity and profitability.

M. Dmitrieva [5] develops a holistic approach to FX and interest rate management that includes setting hedging objectives and hedged positions, identifying and assessing risks, determining the amount of "risk appetite", selecting hedging instruments and determining their key parameters, and calculating hedging costs and efficiency, as well as developing internal documents regulating hedging practices and appointing managers responsible for specific activities.

P. Pankov [51] tries to develop an effective algorithm for planning hedging (price, interest rate, and FX risks) as well as speculative transactions involving derivatives for non-financial organizations, depending on the corporate strategy; thus, comprehensive strategic analysis is required to determine the strategic prerequisites for speculation and the strategic problems requiring hedging.

We should note that the proposed algorithms are designed to hedge different risks. This means that FX exposure management should be part of a company-wide risk management strategy. However, A. Suleimanova et al. [26] regard FX exposure as a stand-alone risk and list the steps required to hedge it effectively, including the identification of FX risks, their qualitative and quantitative evaluation, hedging strategy development and implementation, and results monitoring.

FX Exposure Evaluation and Accounting

To manage FX exposure properly, instruments are needed for its evaluation. Using the results of a PwC study, I. Khmelev [4] asserts that, to evaluate financial risks, more than half of the surveyed companies (61 percent) use sensitivity analysis; 50 percent use scenario modeling; and only 11 percent use Value at Risk (VaR) indicators that are the most common method in international practice.

The advantages and disadvantages of the VaR method are discussed in [29; 32; 42; 48]. E. Kayasheva [32] traces its origins to the banking industry, where it was originally developed to assess capital adequacy. V. Cherkasova [29] argues that VaR can be used not only for internal control and information disclosure but also to monitor the effectiveness of hedging strategies, including those using FX derivatives, analyze possible scenarios, and limit risks. She offers an empirical analysis of the applicability of the VaR methodology for investigating the impact of FX rate change on a company's operating cash flows approximated by EBITDA by incorporating it into the multiple regression model. Of the three strategies considered – no h edging, hedging using a forward contract, and hedging using an option contract – the latter two result in higher profits and lower VaR estimates. Of the two hedging strategies, the strategy using forward contracts provides better results because of lower hedging costs. Thus, the VaR method can be used not only to evaluate risk but also to compare different hedging strategies.

S. Shvets [42] applies different methods – VaR, ETL, Monte Carlo simulation – to evaluate the exposure of foreign currency loans and corresponding interest payments to FX risk and shows that the results are close, possibly overestimated, and nonetheless acceptable for non-financial companies. He identifies another important issue for developing an FX risk management system: determining a company's level of risk tolerance, or losses as a percentage of equity, net profit, or revenue.

A. Sherstobitova and N. Kolacheva [31] discuss existing statistical approaches to risk evaluation and contrast the classic Value-at-Risk method with synthetic evaluation models based on its algorithm, such as Marginal VaR, Incremental VaR, EaR, Cash Flow-at-Risk (C-FaR), as well as beta analysis, SARM, ART, Short Fall, Capital-at-Risk, and Maximum Loss models. According to them, the factors behind the popularity of the VaR model include its software availability, the substantial losses by financial institutions, both from FX risks and from transactions with FX derivatives, and the use of VaR for external monitoring, as the regulator requires commercial banks to use it to determine the volume of reserves. VaR can also be used for internal monitoring. If statistical methods cannot be applied, expert methods such as questionnaires, interviewing, scenario analysis, Delphi, etc. are used.

V. Zaernyuk and N. Snitko [28] list existing instruments of risk evaluation, including models by Marcowitz, Black and Schowls, CAPM, expected shortfall, and Monte Carlo simulation, and discuss their original historical simulation-based Value at Risk (VAR) evaluation method, which is applied to a portfolio of open foreign exchange positions, followed by stress testing.

S. Shvets and A. Sobolev [48] recognize the VaR method as the most common in Russian practice and argue that its limitations can be overcome if the "tail loss" evaluation (ETL – expected tail loss) using such metrics as expected shortfall (ES), tail conditional expectation (TCE), tail VaR (TVaR), conditional VaR (CVaR), etc. are applied. Another approach gaining popularity in the Russian market is spectral risk metrics (SRM) based on companies' willingness to tolerate risk. Testing various methods at different time periods, they show that when markets are relatively stable, the ETL approach can be used to evaluate FX risk, while during crisis periods as well as when trends are mixed, the SRM approach can be more relevant.

V. Yurchenko [21] compares different financial risk assessment techniques, including impact matrix, CAPM, and VaR. He concludes that the historical simulation VaR

method is the optimal choice as it takes into account not only market fluctuations but also the value of assets or liabilities at risk and proposes a VaR calculation algorithm.

Accounting difficulties were cited as one of the problems of using derivatives – a problem that persists today. The specifics of accounting for derivatives in accordance with Russian standards are described in several papers, mostly written by consultants, like A. Chuguj [52], or by professionals sharing their experience [53]. However, they were mainly published in professional magazines or on the web.

However, many non-financial organizations using derivatives are holding structures required to submit their consolidated financial reports according to IFRS. Initially, financial instruments disclosure was regulated by IFRS 7 [24], which was later replaced by IAS 39 and IFRS 9. IFRS 9 permits the use of hedge accounting, which treats an asset and its hedge as one when adjusting the fair value.

O. Okorokova and A. Pisetskaja [12] outline the hedge accounting prerequisites and procedure according to IAS 39 and IFRS 9 and argue that, when accounting for the effect of risk management using derivatives on profits and losses, companies should prioritize content over form for meeting requirements related to organization and administration of hedging transactions. A. Kuz'min [54] advocates centralized FX exposure management by the parent company in the interests of the whole group using IFRS 9.

P. Pankov [55] analyzes the use of hedge accounting in line with IFRS and US GAAP provisions by Russian non-financial blue chips and shows that only half of the sample considered employ this method, despite its advantages such as increased transparency and management performance. On the other hand, the use of hedge accounting increases accounting and auditing expenses, and so the author proposes a methodology to determine whether it is needed. This methodology should be useful for consulting companies providing services in risk hedging.

Conclusions

We can draw the following conclusions from our study. Some of them are related to the reviewed Russian research.

First, Russian publications on derivatives and their use began to appear later and are much less numerous than international research – the topic became popular only in the 2000s with the development of the derivatives market and hedging practices.

Second, Russian research is secondary in comparison to international studies: Russian authors tend to consider issues that have long been discussed and resolved in international research.

Indeed, many Russian specialists ignored international research, especially at first. Of the articles reviewed, only a few [for example, 5; 24, etc.] cite foreign research or are based on it. However, the situation has begun to change for the better, and some recent articles [8; 49] are more aligned with international research in terms of problems, tools, and discussion level.

Next, most articles are descriptive or analyze secondary data; the share of original research, as well as the use of quantitative instruments, is low. These articles mostly treat model examples, while the factual data is limited to the blue chip sample, probably because public companies have to disclose information on using derivatives. Nevertheless, this makes the research one-sided, as the segment of non-public and mid-sized companies is not analyzed, and their hedging practices are not assessed.

Few authors distinguish between economic and transaction exposure or specify the type of exposure being hedged; the latter becomes clear only from the context. Most studies concentrate on hedging transaction exposure, ignoring economic exposure. Moreover, unlike foreign research focusing on specific types of risk and related hedging instruments, FX risks are often considered together with price and interest rate risks and the corresponding derivatives.

To sum up, Russian academic studies are marked by the following features:-

- Short history of economic analysis in the immature market.
- Focus on transaction exposure and secondary data, which may be explained by a comparably small number of listed companies disclosing accounting data and the limited access to the real financial data of private businesses.
- Limited analysis of statistical models and methods used in FX risk management due to a relatively low level of professional financial knowledge in most Russian corporate companies.

Our second set of conclusions is related to the derivatives market.

Different studies note that the market is still immature, and some issues remain unresolved. The latter include the accountancy and taxation of derivatives (from M. Kiseliov in 2012 [36] to E. Afendikova and V. Malyar in 2021 [17]). According to article 304 of the Russian Tax Code, the taxable amount of transactions involving derivatives should be treated separately unless their hedging purpose is substantiated by the company in a special hedging reference. Even if such a reference exists, these deals may be requalified as speculative by tax authorities and entail extra tax liabilities. At the same time, some problems such as high transaction costs mentioned in early studies [36; 38] are not relevant anymore due to the market's development.

Many papers examine derivatives market statistics and hedging trends. However, some of the evidence is contradictory. For example, D. Piskulov [9] estimates the client share at one third of the total bank transactions with FX derivatives by 2016. However, according to official Central Bank of Russia statistics[1], this is true only for FX forwards, while FX swaps and options are much less popular among

[1] URL: http://www.cbr.ru/content/document/file/126537/instruments_market_20210929.pdf

non-financial companies. P. Pankov [34] states that hedging commodity price risks using derivatives is more popular than FX hedging among Russian companies. However, a Central Bank of Russia derivatives market study (2022) notes that commodity derivatives account for an insignificant share of exchange-traded instruments[2].

Other conclusions are of a more general character and are related to Russian company practices of hedging FX exposure using derivatives.

Starting with E. Kayasheva [32], authors debate about optimal hedging volumes – whether to hedge total FX exposure or only part of it. On the one hand, total hedging minimizes transaction exposure for companies. On the other, it reduces flexibility, as underlying transactions remain vulnerable to unexpected changes in contract conditions, counterparty risk and internal decisions. Thus, the discussion should begin with an evaluation of FX exposure. Along with explicit transaction exposure, companies should consider economic exposure and market risks in general. After identifying risks, they should forecast cash flows depending on the FX rate volatility. However, hedging economic exposure using FX derivatives is still an open issue even in foreign research.

A. Efimov [10] suggests hedging when the exchange rate breaks through some predetermined level, ignoring the fact that hedging costs increase with market volatility. Waiting for a favorable market moment to enter hedging turns it into speculation.

The proposal of V. Cherkasova [29] and D. Balaburkina [44] to select optimal hedging instruments based on their maturities and costs raises doubts, as hedging costs are defined from the accounting standpoint, with options carrying explicit costs (option premiums).

Moreover, using accounting information from financial statements to evaluate the effect of hedging is inadequate, as recognized by P. Pankov [50], because, in accounting terms, hedging generates cash flows that are opposite to changes in other accounting items resulting from market volatility. So, the total anticipated accounting effect should be zero.

As for hedging objectives and results, researchers generally agree that hedging aims at risk mitigation rather than earning extra value, in alignment with hedging theory. However, fundamental quantitative studies are still rare in Russia. The article by I. Kuchin et al. [49] is a good example of the latter, as it contributes to international studies confirming investor behavior patterns and differences in importer and exporter positions observed in other markets.

For further research, P. Pankov [34] suggests analyzing FX risk hedging strategies used by individual non-financial companies, with an expanded sample of firms. Also of interest are hedging strategies and the revision of derivatives use under economic sanctions, when some of the cash flows subject to hedging should no longer be received.

The current political and economic situation has inevitably influenced the FX derivatives market and hedging practices. V. Bel'kovec-Krasnov [56] shows that market volume has decreased overall due to sanctions, the withdrawal of foreign participants from the market, and the blocked assets of companies under sanctions. Secondary effects of sanctions in the interbank market include decreased liquidity on the derivatives market, the lower activity of market makers, and insufficient market information and infrastructure due to the withdrawal of foreign news agencies and trading platforms from the Russian market. As commercial flows gradually reorient to other countries, it is necessary to develop new FX derivatives and a market for them.

References

1. Lialin V.A. A. Formation and development of the Russian market of derivative financial tools. Problemy sovremennoj ekonomiki = Problems of Modern Economy. 2015;(1(53)):135-138. (in Russ.)
2. Securities market and derivatives. Bibliographic index. 1993–2003. 2004:155 p. (in Russ.)
3. Piskulov D.Yu. Financial derivatives in the russian interbank market. Den'gi i kredit = Finance and Credit. 2007(3):54-64. (in Russ.).
4. Khmelev I. B. Currency Risk Management in Russian Companies. Transportnoe delo Rossii = Transport Business of Russia. 2012;(6-1):127-131. (in Russ.)
5. Dmitrieva M.A. Hedging Interest and Currency Risks in Non-Financial Sector Companies [dissertation]. Moscow; 2016. (in Russ.). URL: https://www.dissercat.com/content/strategiya-khedzhirovaniya-protsentnogo-i-valyutnogo-riskov-v-kompaniyakh-nefinansovogo-sekt (accessed on 13.07.2023).
6. D'yachkov A.A. Futures as a forward market instrument to hedge currency risks. Nauchnye zapiski molodyh issledovatelej = Scientific Notes of Young Researchers. 2016;(4-5):45-52. (in Russ.)
7. Danilov Yu.A. Analysis of development of the Russian market of derivatives. Moscow: RANEPA; 2018. 100 p. (in Russ.)
8. Bobrovskaja, M.S. Exchange Rate Exposure of Company Value. Korporativnye Finansy = Journal of Corporate Finance Research. 2012;6(1):71-83. (in Russ.) DOI: 10.17323/j.jcfr.2073-0438.6.1.2012.71-83.
9. Piskulov D.Yu. Russian derivatives market in 2016: research done by the national finance association. Den'gi i kredit = Money and Credit. 2017;(3):25-32. (in Russ.)
10. Efimov A.A. Financial methods of foreign currency hedging at the industrial enterprises. Vestnik Udmurtskogo universiteta. Serija «Jekonomika i pravo» = Bulletin of Udmurt University. Economics and Law Series. 2010;(3):13-21. (in Russ.)

[2] Market PFI – 2022. URL: https://www.cbr.ru/content/document/file/141791/press_5.pdf

11. Gubernatorov A.M., Kazmina N.I. The possibility of using derivatives as a powerful «damper» in the policy of floating exchange rate. Vestnik universiteta = Bulletin of. University. 2015;(2):227-234. (in Russ.)
12. Okorokova O.A., Piseckaja A.I. Hedging as a Method Of Currency Risks Control. Nauchnyj zhurnal KubGAU = Scientific Journal of KubGAU. 2017;(130):799-809. (in Russ.) https://doi.org/10.21515/1990-4665-130-056
13. Vinnikova I.S., Kuznetsova E.A., Dudina K.S., et al. Problems and features of hedging risks in the currency market of Russia. Karel'skij nauchnyj zhurnal = Karelian Scientific Journal. 2017;6(4):153-155. (in Russ.)
14. Kazakov V.I. Analysis of the dynamics of the Russian market of derivatives. Biznes-obrazovanie v ekonomike znanij = Business Education in Knowledge Economy. 2018;(2 (10)):36-39. (in Russ.)
15. Anishchenko K.L., Panteleeva T.A. Problems and prospects of the Russian derivatives market. Vestnik Instituta mirovyh civilizacij = Bulletin of Institute of World Civilizations. 2018;9(1(18)):8-11. (in Russ.)
16. Kuklin M.V. Derivative financial instruments as a method to hedge enterprise risks. PRO-Ekonomika = PRO-Economics. 2019;3(1). (in Russ.)
17. Afendikova E.Yu., Malyar V.I. Hedging risks using derivative financial instruments. Vestnik Ural'skogo instituta ekonomiki, upravleniya i prava = Bulletin of Ural Institute of Economics, Management and Law. 2021;4(57):5-15. (in Russ.)
18. Melnikova N.S., Konnova A.V., Logvinova A.S. The Russian market of derivative financial instruments at the present stage of development. Nauchnyj rezul'tat. Ekonomicheskie issledovaniya = Research result. Economic research. 2019;5(2):58-65. (in Russ.). https://doi.org/10.18413/2409-1634-2019-5-2-0-7
19. Serikov S.G., Chuprakova K.E. Analysis of the russian market derivative financial instruments. Vestnik Universiteta. 2019;(8):169-174. (In Russ.) https://doi.org/10.26425/1816-4277-2019-8-169-174
20. Yurchenko V.E. Hedging financial risks of domestic industrial companies on national exchanges. Ekonomika i upravlenie: problemy i resheniya = Economics and management: Problems and Solutions. (in Russ.) 2021;(3(111)):114–119. https://doi.org/10.36871/ek.up.p.r.2021.03.01.016
21. Yurchenko V.E. Global practice of hedging financial risks in the context of developing relevant strategies for their leveling for Russian companies in the real sector of the economy. Obshchestvo: politika, ekonomika, pravo = Society: Politics, Economics, Law. 2021;(10):31-35. (In Russ.) https://doi.org/10.24158/pep.2021.10.4
22. Polteva T.V., Luk'janova E.S. The Practice of Using Derivatives as Instrument for Hedging. Vestnik NGIJeI. 2015:1(44):69-74. (in Russ.)
23. Kurilova A.A. Methodology for the Selection of Hedging Instruments by Automotive Companies. Finansovaya analitika: problemy i resheniya = Financial Analytics: Problems and Solutions. 2011;(17):29-38. (in Russ.)
24. Okulov V.L., Skripyuk V.I. Impact of risk hedging on share price dynamics of Russian companies. Vestnik Sankt-Peterburgskogo universiteta. Menedzhment = Sankt-Petersburg University Bulletin. Management. 2012;(3):3-24. (in Russ.)
25. Krasovskij N.V. Classification of tools for currency risks hedging. Promyshlennost': jekonomika, upravlenie, tehnologii = Industry: Economics, Management, Technologies. 2012;1(40):130-132 (in Russ.).
26. Sulejmanova A.L., Blazhevich O.G., Murashova E.A. Hedging as a method of insurance of currency risks. Science Time. 2016;(12):636-643. (in Russ.)
27. Krasovskij N.V. Options as currency risks management tools. Promyshlennost': jekonomika, upravlenie, tehnologii = Industry: Economics, Management, Technologies. 2012;1(40):132-135 (in Russ.).
28. Zaernyuk V.M., Snitko N.O. Methodological approaches to estimating the currency risk of gold mining enterprises. Finansovaya analitika: problemy i resheniya = Financial Analytics: Problems and Solutions. 2018;11(2):170-178. (in Russ.) https://doi.org/10.24891/fa.11.2.170
29. Cherkasova V.A. Choosing an effective strategy to hedge oil company currency risks. Finansovaya analitika: problemy i resheniya = Financial Analytics: Problems and Solutions. 2013;(26):26-33 (in Russ.).
30. Kiseleva I.A., Simonovich N.E. Risk Management in The Currency Market. Innov: jelektronnyj nauchnyj zhurnal = Innov: Electronic Scientific Journal. 2016;4(29). (in Russ.)
31. Sherstobitova A.A., Kolacheva N.V. Classification and methods of evaluation of currency risks. Karel'skij nauchnyj zhurnal = Karelian Scientific Journal. 2017;6(2):141-145. (in Russ.)
32. Kayasheva E.V. Currency risk: a possibility of his assessment and hedging in modern conditions. Finansy i kredit = Finance and Credit. 2009;(27):70-81. (in Russ.)
33. Krasovskij N.V. Hedging as a method of managing currency risks. Vestnik Tambovskogo universiteta. Seriya: Gumanitarnye nauki. 2012;(1):44-47 (in Russ.).
34. Pankov P.I. Hedging market risks in the branches of the real sector of economy in the Russian Federation. EFO: Ekonomika. Finansy. Obshchestvo = EFS: Economics, Finance, Society. 2022;(3):4-17. (in Russ.) https://doi.org/10.24412/2782-4845-2022-3-4-17
35. Krasovskij N.V. Hedging foreign currency risks in the Russian forward market. [dissertation abstract].

Saratov; 2012. (in Russ.). URL: https://www.dissercat.com/content/khedzhirovanie-valyutnykh-riskov-na-rynke-srochnykh-finansovykh-instrumentov-rossii/read/pdf (Accessed on 15.06.2023).

36. Kiseljov M.V. Peculiarities of Currency Risk Hedging in Russia. Finansy i kredit = Finance and Credit. 2012;(16):44-47. (in Russ.)
37. Kiseljov M.V. Problems of derivatives market development in Russia and ways to solve them. Finansy i kredit = Finance and Credit. 2008;(43):22-30. (in Russ.)
38. Kokosh A.M. The constraints of Russian market in currency risk hedging by corporations. Rossiyskoe predprinimatelstvo. 2015;16(16):2543-2550. (in Russ.) https://doi.org/10.18334/rp.16.16.612
39. Results of a research of treasury function. 2015. (in Russ.). URL: https://rosim.gov.ru/Attachment.aspx?Id=51203 (Accessed on 15.06.2023).
40. Mazin G.E. Russian companies' needs for derivatives in risk management study. Gumanitarnye, social'no-ekonomicheskie i obshchestvennye nauki = Humanities, Socio-Economic and Social Sciences. 2020;(9):200-202. (in Russ.)
41. Mazin G.E. Assessment of the influence of risk management by means of derivative financial instruments on the cost of Russian public companies. Mezhdunarodnyj nauchnyj zhurnal = International Scientific Journal. 2019;(6):83-94. (in Russ.)
42. Shvets S.C. Managing currency risk non-financial companies: methods and tools. Izvestiâ Sankt-Peterburgskogo gosudarstvennogo èkonomičeskogo universiteta. 2016;(6):29-41. (in Russ.)
43. Kurilov K.Yu. Using Derivatives to Hedge Risks of Russian Automakers. Finansovaya analitika: problemy i resheniya = Financial Analytics: Problems and Solutions. 2013;(2):32-42. (in Russ.)
44. Balaburkina D.S. Currency Risk Assessment and Management by Telecommunications Enterprise. Molodoj uchenyj = Young Scientist. 2015;(3):384-389. (in Russ.)
45. Fedosov_E.M. Management of currency risk: approaches and methods [Bachelor Thesis]. St. Petersburg; 2017. (In Russ.) URL: https://dspace.spbu.ru/bitstream/11701/10081/1/VKR_Fedosov_EM_FKSiU-42.pdf (Accessed on 15.06.2023)
46. Study of Financial and Treasury Management Practices in Russia and the CIS in 2014-2015. URL: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/06/ru-ru-finance-and-treasury-survey-2014-2015-april-2016.pdf (Accessed on 15.06.2023).
47. Study of Financial and Treasury Management Practices in Russia in 2020. URL: https://sscclub.ru/wp-content/uploads/2021/05/ru-ru-treasury-survey.pdf (Accessed on 15.06.2023).
48. Shvets S., Sobolev A. Comparative study of the currency risk management efficiency in Russian high-tech companies in the telecommunication sector of the economy. Norwegian Journal of Development of the International Science. 2018;(14-2):27-33.
49. Kuchin I., Elkina M., Dranev Y. The Impact of Currency Risk on Firm's Value in Emerging Countries. / Korporativnye Finansy = Journal of Corporate Finance Research. 2019;13(1):7-27. https://doi.org/10.17323/j.jcfr.2073-0438.13.1.2019.7-27.
50. Pankov P.I. Hedge effectiveness assessment in non-financial organizations: economic approach. Vestnik of Polotsk State University. Part D. Economic and Legal Sciences. 2021;(6):63-72. (in Russ.) https://doi.org/10.52928/2070-1632-2021-57-6-63-72
51. Pankov P.I. Planning transactions with derivatives in non-financial organizations: current state and development. Vestnik Polockogo gosudarstvennogo universiteta. Seriya D. Ekonomicheskie i yuridicheskie nauki = Polotsk State University Bulletin. Series D. Economic and Law Disciplines. 2020;(13):64-70. (in Russ.)
52. Chuguj A. How to maintain tax and financial accounting of derivatives. SberPro [Internet]. 18.08.2020 [cited 2023 June 15]. Available from: https://sber.pro (in Russ.)
53. Goncharov A. If you buy or sell in foreign currency: how to mitigate risks. Finansovyj director = Financial Director. 2017;(8):30-35. (in Russ.)
54. Kuzmin A.Yu. Issuesof Hedge Accounting i n IFRS inConsolidated financial Statement. Uchet. Analiz. Audit = Accounting. Analysis. Auditing. 2019;6(1):40-49. (In Russ.) https://doi.org/10.26794/2408-9303-2019-6-1-40-49
55. Pankov P.I. Theoretical Aspects of Hedge Accounting in Non-Financial Institutions: Problematic Field and Potential Effects. Uchet. Analiz. Audit = Accounting. Analysis. Auditing. 2022;9(5):22-33. (In Russ.) https://doi.org/10.26794/2408-9303-2022-9-5-22-33
56. Bel'kovec-Krasnov V. How the derivatives market will develop. Buhguru. Buhgalterskij internet-zhurnal. 15.08.2022. (In Russ.). URL: https://buhguru.com/finansy/kak-budet-razvivatsya-rynok-proizvodnyh-finansovyh-instrumentov.html (Accessed on 15.06.2023).

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

The authors declare no conflicts of interests.

The article **was submitted** 06.01.2024; **approved after reviewing** 08.02.2024; **accepted for publication** 29.02.2024.