

Financialization and innovation activity of Russian companies: Empirical research

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Abstract

In this paper, we conducted an empirical study to assess the nature of the relationship between financialization and the level of innovation activity in Russian publicly listed companies. We relied on previous research in this area and on the models proposed by the researchers. In the empirical part, we prepared four models, based on the sample including 245 Russian publicly listed companies and having the observation period from 2000 to 2021. We applied Ordinary Least Square (OLS), Pooled Least Square (PLS) models, as well as panel data models with fixed and random effects. According to our hypotheses, financialization has a negative impact on the level of innovation in firms and its impact is varying for firms with different levels of financial constraints. The results of the study have shown that these hypotheses were partially confirmed. We have been convinced of the negative impact of financialization on innovation activity, however, if financial constraints were taken into account, not all coefficients had an unambiguous interpretation. Our assumptions and the results obtained, which generally confirmed the hypotheses put forward, are based on a theoretical understanding of the role of shareholder value orientation in this process. Confirmation of these assumptions is set as the goal of further research.

Keywords: financialization, innovation, panel data, Russian economy, shareholder value.

JEL classification: C23, D22, G30.

1. Introduction

The general trend in the development of the world economy over the past half century has been an accelerated development of financial markets and institutions. In particular, according to the World Bank, the ratio of the total value of traded shares of publicly listed companies to GDP increased from 6.0% to 144.5% in

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the world in the period 1975–2000. On the eve of the Great Recession, in 2007, this ratio exceeded 160% (World Bank data). As a rule, the financial sector's development went hand in hand with the globalization of the world economy. Another consequence of this process is financial liberalization. The latter mainly applies to developing and emerging economies in Latin America, Asia, Africa and Eastern Europe.

The transformation of the world economy in the realm of financial system development is called “financialization.” One of the most common definitions of this concept in the literature belongs to Epstein (2005, p. 3): financialization is “the increasing role of financial motives, financial markets, financial actors and financial institutions in the operations of the domestic and international economies.”

The understanding of financialization varies in different schools. Most representatives of the neoclassical school do not use the term “financialization” at all and prefer to speak about financial development. Financial development is considered to be a generally positive process. Within the neoclassical framework, the development of financial markets and institutions contribute to the growth of the economy and investment (King and Levine, 1993; Beck et al., 2014; Sahay et al., 2015). Profound study and critical evaluation of financialization, as a rule, belongs to the heterodox schools of economic thought, i.e. schools detached from the dominant neoclassical approach. The phenomenon is explained in most works by the change of the corporate governance model in developed countries, which is called the “shareholder revolution.” Criticism of financialization is related to the assessment of its negative effects on various parameters of the economy, such as investments in fixed assets, wage growth, GDP growth, etc.

Innovation is a crucially important component for the modern development of companies. Schumpeter was one of the first who emphasized the importance of innovation for economic development. He stressed that innovation played a key role in the process of structural changes that contribute to economic development (Śledzik, 2013). Schumpeter considered innovation as the launching of new products, implementation of new technologies or new methods of production, the opening of new markets, the acquisition of new sources of supply and the creation of new industry structure (Schumpeter, 1983). Nowadays, digital technologies as well as IT industry have become the flagship of innovation. The same is applicable for Russia. According to Higher School of Economics research, the share of IT industry in Russian GDP grew from 0.5% to 1.1% during 2011–2019. Gross Value Added of IT industry more than doubled in this period, from 400 billion rubles to more than 1000.

The purpose of this study is to assess financialization's impact on investments in innovation activities. We assume that these investments are decreasing due to the growth of financial assets and financial expenses of companies. This proposition is based on the change of development strategy—from long-term growth strategies to short-term ones.

The sample including non-financial publicly listed Russian companies was chosen as the base of the research. It is worth noting that not so many works are devoted to the study of financialization in Russia. Its impact on investments in innovation activities of Russian companies is generally being assessed for the first time.

This research consists of four parts: in section (2) we conduct a literature review and describe the essence of financialization, as well as demonstrate the relevance of the study; section (3) is devoted to describing the relationship between financialization and innovation in companies; in section (4) we provide a short overview of the origins and essence of financialization in Russia; in sections (5), (6), (7) we describe the data we used and the model we prepared. In these sections, we analyze the dynamics of the indicators that we consider further, describe the sample and the equations we formulated, as well as working hypotheses. The core of the empirical research is presented in section (8) “Data analysis and model specification,” where we present four models and test them with accordance to our hypotheses. In section (9) we provide regression diagnostics, whereas section (10) is devoted to describing the results and discussing the perspectives of the study.

2. Literature review and relevance of the study

The study of financialization has several main directions: a macroeconomic approach, a microeconomic approach and a mesoeconomic one. Popularity of research on financialization grew sharply after the Great Recession of 2008–2009 as a reaction to the excessive role of the financial sector in the economy. Thus, Mader et al. (2020) note that the number of journal papers which had the term “financialization” in their title increased 4 times in 2019 compared to 2010 (Fig. 1).

Among researchers who have studied the phenomenon through the prism of macroeconomics, Boyer (2000, p. 116) defines financialization as a “finance-led accumulation regime.” Krippner (2005, p. 174) characterizes the phenomenon as “a pattern of accumulation in which profits accrue primarily through financial channels rather than through trade and commodity production.” Financialization within the framework of microeconomic analysis was defined by Martin (2002, p. 6) as “the introduction of accounting and risk management orientation in all spheres of life.” The works of Froud with coauthors, Lazonick and O’Sullivan are devoted to financialization and its relationship to changes in corporate governance. In an earlier paper, Froud et al. (2000, p. 104) defined financialization

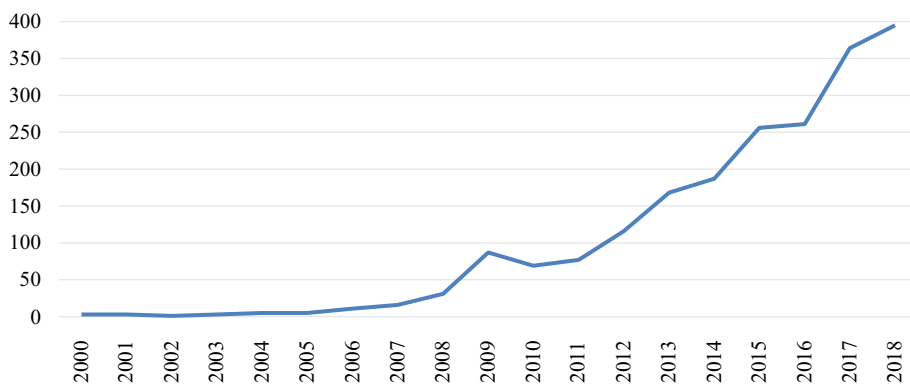


Fig. 1. The number of papers containing the word “financialization” in the title.

Source: Mader et al. (2020).

as “a new form of competition which involves a change in orientation towards financial results but also a kind of speed up in management work.” Six years later, the definition was clarified: financialization is “changes induced by the rhetoric of shareholder value which sets firms and households utopian objectives such as value creation by management intervention for giant firms or security through stock-market saving for households” (Froud et al., 2006, p. 66). Lazonick and O’Sullivan (2000, p. 17) defined financialization as a process in which firms have moved from a managerial strategy related to the accumulation of profits and reinvestment in production to a strategy of distributing funds in favor of shareholders.

On the eve of the Great Recession, several papers were published that became the starting point for research on the effects of financialization. An important work is the research by Stockhammer (2004). This work is devoted to assessing the impact of financialization on the slowdown of capital accumulation in developed countries (Germany, France, Great Britain and the U.S.). The results confirmed the negative impact of financialization on the accumulation of fixed capital, but with some reservations. In particular, the econometric model had autocorrelation problems in several specifications. Additionally, the coefficient associated with the influence of the financialization factor was insignificant and had a positive sign in the case of Germany. Orhangazi (2008) confirmed that the financialization of the U.S. economy in the period from 1973 to 2003 had a negative effect on investments in fixed assets. This was due both to an increase in payments to shareholders in the form of dividends and through the repurchase of shares, and to an increase in the profitability of financial investments relative to investments in fixed assets. These factors prompted firms to abandon long-term investments in real assets and use available funds for short-term financial investments.

There are a number of papers devoted to financialization in developing countries. Most of them also belong to heterodox schools, in particular post-Keynesian (Demir, 2007, 2009), Marxist (Lapavistas, 2009), and Institutional schools (Becker et al., 2010). Demir assessed potential factors contributing to financialization in Turkey, Argentina and Mexico. The conclusion is as follows: the increase in country risk, the volatility of asset prices in the global capital market and the growth rates of interest rates, as well as foreign direct investment (FDI) flows caused the growth of financial investments to exceed fixed ones. Factors constraining financialization were the availability of long-term credit for enterprises, steady GDP growth and sales growth achieved by private firms. Lapavistas showed that in developing countries financialization led to a transition from a financial system based on the dominance of the banking sector (bank-based financial system) to a system based on the dominance of stock markets (market-based financial system). Becker et al. (2010) examined financialization from an institutional point of view using the examples of Chile, Brazil, Serbia and Slovakia. They showed that in these countries the actions of international organizations such as the IMF, the World Bank and their proposed macroeconomic policy, called the Washington Consensus, were important factors in financialization.

Tori and Onaran (2018) examined the impact of financialization on investment using a linear model. They identified the following model factors: the rate

of investments in fixed capital for the previous period, profit margins (ratio of retained earnings to fixed capital), return on funds (ratio of revenue to fixed capital), financial payments (including interest and dividend payments) and income from financial activities. The final specification of model (1):

$$\begin{aligned} \left(\frac{I}{K}\right)_{it} = & \beta_0 + \beta_1 \sum_{j=1}^2 \left(\frac{I}{K}\right)_{it-j} + \beta_2 \sum_{j=1}^2 \left(\frac{\pi - CD}{K}\right)_{it-j} + \beta_3 \sum_{j=1}^2 \left(\frac{S}{K}\right)_{it-j} + \\ & + \beta_4 \sum_{j=1}^2 \left(\frac{F}{K}\right)_{it-j} + \beta_5 \sum_{j=1}^2 \left(\frac{\pi_F}{K}\right)_{it-j} + \beta_t + \varepsilon_{it}, \end{aligned} \quad (1)$$

where: I —gross addition to fixed assets; π —operating income; CD —cash dividends; S —net sales; F —interest and dividend payments; π_F —financial incomes; K —capital.

Within the framework of the hypothesis, variables of financial payments and financial incomes were identified as factors of financialization, since it was assumed that they negatively affected the growth of investments in fixed assets, while other factors, on the contrary, had a positive effect. The authors' hypothesis was confirmed and they showed that the accumulation of fixed capital investments in UK non-financial companies would have been 8.5% higher without an increase in interest and dividend payments in 2007 compared to 1985, and 3.6% higher without the effect of displacement provided by the growth of financial income.

Tretyakov and Rozmainsky (2021) examined the impact of financialization on the accumulation of fixed capital in Russia. The authors utilized the model of Tori and Onaran (2018), trying to account for the impact of financial income for small and large companies. The authors showed that financialization “frozen” investments in fixed assets in the Russian private non-financial sector. These results are consistent with conclusions obtained by the authors of previous works on this topic, and in general confirm the thesis that switching from long-term to short-term strategies drains “free” funds, which could be used for investments in fixed assets. Similar results were obtained by Kuzmina and Rozmainsky (2020) for the non-financial sector of private firms in Spain.

A review of the literature indicates that the relationship between financialization and fixed capital accumulation has been studied in sufficient detail. Another component of real investments other than fixed capital investments is a R&D (research and development) investments and intangible assets of companies. In the next part, we have considered research devoted to the analysis of the relationship between financialization and innovative activity of companies.

3. Financialization and innovation activity

Before we formulate the hypotheses of the study and justify the model specification, we should consider research on the impact of financialization on investments in innovation (R&D and intangible assets) developed in recent years.

Lazonick (2011) examined the impact of financialization on investments in innovation by U.S. companies and identified the role of the shareholder value ideology in this process. He stressed that the transition of U.S. companies from innovation strategies toward strategies based on maximizing shareholder value and finance led to the vulnerability of the U.S. economy in the face of the financial crisis.

Lee et al. (2020) tied the slowdown of innovation development to short-termism, which is caused by financialization and shareholder value orientation. The authors concluded that financialization might lead to an increase of quantitative indicators of innovation (as a number of patents), but causes a decrease in the quality of these innovations. Since the growth of innovation indicators is considered to be a positive market signal about the attractiveness of a firm in terms of shareholder value, firms are increasing the number of patents in the context of growing financialization. However, these innovations are becoming incremental rather than radical.

Yan and Li (2019, p. 2) had been studying the private sector of China, hypothesizing that there was an inverse relationship between the financialization of non-financial publicly listed firms and the level of their investments in R&D. At the same time, an additional hypothesis was a reservation regarding the level of financial constraints. The authors stressed that “when financing constraints are strong, financialization shows a restraining effect on the level of innovation, whereas it shows a mitigating effect on the level of innovation.” The number of patents created by the company is used as a proxy of innovations. Both hypotheses were confirmed according to sample of Chinese companies trading with A-shares (3,175 observations).

Hou et al. (2021) investigated the impact of financialization on manufacturing R&D investments among Chinese private companies in 2007–2018. The authors considered the role of government subsidies in this process. The authors used the size of enterprise, the level of financial constraints, the region of China in which the enterprise operates as control variables — and concluded that the financialization of industrial firms as a whole negatively affected the level of investment in R&D, and a high degree of financial constraints, as well as government subsidies, exacerbated this impact.

Yu et al. (2022) revealed that the financialization of non-financial publicly listed companies in China affected R&D investments differently depending on the type of financial assets that the firm accumulates. The authors distinguished two types of financialization.

1. Transaction-oriented financialization, which “usually refers to short-term financial assets with low returns and risks, but with strong liquidity which can be converted into reserve assets for real investment.”

2. Investment-oriented financialization which can be expressed as the accumulation of “financial assets for profit, long-term investment or speculation purposes.”

The first type of financialization increases the liquidity of companies and gives them resources for development, while the second type promotes the achievement of speculative goals such as extraction of financial income. As a result, the investment-oriented financialization leads to a decrease in R&D investments.

Yu et al. (2022) emphasize that managers often tend to direct funds to less uncertain and more profitable projects, which hinders long-term innovative development of company. According to the authors, the opportunism of large shareholders who prefer short-term profits to the detriment of long-term growth has a negative impact on investment in R&D.

Goda and Larrahondo Dominguez (2022, p. 3) provided cross-country analysis of the role of dividend policy on R&D spending in private companies. The authors showed that “dividend payouts had a substantial negative effect on firm-level R&D investment...” They also emphasized that such considerations proved that financialization displaced not only investments in fixed assets, but also another component of real investments—investments in intangible assets.

According to previous considerations, financialization “freezes” both investments in fixed assets and investments in innovation activities. Moreover, as the authors of the above studies note, in the case of R&D, the reasons for such an impact of financialization also result from the agency conflict—switching from real investments to financial ones is the result of the opportunism of managers and their orientation toward maximizing shareholder value. We focused on the empirical analysis of relationship between financialization and investments in innovation in Russian companies and provided our methodology and results in the following sections.

4. Financialization: Russian pathway

Russia’s pathway of financialization as well as the start of the introduction of neoliberal policies, dates back to the period of the dissolution of the Soviet Union and the implementation of market principles into the Russian economy. Like any emerging market, Russia’s economy experienced typical transformation during 1990–2000—liberalization, deregulation of financial transactions, reduced governmental spending, and the emergence of financial markets.

Ivanov et al. (2019) wrote about the rising financial capital in Russia during the post-Soviet transition to a market economy. They stress that the development of financial sector in Russia in the 1990s coincided with the significant decline of the real sector. A good example of the flow of value into financial assets is a broad wave of voucher privatization, which involved the purchase of shares in enterprises by the population. This practice, as well as the construction of different financial pyramids under circumstances of nearly zero regulation in this field, reflects the transition of financial power to a narrow circle of financial oligarchy. Some researchers wrote about the lack of rationality of the financial markets’ participants and the “invasion” of fraudulent companies into such markets in Russia (Rozmainsky, 2017).

With the intention of describing development of financialization in emerging market economies (EMEs), Stockhammer and Karwowski (2017) defined for Russia and other emerging economies factors of financialization such as: growing value of financial reform index, increasing stock of foreign liabilities, high volatility of prices on real estate market, shift from bank-based to market-based financial system, high indebtedness of non-financial companies and households.

Therefore, we can say that the specifics of Russian financialization are generally similar to those in Eastern European countries, i.e., countries with emerging markets. All of them had similar problems, such as emerging institutions, weak protection of property rights, high debt burden of non-financial companies and households.

In general, in Russia financialization takes place to the same extent as in many other countries. “Non-financial companies are increasing their presence in the financial markets by increasing the number and volume of financial transactions” (Tretyakov and Rozmainsky, 2021, p. 237). Despite many unique characteristics, Russia is a country with poorly protected private property and capitalist finances, rising private indebtedness and financial instability. Most aspects of the theory of financialization can be quite applicable to the analysis of a number of problems of the Russian economy.

5. Data

At first, we should start by describing the dynamics of the main indicators used later in the empirical part of the work. We used the official data of Federal State Statistics Service (Rosstat) and World Bank statistics regarding innovation activities of Russian companies over the past two decades. We focused on two main indicators of innovation: R&D investments and intangible assets. According to Rosstat, investments in innovations had high volatility over the whole period from 2000 to 2021, and were tied to changes in the market and political environment. R&D investments decreased after 2008–2009 crisis and began to grow after 2014, which might be related to the rise of research in the military sphere. At the same time, the number of organizations engaged in R&D is relatively stable throughout the entire period, except for a significant rise since 2015 (Figs. 2–3).

Now let’s consider the dynamics of financialization factors. The dynamics of long-term and short-term financial investments over the past 20 years show a significant increase in the role of finance in the Russian economy (Fig. 4).

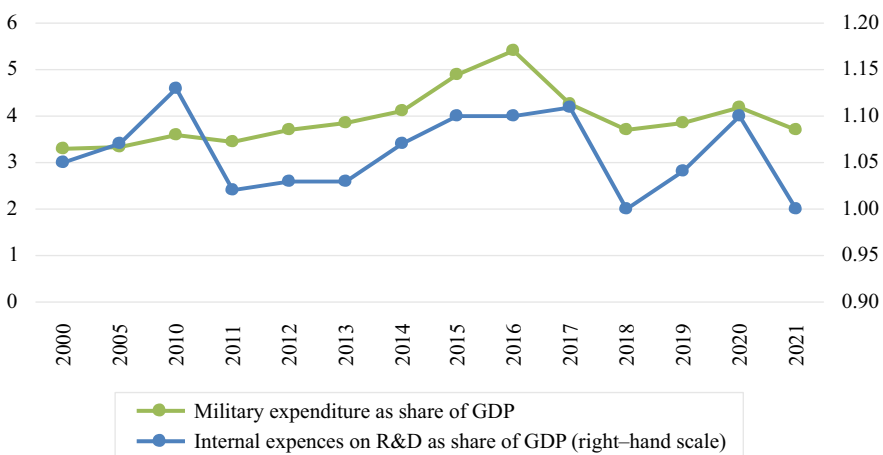


Fig. 2. The dynamics of R&D activities in the Russian economy (%).

Sources: Rosstat; World Bank.

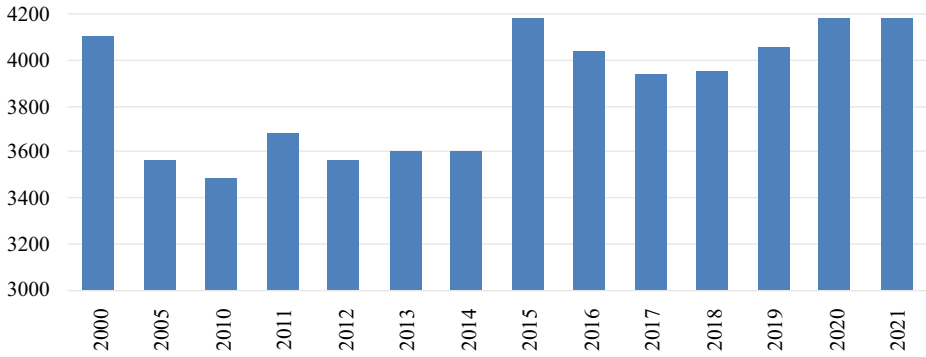


Fig. 3. The number of companies, which carried out R&D activities in Russia.

Source: Rosstat.

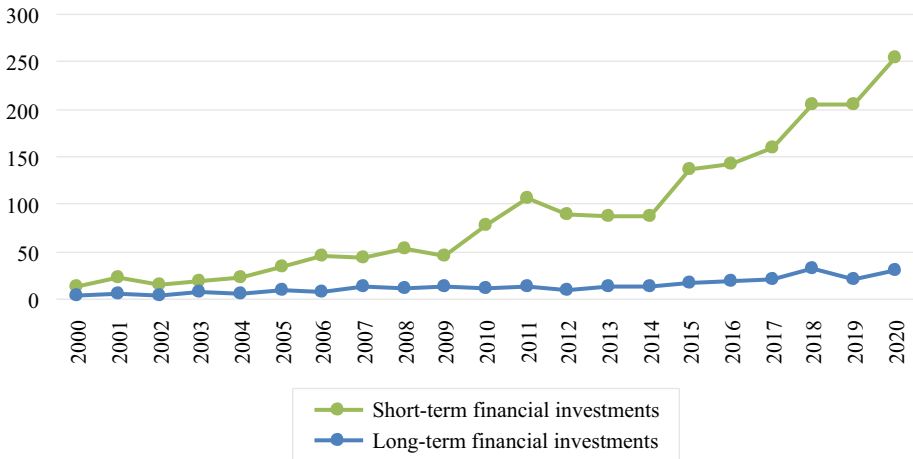


Fig. 4. Financial investments in Russia as a share of GDP, 2000–2021.

Source: Rosstat.

Therefore, one can observe the growing importance of financial investments in the economy, as well as the growing importance of innovation.

6. Working hypotheses

The level of firms' involvement in innovative activity can be defined through two proxy variables—research and development (R&D), which includes the costs of creating innovative goods, services and technologies, and intangible assets (licenses, patents, software etc.) as a result of innovation activity (Pavitt, 1982, 1985). We use intangible assets as an innovation proxy variable because this indicator was widely disclosed in financial statements of companies in the sample.

As for the use of intangible assets as a measure of a company's innovation, there are both positive and negative sides. For example, Kramer et al. (2011) note that the size of intangible assets is often a key factor in creating added value in knowledge-intensive industries. Meanwhile, Banga et al. (2021) stress that

the size of the intangible asset portfolio is not as important as the process of creating and renewing this portfolio, as well as the variability of patents (patent for application or for general purposes) and the breadth/depth of innovation.

However, it is still reasonable to consider intangible assets as an innovation measure since they reflect the value of assets such as intellectual property, patents and industrial designs. Moreover, considering the overall impact of financialization on intangible assets does not require us to provide more detailed information about their structure.

Based on results of previous researches, we formulated the following hypotheses:

H1: Financialization negatively affects firm's investments in intangible assets in Russia;

H2: The impact of financialization on the innovativeness of firms is different for firms with different levels of financial constraints.

We based our research on the assumption that financialization contributes to the decline of real investments, which include both investments in fixed assets and the creation of intangible assets. We also assumed that financialization of the non-financial sector was a consequence of shareholder value maximization ideology dominance in economics and management and that this led to the potential decline of overall real investments (Lazonick, 2013; Stockhammer, 2005).

Our equation is based on previous studies, which investigated the impact of financialization on innovation intensity. Similar to the approach of Yu et al. (2022), we considered the share of long-term and short-term financial assets as significant implications of financialization. We also included the level of financial payments (which consists of interests and dividends), which is similar to the approach of Goda and Larrahondo Dominguez (2022), Tori and Onaran (2018), and Tretyakov and Rozmainsky (2021). We added the amount of gross revenue and dummy-variable of year as control variables to the model. Consistent with previous research, we took the natural logarithm of the most of the variables in order to account for potential nonlinear relationship and to reduce possible heteroscedasticity. We also divided the variables (except the revenue variable) by the firm's total assets to account for its size. The final specification (2):

$$\begin{aligned} \ln\left(\frac{IA}{Assets}\right)_{it} &= \ln\left(\frac{IA}{Assets}\right)_{it-1} + \ln\left(\frac{Fin1}{Assets}\right)_{it-1} + \ln\left(\frac{Fin2}{Assets}\right)_{it-1} + \\ &+ \ln\left(\frac{FE}{Assets}\right)_{it-1} + \ln(Rev)_{it-1} + \ln\left(\frac{IE}{Assets}\right)_{it-1} + \\ &+ DummyYear + \varepsilon_{it}, \end{aligned} \quad (2)$$

where: *IA*—intangible assets; *Assets*—the amount of the firm's total assets; *Fin1*—the short-term financial investments; *Fin2*—the long-term financial investments; *FE*—financial expenses (the interest expenses and dividends payable); *Rev*—the gross revenue of the company; *IE*—interest expenses.

At first, we included a lagged variable in order to take into account the impact of the past level of intangible assets on its level in the reporting year.

Such a financialization factor as the ratio of financial investments to total assets we divided into two variables. *Fin1* includes short-term financial investments, which in Russian Accounting Standards (RAS) consist of bonds and other securities with a maturity of less than 12 months, deposits and loans with the same maturity. *Fin2* includes long-term financial investments, which consist of long-term securities (shares, bonds with a maturity of more than 12 months etc.), share of capital in other organizations, loans granted with a maturity of more than 12 months.

We have taken a separate variable for interest paid (*IE*) and a variable for both interests and dividends (*FE*) for two reasons. At first, we did not obtain the particular information about dividend payments in our dataset, which is based on RAS. Secondly, due to this, we will be able to see the impact of a variable that includes both payments differs from a variable that includes only interest payments.

The level of gross income of the company, *ceteris paribus*, expands the amount of funds available for investment. Therefore, we have included a variable reflecting the amount of revenue (*Rev*) as one of the control variables.

In line with the first hypothesis, we expect that *Fin1*, *Fin2*, *FE* and *IE* have a negative impact on the level of intangible assets (*IA*). The level of intangible assets in the past and the revenue of the firm have a positive impact on the level of intangible assets in the reporting year.

According to our second hypothesis, we expect that the negative impact of financialization is weaker for firms with low financial constraints. Such firms have more free resources, are more stable and therefore are able to attract funds at lower interest rates, and vice versa.

It is also important to emphasize here that the results may be different if we were considering some other indicators of financialization. So, in the work of Tarverdyan and Rozmainsky (2023), the indicator of financial income (interest and dividend income) is used to assess the impact of financialization on R&D investments. Considering separately this indicator, the results of the mentioned work showed a positive impact of the growth of financial income on R&D, i.e., the potential effect of displacement was overlaid by a stimulating effect.

In addition, assessing the impact of the amount of borrowed funds on innovation activity may also make sense. In this case, we believe that the impact of such a financialization factor as the growth of non-financial companies' (NFCs) debt may be positive, since firms often lack internal resources to finance innovations (Bartoloni, 2013). However, in this case it is necessary to take into account the size of firms and their operational efficiency, since financial leverage can have a negative impact on the level of innovation for smaller and more financial unstable firms.

7. Sample description

We collected data of publicly listed companies from Russian information database SPARK. This database contains information from financial statements for a large number of entities and gives an opportunity to export data in the form of a summary report. We considered the longest period, which SPARK can

provide—from 2000 to 2021 as preferable because it gave us the possibility to evaluate the relationship on a long-term basis.

As a data source, we used the financial statements compiled according to RAS. It is important to note here that this standard is national and differs significantly from international financial reporting standards (IFRS), and that the RAS reporting data are unconsolidated. Our choice fell on RAS due to the fact that despite the obligation for publicly listed companies to publish statements in accordance with IFRS, the SPARK database has data on RAS to a much greater extent.

Our sample consists of 245 publicly listed joint-stock companies of 13 industries. The major industry representing our sample is manufacturing (see Table A1 in Appendix A). The sample includes a relatively high percent of companies implementing scientific, technical and professional activities, which in Russia aggregate such areas of activity as engineering and design work, research and development, consulting in the field of law and accounting. The classification of industries is the general classification of economic activities officially approved in Russia. Descriptive statistics for the sample are placed in Appendix A (Table A2).

In the process of preparing data for testing, we encountered the problem of data gaps, which we solved as follows: if 30% of observations are missing for a particular company, we excluded it. We filled in the remaining gaps with zeros.

8. Data analysis and model specification

To analyze the effects of financialization on investments in intangible assets, we tested four models: the Ordinary Least Squares (OLS), the Pooled Least Squares (PLS), a panel model with fixed effects (FE) and a panel model with random effects (RE). We used panel models with both balanced and unbalanced dataset (Baltagi, 2021).

At first, we built an OLS model and checked its quality. The problem with applying OLS to panel data is that it does not take into account both time and dimensional effects, which is typical for panel data models. We additionally created a Pooled Least Squares (PLS) model with year dummy variable. Subsequently, we checked the dataset for the influence of panel data effects through the Breusch and Pagan Lagrangian multiplier test for random effects. This test helps with choosing between PLS and random effects model. The results (see Tables A7–A9 in Appendix A) show that in our case there are the panel data effects. Therefore, we used both random and fixed effects models. Robust clustered standard errors were selected in order to eliminate potential heteroscedasticity and autocorrelation in panel data.

At first, we considered the model for overall sample, which includes 245 companies and covers 1334 observations. Results for this model are presented in Table 1. As we can see, all coefficients in OLS and PLS are significant at least at the level of 10%. As expected, financialization variables have a negative impact on the dependent variable, as well as previous level of innovation and revenue in previous period have a positive impact.

For all models there is a more intense negative relationship of the dependent variable with *Fin1* than with *Fin2* except the *FE* case, where *Fin2* is positive and

Table 1

Results for overall sample.

Variable	OLS	PLS	RE	FE
$\text{Ln}(IA/Assets)_{it-1}$	0.677*** (0.020)	0.750*** (0.021)	0.580*** (0.022)	0.371*** (0.035)
$\text{Ln}(Fin1/Assets)_{it-1}$	-0.150*** (0.024)	-0.085*** (0.022)	-0.080*** (0.027)	-0.050* (0.028)
$\text{Ln}(Fin2/Assets)_{it-1}$	-0.097*** (0.016)	-0.038*** (0.014)	-0.033* (0.020)	0.006 (0.028)
$\text{Ln}(FE/Assets)_{it-1}$	-0.250*** (0.025)	-0.173*** (0.023)	-0.160*** (0.027)	-0.116*** (0.028)
$\text{Ln}(Rev)_{it-1}$	0.102*** (0.007)	0.069*** (0.007)	0.050*** (0.007)	0.039*** (0.008)
$\text{Ln}(IE/Assets)_{it-1}$	-0.066*** (0.019)	-0.220*** (0.036)	-0.173*** (0.032)	-0.105*** (0.033)
_cons	-7.014*** (0.198)	-6.341*** (0.472)	-6.670*** (0.568)	-6.650*** (0.797)
<i>N</i>	1334	1334	1334	1334
Adj. <i>R</i> -square	0.510	0.601		
<i>R</i> -square within			0.273	0.292
<i>R</i> -square between			0.670	0.521
<i>R</i> -square overall			0.594	0.537
prob > <i>F</i>	0.000	0.000		0.000
prob > Wald chi2			0.000	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors and robust clustered standard errors in parentheses for OLS and FE, RE respectively.

Source: Authors' calculations.

insignificant. Despite the fact that long-term financial investments usually have higher returns, they are attracted rather to maintain liquidity in the long term. Moreover, according to some researchers whose works are devoted to the problems of innovative development in Russia, the inhibition of innovation is due precisely to the short-termism of managers and their orientation on short-term investments (Nestik, 2016; Balatsky, 2010).

Next, we consider models that take into account the level of their financial constraints. To test the second hypothesis, we divided the sample into two parts: we calculated the median Financial Leverage Ratio for each observation in the panel data—firms with high leverage are those that had a value above the median, and vice versa.

We obtained the following models for firms with high and low leverage (Tables 2–3). The impact of *Fin1* and *Fin2* factors on average do not differ much for firms with low and high financial leverage. In the case of OLS, there is a stronger negative impact of *Fin1* for firms with low leverage, which was not expected and otherwise for *Fin2*, that is consistent with our second hypothesis. The same result was obtained in PLS. The model with fixed effects shows that *Fin1* and *Fin2* are insignificant in two out of four cases, and according to the model with random effects, there is no sufficient difference for *Fin1* (*Fin2* is insignificant in model for firms with low leverage). More unambiguous results are obtained for the variables *FE* and *IE*. There is a stronger negative impact of variables for firms with high financial leverage, which is consistent with our suggestions.

Table 2

Results for firms with high leverage.

Variable	OLS_HighLev	PLS_HighLev	RE_HighLev	FE_HighLev
$\text{Ln}(IA/Assets)_{it-1}$	0.724*** (0.025)	0.794*** (0.292)	0.617*** (0.030)	0.414*** (0.036)
$\text{Ln}(Fin1/Assets)_{it-1}$	-0.122*** (0.040)	-0.061* (0.035)	-0.068* (0.039)	-0.041* (0.047)
$\text{Ln}(Fin2/Assets)_{it-1}$	-0.112*** (0.022)	-0.051*** (0.019)	-0.049* (0.028)	0.020 (0.037)
$\text{Ln}(FE/Assets)_{it-1}$	-0.323*** (0.053)	-0.271*** (0.054)	-0.242*** (0.056)	-0.212*** (0.078)
$\text{Ln}(Rev)_{it-1}$	0.122*** (0.011)	0.089*** (0.012)	0.060*** (0.011)	0.044*** (0.125)
$\text{Ln}(IE/Assets)_{it-1}$	-0.095*** (0.031)	-0.245*** (0.064)	-0.191*** (0.051)	-0.124** (0.052)
_cons	-7.222*** (0.265)	-8.064*** (0.674)	-8.367*** (1.399)	-6.232*** (0.408)
<i>N</i>	666	666	666	666
Number of groups	174	174	174	174
Adj. <i>R</i> -square	0.525	0.606		
<i>R</i> -square within			0.320	0.341
<i>R</i> -square between			0.645	0.480
<i>R</i> -square overall			0.600	0.519
prob > <i>F</i>	0.000	0.000		0.000
prob > Wald chi2			0.000	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors and robust clustered standard errors in parentheses for OLS and FE, RE respectively.

Source: Authors' calculations.

Table 3

Results for firms with low leverage.

Variable	OLS_LowLev	PLS_LowLev	RE_LowLev	FE_LowLev
$\text{Ln}(IA/Assets)_{it-1}$	0.643*** (0.031)	0.722*** (0.030)	0.485*** (0.037)	0.286*** (0.046)
$\text{Ln}(Fin1/Assets)_{it-1}$	-0.155*** (0.032)	-0.096*** (0.028)	-0.068*** (0.023)	-0.044* (0.024)
$\text{Ln}(Fin2/Assets)_{it-1}$	-0.086*** (0.022)	-0.025 (0.020)	-0.019 (0.034)	0.011 (0.050)
$\text{Ln}(FE/Assets)_{it-1}$	-0.231*** (0.023)	-0.151*** (0.026)	-0.139*** (0.030)	-0.113*** (0.032)
$\text{Ln}(Rev)_{it-1}$	0.083*** (0.010)	0.052*** (0.010)	0.035*** (0.007)	0.025*** (0.007)
$\text{Ln}(IE/Assets)_{it-1}$	-0.041* (0.024)	-0.228*** (0.044)	-0.146*** (0.038)	-0.072* (0.037)
_cons	-6.849*** (0.298)	-5.830*** (0.623)	-6.088*** (0.701)	-6.088*** (0.764)
<i>N</i>	668	668	668	668
Number of groups	180	180	180	180
Adj. <i>R</i> -square	0.507	0.617		
<i>R</i> -square within			0.192	0.2156
<i>R</i> -square between			0.597	0.4336
<i>R</i> -square overall			0.599	0.4974
prob > <i>F</i>	0.000	0.000		0.000
prob > Wald chi2			0.000	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors and robust clustered standard errors in parentheses for OLS and FE, RE respectively.

Source: Authors' calculations.

9. Regression diagnostics

In order to verify the robustness of the results, we conducted several tests for the models. At first, for OLS models we checked the existence of multicollinearity through the Variance Inflation Factor (VIF). Oke et al. (2019, p. 655) stated that “the VIF shows as how much the variance of the coefficient estimate is being inflated by multicollinearity.” According to the rule of thumb, which is accepted by many researchers, a VIF value lower than 10 indicates the absence of multicollinearity (O’Brien, 2007). The results of the VIF test show that there is no sufficient multicollinearity in our models. For additional clarity, we have also presented the pairwise correlation matrix (see Tables A3–A4 in Appendix A).

To check the potential heteroscedasticity, we used the Breusch–Pagan test and provided a graph of the distribution of the residuals in Appendix A (see Table A5, Fig. A1 in Appendix A). Since we took the natural logarithm of the model variables, we were able to reduce the risk of heteroscedasticity. According to the Breusch–Pagan test, the null hypothesis about the constant variance of the residuals is not rejected (probability > 0.05).

To check the correctness of the model, econometrics researchers also apply Kernel Density Estimation (KDE) or Parzen–Rosenblatt window (Parzen, 1962; Rosenblatt, 1956). This test allows us to make sure that the distribution of the model residuals is close to normal (Zamboni and Ronaldo, 2013). This condition is required for the p -values of t -tests and F -tests to be valid. We have constructed a kernel density graph with an overlay of the normal distribution graph. To be sure, we built a normal probability plot. The results showed that the distribution of the model residuals is close to normal (see Figs. A2–A3 in Appendix A).

At the last, we did a model specification test. We applied the Ramsey specification test in order to make sure that there are no omitted variables (Ramsey, 1969). The null hypothesis says that all the necessary variables are present in the model and there are no omitted variables. According to our results, the null hypothesis is not rejected (see Table A6 in Appendix A).

To decide what model is more appropriate—PLS or random effects, we provided a Breusch–Pagan test for all samples (Table A7–A9 in Appendix A). According to results, the random effects model is more appropriate.

To choose a more suitable model between fixed and random effects, we conducted the Hausman test for models with standard errors and The Sargan Test of Overidentifying Restrictions for a model with clustered robust errors (Tables A10–A11 in Appendix A). Both tests showed that the fixed effects model is more suitable.

10. Results and discussion

The first hypothesis has been confirmed. Financialization has a negative impact on the level of intangible assets for publicly listed companies in Russia. The second hypothesis about the differences in the impact of financialization for firms with different levels of financial constraints has been confirmed with reservations. In the cases of OLS and PLS, there are different forms of relationships

for firms with high and low level of financial constraints, in panel data models *Fin1* and *Fin2* are insignificant in many cases. More robust results were obtained for *FE* and *IE* variables. We have seen that in all cases, firms with higher financial leverage have more negative coefficient signs at *FE* and *IE*, which is obviously caused by the need to pay at higher rates and liquidity problems. Anyway, according to our regression diagnostics, panel model with fixed effects should be considered as the only completely reliable one.

11. Conclusion

In the literature review, we have shown that financialization issue is widely studied, and there is a lot of empirical evidence of a negative relationship between financialization and innovation activities in publicly listed firms. In the empirical part, we provided an analysis of panel data for Russian corporate sector covering the period from 2000 to 2021. We used the level of intangible assets as a proxy variable of innovation activities and showed that financial investment and increased spending crowd out investment in innovative projects.

The results obtained in our study were consistent with earlier considerations of researchers. With an example of Russian publicly listed companies, we confirmed a negative relationship between the growing of financial activities and level of innovation. Theoretical assumptions of our work were similar to the approaches of Stockhammer (2004, 2005), Tori and Onaran (2018), and also Tretyakov and Rozmainsky (2021) in the sense of considering the impact of growing financialization on investments in long-term. As Orhangazi (2008) posited, we considered the level of financial assets as a significant factor of financialization. As well as Yu et al. (2022), we applied fixed effects panel data evaluation of subject.

Regarding the technical limitations of this work, the complexity of the study consisted primarily of collecting relevant data, and processing them in order to obtain valid results. In the process of work, we faced an insufficiency of data in SPARK database. It relates both to the shortcomings of the database and to the possibility of non-disclosure of information by companies in some cases. As for the fundamental shortcomings of the work, here we have not been able to study the role of changes in corporate governance in sufficient depth.

Many studies offer an alternative view of investment (including innovation) policy in the context of financialization, rather than the neoclassical school. In this sense, in further research there is a need to combine the results of empirical research with considerations of the theory of the firm, which would explain such a connection.

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References

- Balatsky, E. V. (2010). The role of optimism in economic innovation development. *Society and Economy*, (1), 3–20 (in Russian).
- Baltagi, B. H. (2021). *Econometric analysis of panel data*. Cham: Springer Nature Switzerland. <https://doi.org/10.1007/978-3-030-53953-5>
- Bartoloni, E. (2013). Capital structure and innovation: causality and determinants. *Empirica*, 40(1), 111–151. <https://doi.org/10.1007/s10663-011-9179-y>
- Beck, T., Degryse, H., & Kneer, C. (2014). Is more finance better? Disentangling intermediation and size effects of financial systems. *Journal of Financial Stability*, 10, 50–64. <https://doi.org/10.1016/j.jfs.2013.03.005>
- Becker, J., Jäger, J., Leubolt, B., & Weissenbacher, R. (2010). Peripheral financialization and vulnerability to crisis: A regulationist perspective. *Competition & Change*, 14(3–4), 225–247. <https://doi.org/10.1179/102452910X12837703615337>
- Boyer, R. (2000). Is a finance-led growth regime a viable alternative to Fordism? A preliminary analysis. *Economy and Society*, 29(1), 111–145. <https://doi.org/10.1080/030851400360587>
- Demir, F. (2007). The rise of rentier capitalism and the financialization of real sectors in developing countries. *Review of Radical Political Economics*, 39(3), 351–59. <https://doi.org/10.1177/0486613407305283>
- Demir, F. (2009). Financial liberalization, private investment and portfolio choice: Financialization of real sectors in emerging markets. *Journal of Development Economics*, 88(2), 314–24. <https://doi.org/10.1016/j.jdeveco.2008.04.002>
- Epstein, G. A. (2005). Introduction: Financialization and the world economy. In G. A. Epstein (Ed.), *Financialization and the world economy* (pp. 3–16). Cheltenham: Edward Elgar.
- Froud, J., Haslam, C., Johal, S., & Williams, K. (2000). Shareholder value and financialization: Consultancy promises, management moves. *Economy and Society*, 29(1), 80–110. <https://doi.org/10.1080/030851400360578>
- Froud, J., Johal, S., Leaver, A., & Williams, K. (2006). *Financialization and strategy: Narrative and numbers*. London: Routledge. <https://doi.org/10.4324/9780203414941>
- Goda, T., & Larrahondo Dominguez, C. (2022). *The effect of dividend payouts on firm level R&D*. Unpublished manuscript. Available at: https://www.researchgate.net/publication/365683436_The_effect_of_dividend_payouts_on_firm-level_RD
- Hou, P., Zhou, M., Xu, J., & Liu, Y. (2021). Financialization, government subsidies, and manufacturing R&D investment: Evidence from listed companies in China. *Sustainability*, 13(22), 12633. <https://doi.org/10.3390/su132212633>
- Ivanov, V. V., Lvova, N. A., Pokrovskaya, N. V., & Saksonova, S. M. (2019). Financialization of the Russian economy: Features and role in stimulating investment activity. *Corporate Governance and Innovative Economic Development of the North: Bulletin of the Research Center of Corporate Law, Management and Venture Capital of Syktyvkar State University*, (1), 160–167. <https://doi.org/10.34130/2070-4992-2019-1-160-167>
- Karwowski, E., & Stockhammer, E. (2017). Financialisation in emerging economies: A systematic overview and comparison with Anglo-Saxon economies. *Economic and Political Studies*, 5(1), 60–86. <https://doi.org/10.1080/20954816.2016.1274520>
- King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics*, 108(3), 717–737. <https://doi.org/10.2307/2118406>
- Kramer, J. P., Marinelli, E., Iammarino, S., & Diez, J. R. (2011). Intangible assets as drivers of innovation: Empirical evidence on multinational enterprises in German and UK regional systems of innovation. *Technovation*, 31(9), 447–458. <https://doi.org/10.1016/j.technovation.2011.06.005>
- Krippner, G. R. (2005). The financialization of the American economy. *Socio-Economic Review*, 3(2), 173–208. <https://doi.org/10.1093/SER/mwi008>
- Kuzmina, A. F., & Rozmainsky, I. V. (2020). The effect of financialization on investment by non-financial private sector in Spain: An empirical analysis. *Journal of Institutional Studies*, 12(3), 60–82 (in Russian). <https://doi.org/10.17835/2076-6297.2020.12.3.060-082>
- Lapavitsas, C. (2009). Financialised capitalism: Crisis and financial expropriation. *Historical Materialism*, 17, 114–148. <https://doi.org/10.1163/156920609X436153>

- Lazonick, W. (2013). From innovation to financialization: How shareholder value ideology is destroying the US economy. In: M. H. Wolfson, & G. A. Epstein (Eds.), *The handbook of the political economy of financial crises* (pp. 52–74). Oxford and New York: Oxford University Press.
- Lazonick, W., & O'Sullivan, M. (2000). Maximizing shareholder value: A new ideology for corporate governance. *Economy and Society*, 29(1), 13–35. <https://doi.org/10.1080/030851400360541>
- Lee, Y. S., Kim, H. S., & Hwan Joo, S. (2020). Financialization and innovation short-termism in OECD countries. *Review of Radical Political Economics*, 52(2), 259–286. <https://doi.org/10.1177/0486613419886409>
- Mader, P., Mertens, D., & Van der Zwan, N. (2020). Financialization: An introduction. In P. Mader, D. Mertens, & N. van der Zwan (Eds.), *The Routledge international handbook of financialization* (pp. 1–16). Abingdon: Routledge. <https://doi.org/10.4324/9781315142876-1>
- Martin, R. (2002). *Financialization of daily life*. Philadelphia: Temple University Press.
- Nestik, T. A. (2016). The socio-psychological mechanisms of long-term orientation. *Social and Economic Psychology*, 1(4), 16–60 (in Russian).
- O'Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41, 673–690. <https://doi.org/10.1007/s11135-006-9018-6>
- Oke, J. A., Akinkunmi, W. B., & Etebefia, S. O. (2019). Use of correlation, tolerance, and variance inflation factor for multicollinearity test. *Global Scientific Journals*, 7(5), 652–659.
- Orhangazi, Ö. (2008). Financialisation and capital accumulation in the non-financial corporate sector: A theoretical and empirical investigation on the US economy: 1973–2003. *Cambridge Journal of Economics*, 32(6), 863–886. <https://doi.org/10.1093/cje/ben009>
- Parzen, E. (1962). On estimation of a probability density function and mode. *Annals of Mathematical Statistics*, 33(3), 1065–1076. <https://doi.org/10.1214/aoms/1177704472>
- Pavitt, K. (1982). R&D, patenting and innovative activities: A statistical exploration. *Research Policy*, 11(1), 33–51. [https://doi.org/10.1016/0048-7333\(82\)90005-1](https://doi.org/10.1016/0048-7333(82)90005-1)
- Pavitt, K. (1985). Patent statistics as indicators of innovative activities: Possibilities and problems. *Scientometrics*, 7(1–2), 77–99. <https://doi.org/10.1007/BF02020142>
- Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society: Series B (Methodological)*, 31(2), 350–371. <https://doi.org/10.1111/j.2517-6161.1969.tb00796.x>
- Rosenblatt, M. (1956). Remarks on some nonparametric estimates of a density function. *Annals of Mathematical Statistics*, 27(3), 832–837. <https://doi.org/10.1214/aoms/1177728190>
- Rozmainsky, I. V. (2017). Shock therapy as a generator of limits to rationality in the Russian transitional economy in the 1990s. *Terra Economicus*, 15(1), 68–78 (in Russian).
- Sahay, R., Čihák, M., Papa N'Diaye, A., Barajas, R. B., Ayala, D., Gao, Y., & Yousefi, S. R. (2015). Rethinking financial deepening: Stability and growth in emerging markets. *IMF Staff Discussion Notes*, No. SDN/15/08. <https://doi.org/10.5089/9781498312615.006>
- Schumpeter, J. A. (1983). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Brunswick, NJ: Transaction Publishers.
- Śledzik, K. (2013). Schumpeter's view on innovation and entrepreneurship. In S. Hittmar (Ed.), *Management trends in theory and practice* (pp. 89–95). Faculty of Management Science and Informatics, University of Zilina & Institute of Management by University of Zilina.
- Stockhammer, E. (2004). Financialisation and the slowdown of accumulation. *Cambridge Journal of Economics*, 28, 719–741. <https://doi.org/10.1093/cje/beh032>
- Stockhammer, E. (2005). Shareholder value orientation and the investment-profit puzzle. *Journal of Post Keynesian Economics*, 28(2), 193–215. <https://doi.org/10.2753/PKE0160-3477280203>
- Tarverdyan, M., & Rozmainsky, I. V. (2023). An empirical analysis of the influence of financialization on the innovative activity of the firms' managers in Italy. *Terra Economicus*, 21(1), 61–79. <https://doi.org/10.18522/2073-6606-2023-21-1-61-79>
- Tori, D., & Onaran, Ö. (2018). The effects of financialization on investment: Evidence from firm-level data for the UK. *Cambridge Journal of Economics*, 42(5), 1393–1416. <https://doi.org/10.1093/cje/bex085>
- Tretyakov, D. S., & Rozmainsky, I. V. (2021). An empirical analysis of the influence of financialization on investment in Russia. *Russian Journal of Economics*, 7(3), 233–249. <https://doi.org/10.32609/j.ruje.7.58419>

- Yu, W., Zhan, Q., Ameer, W., Li L., Tarczyński, W., & Mentel, U. (2022). Effects of heterogeneity of financialization on firm innovation: Evidence in context of energy transition in lens of research and development. *Frontiers in Energy Research*, 10, 930974. <https://doi.org/10.3389/fenrg.2022.930974>
- Yan, Y., & Li, Y. (2019). Industrial company financialization and innovation level. In *IOP Conference Series: Materials Science and Engineering*, 688(5), 055021. <https://doi.org/10.1088/1757-899X/688/5/055021>
- Zambom, A. Z., & Ronaldo, D. (2013). A review of kernel density estimation with applications to econometrics. *International Econometric Review*, 5(1), 20–42.

Appendix A

Table A1

Firms in a sample by sector.

Sector	Number of firms
Manufacturing	116
Professional, scientific and technical activities	26
Real estate activities	23
Wholesale and retail trade; repair of motor vehicles and motorcycles	14
Construction	14
Transporting and storage	13
Mining and quarrying	13
Electricity, gas, steam and air conditioning supply	11
Agriculture, forestry and fishing	6
Information and communication	4
Human health and social work activities	2
Administrative and support service activities	2
Accommodation and food service activities	1

Source: Compiled by the authors.

Table A2

Descriptive statistics.

Variable	Obs.	Mean, %	St. dev., %	Min, %	Max, %
$IA/Assets$	1,334	0.52	1.99	0.00	23.46
$Fin1/Assets$	1,334	9.39	11.62	0.00	85.22
$Fin2/Assets$	1,334	13.15	18.78	0.00	85.67
$FE/Assets$	1,334	3.94	5.81	0.00	86.61
$IE/Assets$	1,334	2.48	2.44	0.00	25.54
Revenue, thousands RUB	1,334	81,906	482,185	0	7,593,832

Source: Authors' calculations.

Table A3

Multicollinearity test.

Variable	VIF	1/VIF
$\ln(IA/Assets)_{it-1}$	1.74	0.573
$\ln(Rev)_{it-1}$	1.49	0.671
$\ln(FE/Assets)_{it-1}$	1.36	0.734
$\ln(Fin1/Assets)_{it-1}$	1.22	0.822
$\ln(IE/Assets)_{it-1}$	1.21	0.825
$\ln(Fin2/Assets)_{it-1}$	1.15	0.866
Mean VIF	1.36	

Source: Authors' calculations.

Table A4

Pairwise correlation matrix.

Variable	$\text{Ln}(IA/Assets)_{it}$	$\text{Ln}(IA/Assets)_{it-1}$	$\text{Ln}(Fin1/Assets)_{it-1}$	$\text{Ln}(Fin2/Assets)_{it-1}$	$\text{Ln}(FE/Assets)_{it-1}$	$\text{Ln}(Rev)_{it-1}$	$\text{Ln}(IE/Assets)_{it-1}$
$\text{Ln}(IA/Assets)_{it}$	1						
$\text{Ln}(IA/Assets)_{it-1}$	0.550	1					
$\text{Ln}(Fin1/Assets)_{it-1}$	-0.021	0.344	1				
$\text{Ln}(Fin2/Assets)_{it-1}$	0.015	0.317	0.251	1			
$\text{Ln}(FE/Assets)_{it-1}$	-0.011	0.426	0.267	0.227	1		
$\text{Ln}(Rev)_{it-1}$	-0.001	-0.528	-0.317	-0.219	-0.294	1	
$\text{Ln}(IE/Assets)_{it-1}$	0.092	0.283	0.149	0.065	0.344	-0.023	1

Source: Authors' calculations.

Table A5

Test for heteroscedasticity.

Breusch–Pagan / Cook–Weisberg test for heteroscedasticity	
Ho: Constant variance	
Variables: fitted values of $\text{Ln}(IA/Assets)_{it}$	
Indicator	Value
chi2(1)	0.2300
Prob > chi2	0.6291

Source: Authors' calculations.

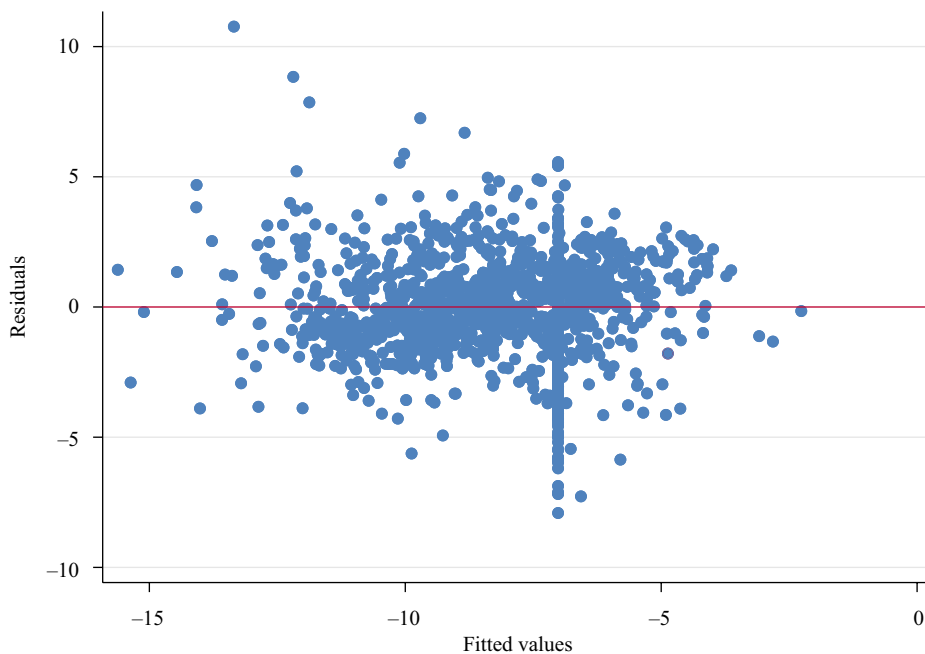


Fig. A1. Graph of residuals.

Source: Authors' calculations.

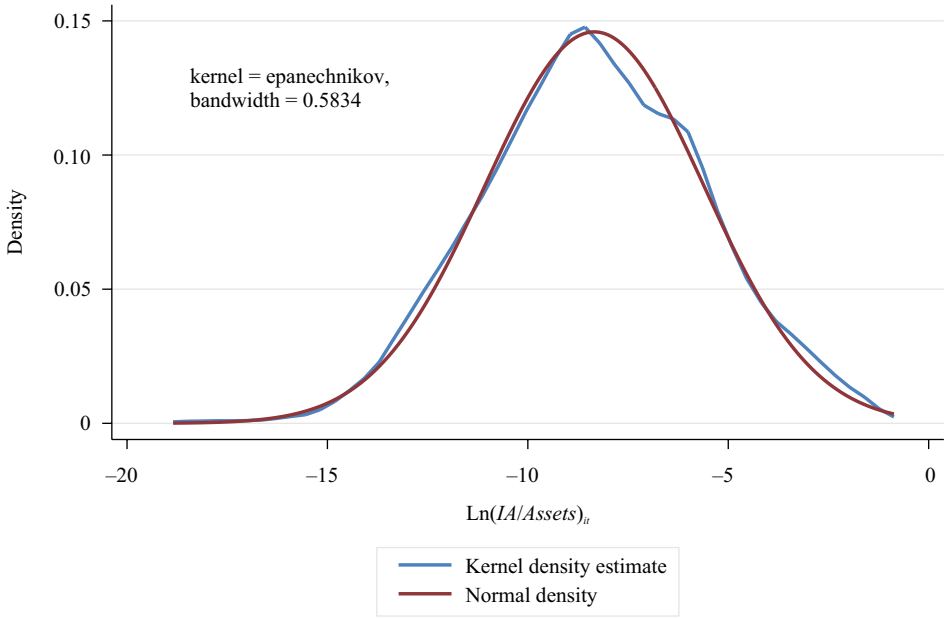


Fig. A2. Kernel density estimation graph.

Source: Authors' calculations.

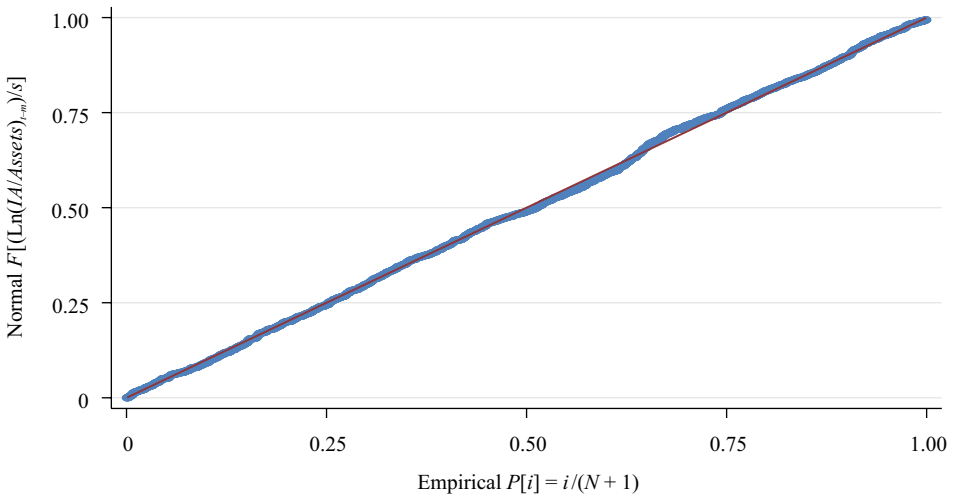


Fig. A3. Normal probability plot.

Source: Authors' calculations.

Table A6

Ramsey test for presence of omitted variables.

Ramsey RESET test using powers of the fitted values of $\text{Ln}(IA/Assets)_it$	
Indicator	Value
$F(3, 1323)$	2.0900
Prob > F	0.0994

Source: Authors' calculations.

Table A7

Breusch and Pagan Lagrangian multiplier test for random effects (overall sample).

Ln($IA/Assets$)[ID, t] = $Xb + u[ID] + e[ID, t]$		
Estimated results:	Var	$sd = \sqrt{\text{Var}}$
Ln($IA/Assets$) $_{it-1}$	7.474	2.733
e	1.843	1.357
u	0.504	0.71
Test: $\text{Var}(u) = 0$ chibar2(01) = 146.85 Prob > chibar2 = 0.0000		

Source: Authors' calculations.

Table A8

Breusch and Pagan Lagrangian multiplier test for random effects (High Leverage sample).

Ln($IA/Assets$)[ID, t] = $Xb + u[ID] + e[ID, t]$		
Estimated results:	Var	$sd = \sqrt{\text{Var}}$
Ln($IA/Assets$) $_{it-1}$	7.802	2.793
e	1.999	1.414
u	0.930	0.964
Test: $\text{Var}(u) = 0$ chibar2(01) = 39.36 Prob > chibar2 = 0.0000		

Source: Authors' calculations.

Table A9

Breusch and Pagan Lagrangian multiplier test for random effects (Low Leverage sample).

Ln($IA/Assets$)[ID, t] = $Xb + u[ID] + e[ID, t]$		
Estimated results:	Var	$sd = \sqrt{\text{Var}}$
Ln($IA/Assets$) $_{it-1}$	7.151	2.674
e	1.544	1.242
u	1.238	1.113
Test: $\text{Var}(u) = 0$ chibar2(01) = 48.77 Prob > chibar2 = 0.0000		

Source: Authors' calculations.

Table A10

Hausman test for fixed and random effects.

Test: Ho: difference in coefficients not systematic
chi2(27) = $(b - B)[(V_b - V_B)^{-1}](b - B) = 670.75$
Prob > chi2 = 0.0000
$(V_b - V_B)$ is not positive definite

Source: Authors' calculations.

Table A11

Test of overidentifying restrictions: Fixed vs random effects.

Cross-section time-series model: xtreg re robust cluster(ID)
Sargan–Hansen statistic 422.474 Chi2(27) p -value = 0.0000

Source: Compiled by the authors.