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The Impact of Financial Capital on Innovative Behavior of Industrial Companies

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ABSTRACT

The authors empirically assessed the impact of the availability of industrial companies to financial capital on their innovative behavior. **The relevance** of the study is due to the need to develop new analysis tools and stimulate the innovative development of industrial companies in an unfavorable external environment**. The aim** of the study is to assess the relationship between the availability of financial capital for industrial companies and the possibility of transforming their innovative behavior into a more advanced innovative regime. The authors applied **the method** of regression analysis of survey data in 648 Russian industrial companies for 2015–2019 to test the three following hypotheses: 1. The financial performance of industrial companies depends on the model of innovative behavior; 2. Financial capital has a significant positive effect on the choice of a more advanced innovative behavior and on the performance of industrial companies; 3. Different availability restrictions to financial capital have a different impact on the choice of innovative behavior and the performance of industrial companies. The authors analyzed two types of restrictions on financial capital: light, when the rate of return from the company's activities is below the lending interest rate; and strict, when the company does not have access to the credit market. The authors proved that the choice of a particular model of innovative behavior depends on the availability of financial capital of industrial companies. **The conclusion** is that different types of financial capital constraints affect the choice of a model of innovative behavior in different ways. The authors suggest allocating resources for innovation, development and launch of new products on the market even in conditions of limited access to financial capital. Alternatively, in the context of extremely limited financial capital, it is to develop imitation innovations in new or existing markets.

Keywords: financial capital; liquidity restriction; innovative behavior; efficient producers; value innovators; technological innovators; radical innovators; imitators; industrial companies

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INTRODUCTION

Research on the growth of the world's leading economies confirms the key role of innovation in social and economic progress. Numerous studies have proven that the creation and implementation of innovations are the key intracompany capabilities that build an unbeatable competitive advantage [1, 2]. Besides, developing innovative activities of companies is an important factor of internationalisation of an enterprise, as well as overcoming unfavorable conditions of the external economic environment, the recent subject of many studies (for example, [3–5]). To achieve the best results, companies follow different principles and models of behavior and management of innovation, allocate resources in different ways, and thus build their own line of innovative behavior [6].

Empirical research and microdata analysis make it possible to identify features for classifying innovative behavior and clearly identify innovative modes in industry. Thus, the characteristics of innovative behavior classification most often include: the type of innovations, the intensity of investments in research and development, the level of novelty of innovations, the presence of knowledge generation processes [7]. To analyze the types of innovations, one is most often guided by the Oslo Guide. The novelty is determined relative to the international market (not the company itself). The knowledge creation process is defined as insource research and development. Most studies ground their classification on: their own research and development, cooperation in the implementation of innovative projects, the availability of patents, and the dissemination of knowledge [8].

There are currently enough empirical works confirming the possibility to identify stable types of innovative behavior (for example, the works by T. Hatzichronoglou [9], K. Pavitt [10], A. Pyka, R. Nelson [11], F. Malerba, R. Nelson, L. Orsenigo, S. Winter [12], J. Van den Bergh [13], L. Faria, M. M. Andersen [14].

However, most authors analyzed the microdata of companies operating in conditions of economic stability that do not consider the impact of access to financial capital on the transformation of the innovative behavior of industrial companies. Currently, Russian industrial companies operate under the sanctions against Russia, which constraint companies' access to the most valuable resources, including financial capital [15]. The choice of innovative behavior is usually determined by the availability and accessibility of industrial companies to financial capital. The study of its role will determine whether a company will be able to transform its innovative behavior and move to a more advanced level.

This article attempts to address the following research questions:

1) which of the types of innovative behavior provides the greatest performance for industrial companies in the context of limited access to financial capital?

2) how does restricting access to financial capital affect the choice of a model of innovative behavior and company performance?

3) what types of liquidity constraints most affect the transformation of the innovative behavior of industrial companies?

We tested the generated research model on data collected during the period of sanctions imposed on the Russian economy and restrictions on access to resources, including financial capital (2015–2019). The empirical analysis is based on a survey of 648 industrial companies.

LITERATURE REVIEW

Types of innovative behavior of industrial companies

According to the behavioral theory of a firm, a strategy is a "stable model of behavior or

a pattern in a stream of decisions" [16]. The rules and principles followed by managers when implementing an innovation strategy to increase the results of innovative activities determine the innovative behavior of a company.

A group of companies with similar characteristics of innovative behavior forms an innovative (in some studies, technological [11, 13]) regime in the economic sector, which is "a tool for analyzing the diversity of innovative and competitive behavior of firms" [13]. Among the first was the classification of innovation regimes by the Organization for Economic Cooperation and Development (OECD), based on the level of technology of the sectors: high-, medium- and low-tech sectors [9]. The OECD study shows that companies in high-tech industries invest more in research and development, more often enter international markets, have higher performance indicators, and thus stimulate the development of related industries [9]. The researchers believe that high-tech industries are the engines of innovative economic growth. After 20 years of research, collecting information and analysis of radical differences in innovation behavior in different sectors, two distinct subgroups have been identified in the medium-tech sector: high and low.

K. Pavitt [10] developed the theory of innovative behavior that for the first time in the analysis used indicators of innovation introduction in companies. They showed a certain trajectory of the technological development of the company. Based on the analysis of 26 industries, Pavitt identified three types of innovation regimes based on the type of innovative behavior:

- science based companies that have a high share of investments in research and development in revenue, creating numerous cooperative relationships in the implementation of innovative projects (with universities, centers engaged in fundamental and applied scientific research);
- production intensive including two groups of companies: 1) "scale intensive", focused on the implementation of technological innovations to reduce costs; and 2) "specialized suppliers" with a lower intensity of investment in research and development and aimed at introducing product innovation;
- supplier dominated companies that do not generate knowledge on their own, but provide demand for new technologies, i.e. stimulate the development of innovation-oriented companies in related industries [10].

Pavitt proved the hypothesis of the need to develop supporting industries that do not generate knowledge on their own, but stimulate the dissemination of new knowledge and technologies and thus affect economic growth.

A further development of the theory of innovative regimes was its focus on the level of national economies and industries. This made it possible to identify completely new types of innovative behavior:

- "technology users" (similar to Pavitt's "supplier dominated" type) [17];
- "technical consultancy" focused on the "generation and distribution of specific technological innovations" [17].

L. M. Gokhberg, T. E. Kuznetsova and V. A. Rud' [18] based on the data of 30.8 thousand Russian companies in the extractive, manufacturing, electricity, gas and water production, innovative modes were identified based on a certain type of companies' innovative behavior:

- "innovators in the international market";
- "innovators in the national/local market";
- "imitators on the international market";
- "imitators on the national/local market";
- "technological borrowing";
- "unfinished innovations" [18].

Another work by Russian authors, devoted to the modes of innovation activities of companies in the sector of intellectual services, based on the analysis of 477 Russian companies, identifies six clusters of companies:

- "innovative-passive";
- "organization-oriented";
- "marketing-oriented";
- "non-technological";
- "technological";
- "diversified innovators" [19].

In our work [20], we identified the following types of innovative behavior of industrial companies:

– *efficient producers* are the companies whose innovative strategies aim to introduce process and technological innovations to increase the effectiveness of operating activities. Investments in equipment and production, process innovations and improvement of infrastructure occupy a dominant share in the structure of costs for innovation activities. The costs of marketing and organizational innovation are extremely low. This model of innovative behavior prevails among companies in labor-intensive and capital-intensive industries, for example, textiles, woodworking, oil and gas industries, metallurgy, machinery and equipment. Building a corporate innovation system and specifics of the innovation process of these companies are determined by the changes necessary to improve production processes and products aimed at reducing costs while maintaining or improving product quality. The innovative behavior of these companies is characterized by innovative approaches to the development and implementation of new products, the introduction of organizational innovations in order to reduce administrative or operational costs, increase the productivity of workplaces, reduce supply costs, manage logistics systems, a developed system of interfirm relationships that contribute to effective interaction of companies with suppliers, customers, manufacturers and end users [20];

- *technological innovators* are the innovative strategies of companies of this type are aimed at creating and developing new products, due to the integration of technologies with partners along the value chain. In the structure of costs for innovation, costs for research and development prevail, accounting for an average of 3–10% of gross revenues; the product life cycle of these companies is from 3 to 10 years. This innovative regime dominates among the industries of mechanical engineering, electric power engineering, and production of building materials. To succeed, innovative strategies of companies of this type include the development of professional training among employees, ensuring the protection of intellectual property, patenting inventions, creating partnerships aimed at accessing global sources of new knowledge and technologies, highly qualified personnel [20];

- *value innovators* are the innovative strategies of companies of this type are aimed at creating the highest value for customers and optimizing the delivery ways, while ensuring the proposal of new products, services and the formation of alternative business models. Companies of this type of innovative behavior aim to get to know their consumer in order to increase the consumer value of goods, reduce consumer operating costs, and find new markets. This innovative regime is typical, for example, for the food, clothing, and textile industry. In the structure of costs for innovation activities, costs for marketing innovations prevail (about 3–7% of gross revenue). The innovation cycle is characterized by a relatively short development period for new products. Since the products and services of companies of this innovative regime are

largely focused on consumers of national/local markets, in the development and implementation of innovations, national companies can have advantages over global players. Building an innovation system and specifics of the innovation process are determined by the possibilities of entering new markets, the presence of market niches with unsatisfied consumer needs where the company could succeed. The key success factors for implementing this strategy are: the ability to develop new sales markets, the ability to quickly scale up the production of innovations and refine products after their launch. Besides, the presence of domestic demand for innovations and measures to support entrepreneurship has a positive effect on the performance of these companies [20];

- *radical innovators* are the innovative strategies of companies of this type built on the commercialization of fundamental research by creating new products on their basis. Research and development costs account for the largest share in the structure of costs for innovation activities (on average, 15% to 35% of gross proceeds from sales). Due to the fact that the innovation process includes fundamental and applied research, its duration is also relatively long — about 5–20 years. To implement an innovative strategy, companies of this type are building an extensive network of partnerships with research centres, universities, and consulting companies. In Russia, the radical innovators regime is most widespread among the petrochemical industries, enterprises of the military-industrial complex, and the pharmaceutical industry. The factors contributing to the successful implementation of these industries are: legal protection of intellectual property, which guarantees companies profit from the sale of new products based on their inventions; stimulating tax policy; patent activity; access to international markets [20];
- *imitators* are the companies that do not participate in creating and disseminating of new knowledge and products in the market, since they do not have the resources to conduct their own research and development or to innovate. The imitation strategy allows companies to learn from market leaders, compete, and develop their own research and development competencies. The scientific literature defines three types of imitation strategies: "copying the entire product"; "copying individual technical parameters, design and brand elements, borrowing innovative solutions (technologies, patents, knowledge, business processes, management principles and business models)"; "creative imitation, when a company makes changes to an original innovation or finds a new application, as a result of which it creates a new product, process, technology" [21]. Under certain conditions, imitation strategies, can also help create sustainable competitive advantage and improve business performance.

Effect of financial capital on innovative behavior of industrial companies

Financial capital is an essential resource for implementing innovative strategies and, therefore, the choice of innovative behavior by industrial companies. Availability and access to financial capital for efficient producers makes it possible to improve infrastructure and introduce new technologies to improve product quality while reducing costs; for technological innovators, to experiment more with the development of new products and to implement new projects in the field of technology integration with partners along the value chain without reducing resources; for value innovators, the access to financial capital allows for a deeper survey of consumers and their needs and requirements, systematically tracking changes, while measuring their satisfaction; radical

innovators who possess financial capital, have more opportunities to conduct research and development, and, consequently, to commercialize their results; imitators will be able to search for new products and services that the market needs, as well as to assess the possibilities of adapting new products to market requirements or full imitation.

The accumulated empirical studies have shown that restrictions of access to financial capital (in some studies — liquidity restriction, for example, [22]) adversely affects research and development [23], the effectiveness of innovation [22, 24]. However, there is no consensus regarding the importance of own sources or external financing of innovative activities. Thus, works [25, 26] substantiated that external financing has a more obvious positive effect on innovation among high-tech companies, while for medium- and low-tech firms, their own sources of financing are of greater importance.

Work [27] shows that, given the limited equity capital, only external financing can guarantee continuous investment in innovation for companies in all industries.

Work [28], on the contrary, substantiated a significant positive effect of equity capital for financing innovative activities.

At the same time, different types of liquidity restrictions have different effects on the effectiveness of innovation activities.

Thus, this review allows for the following hypotheses:

Hypothesis 1: The financial performance of industrial companies depends on the model of innovative behavior, while a combination of models of innovative behavior will allow achieving the highest possible performance results.

Hypothesis 2: Financial capital has a significant positive effect on the choice of a more advanced innovative type of behavior and the effectiveness of innovation.

Hypothesis 3: Different types of restrictions on access to financial capital have different effects on the choice of innovative behavior and the performance of industrial companies.

In this study, we will consider two types of restrictions on access to financial capital: soft, when the rate of return on the company's activities is below the lending interest rate, and rigid, which assumes that the company does not have access to the credit market.

Fig. 1 presents the theoretical research model developed by the authors.

USED DATA AND RESEARCH METHODS

Research sampling

Data on industrial companies was collected for the period from 2015 to 2019, characterized by increased economic sanctions against Russia, deterioration of macroeconomic indicators, loss of the value of the national currency, deterioration in business activity, a noticeable decline in investment in all industries and, as a result, access for industrial companies to financial capital.

For the empirical analysis, we selected 648 industrial companies with over 250 people each. 28% of the selected companies are exporters and operate in global markets. More than 40% of the companies conduct independent research and development (R&D). The average share of sales proceeds directed to R&D is 5.5%. About 10% of the companies have joint research projects.

Research variables

Three groups of indicators were used as *dependent variables*, each of them was assessed on a 7-point scale, where 1 stands for "the indicator has significantly decreased", 4 stands for "the indicator has not changed", and 7 stands for "the indicator has significantly increased":

- financial performance indicators: sales proceeds, profitability of sales;
- indicators of the effectiveness of innovation: revenue from sales of new

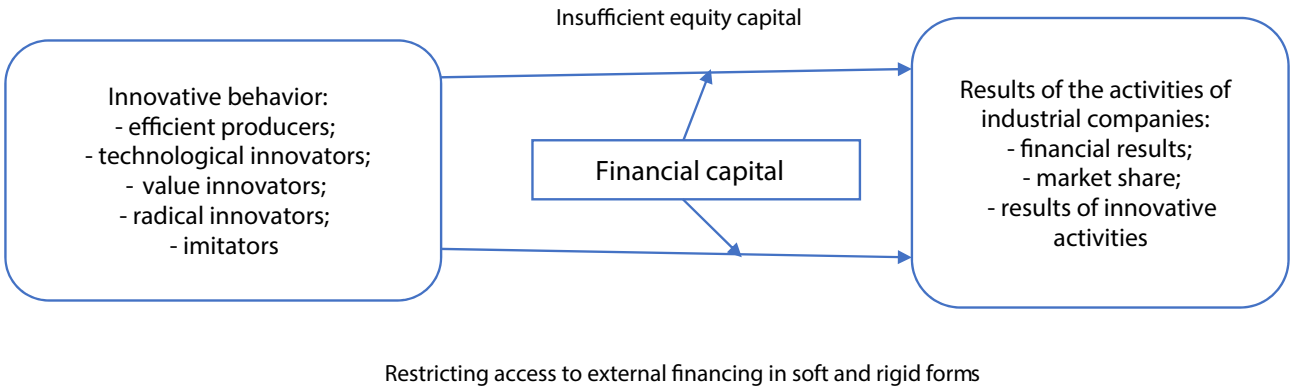

Fig. 1. **Theoretical research model**

Source: compiled by the authors.

products, the availability of investments in research and development, the availability of patents;

• market indicators: market share, incremental value for customers.

Subjective performance indicators are often used in management research (for example, [29, 30]), due to the fact that objective results vary greatly depending on the industry, while subjective indicators reflect the dynamics of changes from the point of view of the company's management. Besides, works [31, 32] confirmed the correlation between subjective and objective assessments. Therefore, subjective indicators are justified and can be considered reliable.

Independent variables — to assign industrial companies to a particular innovation regime, we developed a scale, consisting of questions to measure the "gravitation" of a company to one or another innovative behavior: the presence of its own R&D departments, the level of innovation novelty, the structure of investments in innovative activities, investments in research and development, conducting fundamental research by own resources, working in international markets, the duration of the innovation cycle, the use of open innovation tools. Based on these indicators, we divided industrial companies into five innovative regimes: efficient producers; technological innovators; value innovators; radical innovators; imitators.

Control variables — the performance of industrial companies varies significantly depending on the industry, the size of the company, its age, which became the control variables. The industry variable is accounted for as a dummy variable denoting "1" if the company belongs to the industry, and "0" otherwise.[1] A firm's age is measured by its age, and its size is measured by the average number of employees. We transformed all variables using the natural logarithm, which allows the assumption of a normal distribution to be met.

EMPIRICAL RESULTS

To achieve the aim of the study, we first analyzed the data for reliability and validity using confirmatory factor analysis (CFA). We assessed the quality of the models with statistical indicators that allow establishing

[1] Classification of industries: food production, including beverages and tobacco products; textile and clothing production; production of leather, leather goods and footwear; wood processing and production of wood products; pulp and paper production; publishing and printing activities; chemical production; manufacture of rubber and plastic products; manufacture of other non-metallic mineral products; metallurgical production and production of finished metal products; manufacture of machinery and equipment; production of electrical equipment, electronic and optical equipment; production of vehicles and equipment; production and distribution of electricity, gas and water; exploration and extraction of minerals.

Table 1

Results of reliability and validity of measurement models

Measurement models	Cronbach's alpha	Reliability statistics
First order models		
Industrial results	0.782 to 0.921	χ^2/df = 2.004; GFI = 0.871; CFI = 0.883; AGFI = 0.862; TLI = 0.913; RMSEA = 0.034
Financial capital availability	0.748–0.836	
Second order models		
Efficient producers	0.726 to 0.811	χ^2/df = 1.994; GFI = 0.822; CFI = 0.901; AGFI = 0.879; TLI = 0.934; RMSEA = 0.041
Infrastructure improvement costs	0.711 to 0.876	
Costs of introducing new technologies	0.735 to 0.884	
Process innovation costs	0.773 to 0.825	
Improving the quality of products	0.716 to 0.939	
Technological innovators	0.854 to 0.983	χ^2/df = 1.873; GFI = 0.808; CFI = 0.829; AGFI = 0.849; TLI = 0.962; RMSEA = 0.039
Availability of patents	0.725 to 0.873	
Research and development costs	0.902 to 0.955	
Development and implementation costs of new products	0.889 to 0.942	
Staff training costs	0.819 to 0.908	
Value innovators	0.854 to 0.983	χ^2/df = 1.833; GFI = 0.819; CFI = 0.805; AGFI = 0.822; TLI = 0.911; RMSEA = 0.036
Marketing innovation costs	0.751 to 0.893	
Development and implementation costs of new products	0.774 to 0.886	
Number of new products introduced to the market	0.716 to 0.908	
Radical innovators	0.854 to 0.983	χ^2/df = 1.917; GFI = 0.842; CFI = 0.854; AGFI = 0.866; TLI = 0.906; RMSEA = 0.042
Share of revenue from export of new products	0.809 to 0.916	
Availability of patents	0.761 to 0.829	
Basic research costs	0.779 to 0.889	
Applied research costs	0.902 to 0.955	
Development and implementation costs of new products	0.889 to 0.942	
Share of products new to the world	0.819 to 0.908	
Imitators	0.828 to 0.915	χ^2/df = 1.995; GFI = 0.831; CFI = 0.878; AGFI = 0.819; TLI = 0.947; RMSEA = 0.038
Cost of copying entire products	0.889 to 0.926	
Copying costs of individual technical parameters	0.877 to 0.907	
Cost of performing a creative imitation	0.819 to 0.948	

Note: * — $p < 0.001$.

Source: compiled by the authors.

Table 2

Analysis of the reliability and validity of the variables used in the model

	Variable	Cronbach's alpha	Composite reliability	Average variance extracted	1	2	3	4	5	6	7
1	Efficient producers	0.838	0.82	0.68	0.68						
2	Technological innovators	0.857	0.79	0.71	0.179	0.71					
3	Value innovators	0.884	0.75	0.73	0.227	0.294	0.73				
4	Radical innovators	0.902	0.90	0.59	0.110	0.019	0.029	0.59			
5	Imitators	0.902	0.90	9.65	0.022	0.008	0.017	0.059	0.65		
6	Financial capital	0.654	0.583	0.696	0.284	0.308	0.207	0.113	0.169	0.61	
7	Performance results	0.813	0.72	0.82	0.223	0.054	0.048	0.079	0.134	0.109	0.69

Source: compiled by the authors.

Table 3

Descriptive statistics and correlation matrix

	Variable	Average	Standard англ ное отклонение	Min value	Max value	1	2	3	4	5	6	7	8	9
1	Performance results	6.17	1.18	1	7	1								
2	Access to financial capital	6.85	1.26	4.23	6.95	0.639	1							
3	Company size	4.8	1.14	1.49	6.3	0.74	0.187	1						
4	Company age	5.51	1.15	1.23	10.2	–0.044	0.105	0.148	1					
5	Efficient producers (EP)	4.75	1.08	1.03	7.47	0.036	0.139	0.084	0.039	1				
6	Technological innovators (TI)	2.74	1.01	0.01	4.78	0.407	0.438	0.217	0.439	0.509	1			
7	Value innovators (VI)	4.56	1.03	1.02	7.05	0.502	0.519	0.377	0.156	0.472	0.442	1		
8	Radical innovators (RI)	6.07	1.06	1.04	6.99	0.278	0.212	0.274	0.103	0.513	0.567	0.372	1	
9	Imitators (IM)	6.54	1.05	1.03	7.12	0.179	0.198	0.182	0.116	0.438	0.471	0.589	0.43	1

Note: n = 648.

Source: compiled by the authors.

the correspondence between the calculated and modeled indicators.[2] *Table 1* shows the results.

The significance of the variables is confirmed by the Cronbach's alpha, whose threshold value should at least be 0.7. In this case, all variables have values from 0.711 to 0.921, which confirms the reliability of measurements. Further, to assess the consistency of the constituent components of second-order variables, we used the average variance explained (*AVE*[3]) indicator, whose threshold value should exceed 0.5 [33]. For all variables, the value turned out to be higher than the norm. *Table 2* presents the results.

We used the Harman's test to estimate the total bias error, since we obtained the variables using the subjective opinions of the same respondents. The results of applying the method of principal components showed the presence of nine principal components, whose values are greater than 1, and none of which accounted for more than 50% of the variance. Therefore, there is no overall estimate of the bias. We calculated the values of all variables as the arithmetic mean of the answers to this question on the scale. For the models of innovative behavior, we first calculated the means for each dimension, and then the mean over the constituent elements. *Table 3* presents the results.

Correlation analysis showed a fairly high correlation relationship between models of innovative behavior: efficient producers and technological innovators, value innovators and imitators, technological innovators and disruptive innovators, as well as efficient producers, technological innovators and radical innovators. There is a lack of correlation between other models of innovative behavior. Therefore, to reduce multicollinearity, the model includes double and triple cross variables.

At the second stage, using linear regression, we analyzed the relationship between innovative behavior, restrictions on access to capital, and company performance. The empirical study included step-by-step analysis:

- Stage 1 (Model 1): analysis of the base model and control variables;
- Stage 2 (Model 2): analysis of the basic model and direct effects of the choice of innovative behavior by companies (efficient producers; technological innovators; value innovators; radical innovators; imitators);
- Stage 3 (Model 3–5): double cross variable analysis (efficient producers and technological innovators (Model 3), value innovators and imitators (Model 4), technological innovators and radical innovators (Model 5);
- Stage 4 (Model 6): triple cross variable analysis (efficient producers, technological innovators and radical innovators).

To make sure there is no multicollinearity of the constructed models, we used the variance inflation factors (*VIFs*) indicator. In all cases it did not exceed 4.5 (with a standard of 10), therefore, there is no multicollinearity in the studied models. *Table 4* presents the results.

As we see, the greatest performance results are achieved by companies that choose models of innovative behavior by efficient producers ($b = 0.0129$, $p < 0.05$), value innovators ($b = 0.0158$, $p < 0.05$), and imitators ($b = 0.0167$, $p < 0.05$). In this case, the greatest results are achieved by imitators who have proceeds from export activities, i.e. operating in the international

[2] For the analysis, we used the approach tested in [36]: "χ^2/df is the general indicator of the model's quality (threshold value < 2 (3); GFI (goodness of fit index) is the fit index (threshold value > 0.9); CFI (comparative fit index) is the comparative fit index (threshold value > 0.9); AGFI (adjusted goodness of fit index) is the adjusted fit index (threshold value > 0.9); TLI (Tucker-Lewis index) is the comparative Tucker-Lewis index (threshold value> 0.9); RMSEA (root mean square error of approximation) is the squared average error of approximation (threshold value < 0.08)".

[3] Calculated by the formula: sum of squares of standardized loads / (sum of squares of standardized loads + sum of measurement errors).

Table 4

Results of the analysis of the relationship between financial capital, innovative behavior and performance in a general sample of industrial enterprises

Research variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Control variables						
Research and development costs	0.0067*** (0.0016)	0.0049*** (0.0019)	0.0054*** (0.0024)	0.0097*** (0.0022)	0.0057*** (0.0017)	0.0069*** (0.0022)
Technology purchase costs	0.0045*** (0.0026)	0.0058*** (0.0019)	0.0067*** (0.0019)	0.0074*** (0.0028)	0.0063*** (0.0039)	0.0089*** (0.0044)
Costs of machinery and equipment	0.0058*** (0.0013)	0.0074** (0.0029)	0.0099*** (0.0035)	0.0088*** (0.0019)	0.0052*** (0.0018)	0.0116*** (0.0014)
Other costs of technological innovation	0.0083*** (0.0018)	0.0065*** (0.0017)	0.0072*** (0.0021)	0.0084*** (0.0032)	0.0093*** (0.0018)	0.0059*** (0.0033)
Training	0.0031*** (0.0017)	0.0054*** (0.0018)	0.0049*** (0.0026)	0.0052*** (0.0015)	0.0073*** (0.0019)	0.0046*** (0.0028)
Marketing innovation costs	0.0054*** (0.0016)	0.0068** (0.0022)	0.0027*** (0.0027)	0.0042** (0.0037)	0.0053 (0.0014)	0.0079*** (0.0019)
Company size	0.0028*** (0.0011)	0.0034*** (0.0009)	0.0029*** (0.0015)	0.0037*** (0.0016)	0.0041 (0.0023)	0.0016*** (0.0014)
Company age	−0.0124** (0.0051)	−0.0153*** (0.0069)	−0.0125** (0.0075)	−0.0167*** (0.0063)	−0.0183*** (0.0082)	−0.0195** (0.0091)
Financial capital	0.0297*** (0.0032)	0.0213*** (0.0052)	0.0199*** (0.0037)	0.0187*** (0.0028)	0.0171*** (0.0035)	0.0224*** (0.0041)
Export proceeds	0.0153*** (0.0028)	0.0149*** (0.0037)	0.0191*** (0.0044)	0.0176*** (0.0045)	0.0173*** (0.0048)	0.0184** (0.0014)
Industries	INC	INC	INC	INC	INC	INC
Basic variables						
Efficient producers (EP)		0.0129*** (0.0047)	0.0148*** (0.0061)	0.0139*** (0.0052)	0.0146*** (0.0057)	0.0169*** (0.0046)
Technological innovators (TI)		−0.0008*** (0.0048)	−0.0026*** (0.0044)	−0.0081*** (0.0052)	−0.0069*** (0.0065)	−0.0038*** (0.0075)
Value innovators (VI)		0.0158*** (0.0024)	0.0136*** (0.0021)	0.0178*** (0.0032)	0.0151** (0.0039)	0.0191*** (0.0057)
Radical innovators (RI)		−0.0024*** (0.0022)	−0.0059*** (0.0031)	−0.0093*** (0.0042)	−0.0086*** (0.0037)	−0.0046*** (0.0016)
Imitators (IM)		0.1067*** (0.0026)	0.0182*** (0.0035)	0.0174** (0.0028)	0.0198*** (0.0026)	0.0106** (0.0044)
Double cross variables						
EP × TI			−0.0217*** (0.055)			−0.0012*** (0.0033)
TI × RI				−0.0162*** (0.0029)		−0.0071*** (0.034)
VI × IM					−0.0179*** (0.0082)	−0.0167*** (0.0059)
Triple cross variable						
EP × TI × RI						−0.0068*** (0.0037)
Constant	1.442*** (0.351)	2.589** (0.475)	2.981*** (0.644)	3.058 *** (0.392)	2.533*** (0.489)	3.062*** (0.358)
F-statistics	42.12***	38.17***	29.87***	34.83***	35.28***	31.56***
$R2\ adj.$	0.18	0.15	0.16	0.15	0.18	0.17

Note: n = 648; standard errors are in brackets; *** – $p < 0.001$; ** – $p < 0.05$.

Source: compiled by the authors.

market. Increasing research and development costs are driving companies towards a more advanced innovation regime. Investments in new technologies and equipment stimulate innovation and have a greater impact on the effectiveness of innovation.

Value innovators have a negative effect on the effectiveness of innovation, but has a stronger positive relationship with the financial results of industrial companies. The industry specificity on the choice of innovative behavior has an effect only for imitators and value innovators. The test result of 3–5 models indicates a negative relationship between the combination of innovative behavior models and performance results (EP × TI: b = –0.0217, p < 0.10; TI × RI: b = –0.0162, p < 0.05; VI × IM: b = –0.0179, p < 0.10). The effects of a triple combination of innovative strategies do not affect the performance of industrial companies (when analyzing a general sample — (Model 6). Focusing a company on one type of innovative behavior gives more significant results than following mixed strategies of innovative behavior.

Thus, Hypothesis 1 is confirmed. The chosen type of innovative behavior really affects the performance of industrial companies.

Hypothesis 2 about the effect of financial capital is also confirmed, and the presence of financial capital has a statically significant positive effect with the maximum level of significance (b = 0.0297, p < 0.05).

To test Hypothesis 3, we divided the total sample of Russian industrial companies into three subsamples according to the level of financial capital limitation:

- companies with sufficient financial capital and not experiencing liquidity restrictions;
- companies experiencing liquidity restrictions *due to the high cost of loan capital*. This group includes companies whose return[4] on invested capital was below the average interest rate on loans. This situation in the long term leads to unprofitable core activities, but we are interested in changing the behavior of companies, whether they can turn the tide through innovations and achieve an increase in the return on investment or their innovative behavior will be inclined to use a strategy of imitation;
- companies experiencing liquidity restrictions *due to poor financial condition* and therefore, they do not have access to the capital market. To select companies in this category, we used a normative approach to determining financial condition, which consists in comparing the calculated financial indicator with the normative value, just as in work [33]. If the value of a particular indicator was outside the range of the normative value, then it was assumed that the financial position of the company was poor and it was experiencing liquidity restrictions due to the inability to access the capital markets. The sample includes those companies that have at least two coefficients below the standard.

For each subsample, we carried out a regression analysis in several steps (a total of 6 Models), similar to the analysis of the general sample. *Table 5* presents the results.

The results of the analysis show that the models of innovative behavior of technological innovators and radical innovators have a positive relationship only in the group of companies that do not lack financial capital. For the other two subgroups in the sample that experience restrictions on access to financial capital, these models of innovative behavior do not have a significant result on the performance of industrial companies (b = –0.0065, p < 0.05; b = –0.0053, p < 0.10).

In the subgroup of companies experiencing liquidity restrictions due to

[4] In this case, the return on invested capital (ROIC) is understood as the ratio of net operating income to the average for the period of equity and long-term borrowed capital.

Table 5

Results of regression analysis of three sample industrial companies by restrictions on access to financial capital

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Control variables	INC	INC	INC	INC	INC	INC
Companies without liquidity restrictions						
Basic variables						
Efficient producers (EP)		0.0211*** (0.042)	0.0195** (0.048)	0.0189*** (0.039)	0.0206*** (0.028)	0.0178*** (0.035)
technological innovators (TI)		0.0177*** (0.0016)	0.0158*** (0.0019)	0.0161*** (0.0017)	0.0182*** (0.0045)	0.0108*** (0.0038)
Value innovators (VI)		0.0157*** (0.0039)	0.0132** (0.0051)	0.0183*** (0.0047)	0.0191*** (0.0104)	0.0164*** (0.0058)
Radical innovators (RI)		0.0305*** (0.0022)	0.0312*** (0.0018)	0.0289*** (0.0031)	0.0296*** (0.0065)	0.0321*** (0.0027)
Imitators (IM)		0.0109*** (0.0015)	0.0112*** (0.0044)	0.0123*** (0.0038)	0.0162*** (0.0101)	0.0164*** (0.0063)
Double cross variables						
EP × TI			0.0207*** (0.029)			0.0194*** (0.022)
TI × RI				0.0349*** (0.0042)		0.0411*** (0.0028)
VI × IM					0.0166*** (0.0051)	0.0193*** (0.0042)
Triple cross variable						
EP × TI × RI						– 0.0083** (0.0124)
Constant	1.442*** (0.351)	2.589*** (0.475)	2.981*** (0.644)	3.058*** (0.392)	2.533*** (0.489)	3.062*** (0.358)
F–statistics	37.22	34.19	28.79	36.91	41.18	36.33
*R*2 adj.	0.18	0.17	0.17	0.15	0.14	0.15
Companies experiencing liquidity restrictions due to the high cost of loan capital						
Basic variables						
Efficient producers (EP)		0.0269*** (0.0021)	0.0256*** (0.0032)	0.0282*** (0.0034)	0.0251*** (0.0036)	0.0268*** (0.0035)
Technological innovators (TI)		–0.0065*** (0.0031)	–0.0084** (0.0045)	–0.0069*** (0.0039)	–0.0046*** (0.0042)	–0.0111*** (0.0027)
Value innovators (VI)		0.0228*** (0.0022)	0.0231*** (0.0014)	0.0228*** (0.0025)	0.0219*** (0.0018)	0.0233*** (0.0031)
Radical innovators (RI)		–0.0053*** (0.0038)	–0.0131*** (0.0029)	–0.0148*** (0.026)	–0.0139** (0.019)	–0.0153** (0.034)
Imitators (IM)		0.0313** (0.0034)	0.131*** (0.024)	0.128*** (0.026)	0.119*** (0.019)	0.133*** (0.034)
Double cross variables						
EP × TI			–0.0193*** (0.0069)			–0.0066** (0.0021)

Table 5 (continued)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
TI × RI				−0.0141*** (0.038)		− 0.0136*** (0.038)
VI × IM					0.0184** (0.0027)	0.0199*** (0.0053)
Triple cross variable						
EP × TI × RI						−0.0072** (0.013)
Constant	2.012*** (0.371)	2.009*** (0.384)	2.481*** (0.512)	1.005*** (0.447)	3.443*** (0.316)	2.562*** (0.339)
F−statistics	34.63	35.23	31.28	34.11	32.54	33.88
*R*2 adj.	0.16	0.16	0.15	0.16	0.15	0.17
Companies experiencing liquidity restrictions due to poor financial condition						
Basic variables						
Efficient producers (EP)		−0.1068*** (0.0033)	−0.0195*** (0.0037)	−0.0159*** (0.0032)	−0.0171*** (0.0502)	−0.0055*** (0.0032)
Technological innovators (TI)		−0.0098*** (0.0011)	−0.0083*** (0.0024)	−0.0092** (0.0028)	−0.0146*** (0.0304)	− 0.0169*** (0.0027)
Value innovators (VI)		−0.0126** (0.0032)	−0.0138*** (0.0027)	−0.0118*** (0.0031)	−0.0182*** (0.0026)	−0.0149*** (0.0039)
Radical innovators (RI)		−0.0192*** (0.0033)	−0.0169*** (0.0037)	−0.0174** (0.0032)	−0.0136*** (0.0052)	−0.0079** (0.0032)
Imitators (IM)		0.0179*** (0.0033)	0.0188*** (0.0069)	0.0171*** (0.0055)	0.0163*** (0.0057)	0.0154*** (0.0081)
Double cross variables						
EP × TI			− 0.016*** (0.0028)			− 0.0172** (0.062)
TI × RI				−0.0173*** (0.0004)		− 0.0085*** (0.029)
VI × IM					−0.0169*** (0.0029)	− 0.0108*** (0.0049)
Triple cross variable						
EP× TI × RI						−0.0065*** (0.0013)
Constant	2.371*** (0.279)	3.008*** (0.319)	2.173*** (0.429)	2.993*** (0.284)	1.486*** (0.319)	2.108*** (0.402)
F−statistics	31.59	33.26	37.29	38.42	35.44	32.37
*R*2 adj.	0.16	0.15	0.15	0.16	0.15	0.17

Note: n = 648; standard errors are in brackets; *** – $p < 0.001$; ** – $p < 0.05$.

Source: compiled by the authors.

the high cost of loan capital, the greatest positive relationship with performance is only in the companies that have chosen the model of innovative behavior "efficient producers" (b = 0.0269, p < 0.05), "value innovators" (b = 0.0228, p < 0.05) and "imitators" (b = 0.0313, p < 0.05). Consequently, companies have no incentive to choose a more advanced model of innovative behavior.

In the subgroup of companies experiencing liquidity restrictions due to poor financial condition, only one model of innovative behavior, "imitators" (b = 0.0192, p < 0.05), is positively associated with the performance of industrial companies

Following mixed strategies of innovative behavior (Models 3–5) positively affects the performance of industrial companies only in the subgroup of companies that are not experiencing liquidity restrictions.

Also, different types of liquidity restrictions have a different effect on mixed strategies: in the subgroup of companies experiencing soft liquidity restrictions, the mixed strategy of value innovators and imitators has a positive relationship, while in the subgroup of companies experiencing hard liquidity restrictions, all types of mixed strategies have an insignificant relationship with company performance.

Thus, industrial companies will choose more advanced strategies for innovative behavior only if they do not experience restrictions on access to financial capital.

Adherence to triple models of mixed innovation behavior has a positive relationship with performance also only in the subgroup of companies that do not lack funding. For the other two subgroups, triple mixed strategies of innovative behavior have a negative relationship with performance.

Thus, Hypothesis 3 is confirmed: sufficient financial capital helps companies expand their innovative capabilities and support the development of both two and three mixed strategies of innovative behavior. Different types of financial restrictions have different effects on innovative behavior: soft restrictions allow the development of dual strategies, for example, value innovators and imitators. They also allow the selection of more advanced models of innovative behavior, i.e. move from "imitators" to "value innovators" or "efficient producers", while restricting access to capital in a rigid form has only one model of innovative behavior, which is positively related to the performance of industrial companies and does not allow the transition to more advanced innovative modes.

CONCLUSIONS

Financial capital is a strategically important resource that affects developing certain models of innovative behavior and the performance of industrial companies. The current research gives a new insight on the relationship between the chosen model/combination of models of innovative behavior and the performance of industrial companies in the context of restrictions on access to financial capital. The empirical analysis led to the following conclusions. The choice of models of innovative behavior "efficient producers", "value innovators" and "imitators" when these companies operate in the international market has the greatest effect on financial performance. On the contrary, the effectiveness of innovation activity is most influenced by "technological innovators" and "radical innovators", and "imitators" and "value innovators" prevent the creation of radical innovations. The availability and access to financial capital of industrial companies affect the choice of an innovative behavior model (with the maximum significance). For example, despite the fact that many studies justify the important role of technological and radical innovators [34], our study shows a positive relationship between these models

of innovative behavior and performance only for companies that are not experiencing liquidity restrictions. Besides, for these companies, focusing on a combination of innovative behavior patterns is positively associated with performance, with a combination of technological innovators and radical innovators showing the strongest link and enabling companies to benefit from complementarities. The combination of the three strategies of innovative behavior does not give a positive effect even for companies not experiencing liquidity restrictions. It is likely that the combination of the three models of innovative behavior creates difficulties in attracting resources, which undermines the company's ability to develop and maintain several models of innovative behavior at once.

Different types of restrictions on access to financial capital affect the choice of an innovative behavior model and its transformation in different ways.

Thus, for companies experiencing soft restrictions, the greatest positive effect is provided by "efficient producers", "value innovators", and "imitators". It is only the combination of "value innovators" and "imitators" that provides positive effects from the combination of models of innovative behavior. This is likely due to the fact that such strategies require less investment and form a competitive advantage by creating the most value for customers.

For companies experiencing rigid restrictions, only focusing on imitation strategies yields positive results. Rigid restrictions also do not allow for the effects and benefits of complementarities between innovation strategies.

The research results are of practical value for industrial leaders, business owners and entrepreneurs. Even with the limited access to financial capital, the results indicate the need to allocate resources for innovation, development and launch of new products on the market, and access to foreign markets. Developing imitation innovations in new or existing markets is an alternative in the context of rigid liquidity restrictions. Besides, business leaders should be aware of the limitations of combined innovation strategies and their potential negative impact on company performance.

The study is limited by the subjective assessments of the survey participants. In the future, one could use objective data and compare the results. Moreover, we conducted the study on a sample of industrial companies; in the future, the analysis could be extended to other industries. Also, future studies may consider other factors of the internal and external environment, for example, innovation networks and intercompany cooperation, the qualifications of employees engaged in innovative activities, etc., that can affect the relationship between innovative behavior and the company's performance in the context of financial capital restrictions, which will allow for further significant development of the considered problems.

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