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Long-term financing, investment and innovation-related growth

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Abstract

This study analyses the impact of access to debt finance on Russian firms' productivity growth and exit patterns. Using survey data (BEEPS V) we investigate the relationship between bank loans, innovation and firms' performance. We find that innovation activity per se does not lead to Russian firms' stronger productivity growth and does not reduce the risk of exit in the period of unstable economic situation in 2013–2015. Inverse-probability-weighted regression-adjustment (IPWRA) estimators show that long-term bank loans help firms improve productivity but only if they engage in innovation activity. The positive effect of debt finance on the likelihood of staying in the market comes from the group of large enterprises which are not involved in innovation activities. It could be a sign of an ineffective reallocation of financial resources towards large enterprises not necessarily showing higher productivity growth rates. At the same time, firms engaging in more sophisticated innovation stay on the market longer if they manage to obtain long-term loans.

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1. Introduction

In recent years, the issue of the causes behind the productivity growth slowdown after the 2008 financial crisis has increasingly attracted researches' attention. The economic literature dealing with this issue has extensively discussed problems stemming from a long period of extremely low interest rates, which has likely resulted in the reallocation of resources towards less efficient companies. This is a trend common to advanced countries, but at the same time, a productivity growth slowdown and an increasing gap between more and less efficient companies are also found in developing and transition economies which have not necessarily gone through the periods of low interest rates.

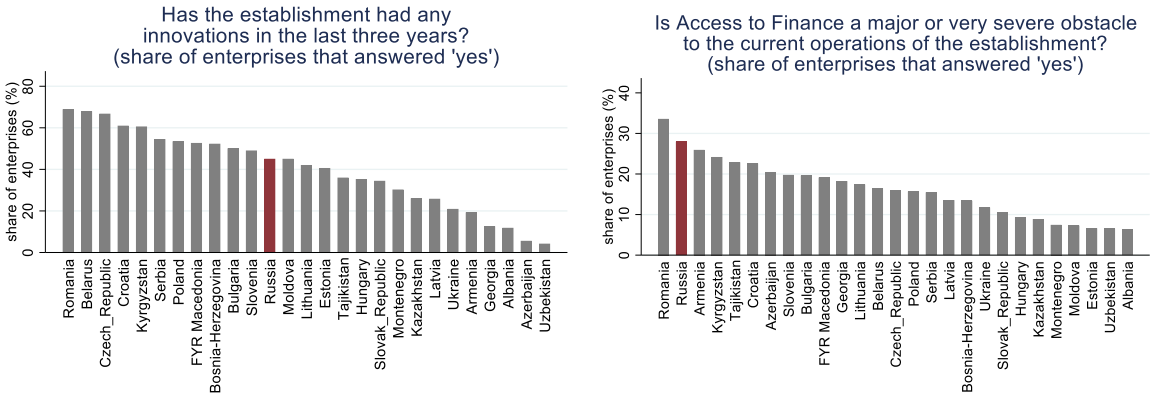
This study analyses the impact of access to debt finance on Russian firms' productivity growth. Using data from the Business Environment and Enterprise Performance Survey for Russia, round V (BEEPS V), we investigate productivity-enhancing link between bank loans, innovation and firms' performance. Economic studies have, in general, found a positive relationship between financial development and productivity growth (Rajan and Zingales, 1998). The positive impact could, however, be weak if financial markets suffer from substantial frictions. The existing literature shows that the direct effects of access to credit on productivity mainly materialize via innovation-related investment. For example, Bircan and De Haas (2020) show that deeper credit markets increase Russian firms' use of bank credit, their adoption of new products and technologies, and their productivity growth. At the same time, Heil, in his review dealing with productivity and finance (2017), stressed that the presence of frictions or low financial development could lead to a systemic misallocation of financial flows towards less efficient market players. More recent research, focusing on the 2008 financial crisis, finds that increased financial constraints have a significant negative impact on productivity growth (Duval et al. (2020), Besley et al. (2020), and Manaresi and Pierr (2017)).

We investigate two possible effects of access to debt finance: the availability of additional resources for productivity-enhancing investment and survival of firms. In the economic literature, there is no unambiguous opinion about these two channels of impact of debt finance on firms' performance. Thus, the effect is in both cases unpredictable and depends on the current development of the financial system and institutions, which in turn affects an economy's resource allocation efficiency.

The BEEPS V data for Russian firms shows that firms engaged in different types of innovation activities tend to complain of problems with access to financing more often. This is a worrying signal suggesting that more efficient firms' growth could be constrained by limited access to external financing.

If we compare the BEEPS V data for different countries, we will see that the share of innovative enterprises among Russian firms is not low compared to other transition economies. At the same time, there is a high proportion of enterprises which complain of problems with access to finance (see Figure 1). Russia has one of the largest shares of enterprises (28%) citing access to finance as a major or very severe obstacle to their current operations. More than 60% of respondents note that access to finance is a problem for their businesses.

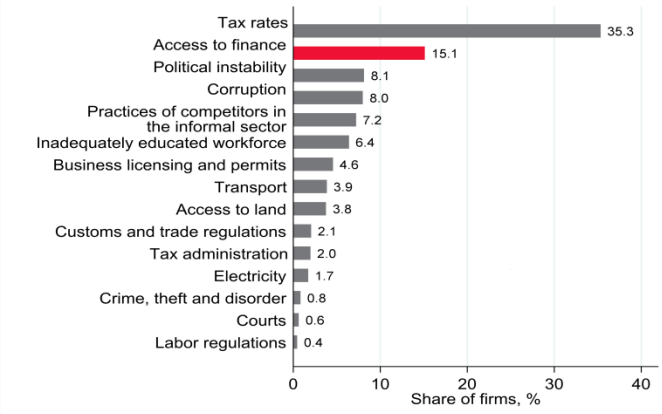
Figure 1. Share of innovative firms and that of firms claiming problems with access to finance



Source: BEEPS V, authors' estimates

For Russian companies, access to financing is the second most important obstacle to doing business after taxes. In other transition economies, access to finance is also often a major issue, usually the first or second in importance, unless the country is politically unstable. Other obstacles to doing business in Russia are, meanwhile, much less of concern to enterprises than the level of taxation and access to finance. Thus, despite the relatively positive situation with innovation activity, Russian enterprises are, according to the survey, experiencing significant problems with access to financing.

Figure 2. The most important obstacle for a firm in Russia



Source: BEEPS V, authors' estimates

Thus, the share of innovatively active firms in Russia is higher than in many other developing economies, but Russian enterprises are experiencing serious problems with borrowing funds, which may lead to a lower level of innovation-related investment. This will in turn result in a low impact of innovation on firms' performance.

Indeed, in this paper we have shown that innovation does not bring about subsequent higher growth rates, which could be due to the smaller scale of innovation on account of the lack of funds at potentially more productive firms. We find that innovation has a positive effect on productivity growth only if it is accompanied by fixed investment, especially where investment is financed through bank loans.

Estimates based on Russian credit registry show that the most productive firms have better access to credit. This fact complicates empirical studies of the impact of long-term bank loans on productivity growth. In our research, we apply inverse-probability-weighted regression-adjustment (IPWRA) estimators to assess the relationship between debt finance, innovation, and productivity growth. Our estimates show that long-term bank loans are associated with productivity growth only if a firm is involved in innovation. Our results show weaker effects of credit on productivity growth than the Bircan and De Haas (2020) study reports based on the same survey as we looked into. The differences between the findings of their study and our results may be due to the fact that we consider firms' performance in the period after the survey was conducted, while this period saw a growth slowdown on the back of geopolitical developments, which may have caused shifts to the relationship in question.

Our analysis of exit patterns and debt finance shows that long-term bank loans reduce the likelihood of a firm's exit from the market, but this effect comes from the group of large companies which are not involved in innovation. Involvement in innovation does not in itself increase the likelihood of a firm staying on in the market. However, if firms involved in more sophisticated innovation manage to obtain long-term bank financing, then their risk of exiting the market is reduced.

This paper is organized as follows. The next section contains a literature review. Section 3 provides data description. Section 4 describes the estimation methodology. Findings regarding innovation activity, fixed investment, bank loans, and productivity growth are described in sections 5.1 and 5.2. Section 5.3 contains the analysis of exit patterns. Section 6 concludes.

2. Literature review

Economic studies have, in general, found a positive relationship between financial development and productivity growth. There is, however, no generally accepted view on the mechanism of this relationship, with various studies investigating different aspects of it. Heil (2017) summarizes the results of recent studies in his review, suggesting that financial development is quite likely to have a positive effect on productivity growth, although financial frictions weaken this effect. In an earlier study, Rajan and Zingales (1998) emphasize that the low level of financial constraints enhances innovation-based growth. That said, more recent research, focusing on the 2008 financial crisis, finds that increased financial constraints have a significant negative impact on productivity growth (see Duval et al. (2020), Besley et al. (2020), and Manaresi and Pierr (2017)).

A broad strand of the literature investigates how the presence of financial frictions weakens the productivity-enhancing link between access to credit and firms' incentives to improve their performance. The direct effect of financial frictions is that they diminish firms' access to credit and reduce the scope of their investment in innovation (Aghion at al. (2010)). Financial frictions also involve an indirect effect, that of affecting the optimal allocation of resources in the economy (Hsieh and Klenow, 2009). Gopinath et al. (2017) argue that easier access to credit could result in systematic capital misallocation towards large but not necessarily the most productive firms. Midrigan and Xu (2014) conclude that

sizable losses from the presence of financial frictions are owed to the low levels of firms' entry in the market and insufficient technology adoption.

Both types of effects could vary in strength for firms with different efficiency levels and countries with different levels of economic and institutional development. According to the literature survey by Heil (2017), recent research suggests that the presence of financial frictions does more damage to productivity in less developed countries than in those with more developed financial systems.

Theoretical models analysing financial friction, firm dynamics and productivity growth

The indirect effects of the presence of financial frictions on productivity growth during a recession are often analysed in theoretical models. Using a general equilibrium model, Barlevy (2003) shows that the presence of credit market frictions reduces the cleansing effect of recessions by reallocating resources from more to less efficient companies. In his model, such effects occur because more efficient firms require larger financial resources, thus becoming more vulnerable to credit constraints. Ouyang (2009), in her model calibrated on US manufacturing data, demonstrates that during recessions young firms are forced to exit sooner without revealing their growth potential. According to her model, this "scarring" effect prevails over the cleansing effect, reducing average productivity during recessions.

The findings of Osotimehin and Pappada (2017) are opposite to those above. Calibrating a model of firm dynamics with credit frictions the authors show that the cleansing effect of recessions prevails even in the presence of credit frictions, despite their effect on the selection of exiting and entering firms. The study finds that average firm‐level productivity rises following both productivity and financial shocks.

Aghion et al. (2019) use the Schumpeterian type model, which focuses on creative destruction and entry, to demonstrate two opposite effects of credit access on firms' performance. A direct effect arises because firms with easier access to credit enjoy greater opportunities for innovation-based growth. At the same time, the allocation effect goes the opposite way: an easier credit access brings down the pace of exit, especially among low productive firms, and since these firms stay in the market longer, average productivity growth slows down.

Access to finance and investment

The existing literature shows that the direct effects of access to credit on productivity mainly materialize via investment in new equipment and machinery, as well as intangible assets, the adoption of new technologies and managerial practices, along with spending on research and development. Mancusi and Vezzulli (2010), using data on Italian firms, find that the presence of financial constraints negatively affects companies' decisions to invest in research and development. Campello et al. (2010), analyzing the consequences of the 2008 financial crisis in the U.S., Europe, and Asia, show that more financially constrained firms tend to scale down spending on new technologies and on employment and capital more significantly. They also find that limited access to external financing made many firms skip attractive investment opportunities.

The estimates of the size of the effect of credit constraints on the investment rate vary across studies. Bond et al. (2015), using data on the 1995–2013 period, find that such negative effects are not sizeable at the aggregate level. On the other hand, research examining the period around the 2008 financial crisis finds that a negative credit supply shock had a strong impact, producing a sharp investment decline (see Cingano et al. (2016), Bottero et al. (2020)).

Access to finance and productivity growth and innovation

A number of studies investigating the effect of the 2008 financial crisis on firms' productivity growth find that more financially unstable firms experienced a larger productivity slowdown than companies less dependent on external financing. Duval at al. (2020) explain this relationship by the fact that firms highly dependent on external financing had to significantly reduce their innovation activities, which eventually slowed post-crisis productivity growth. Ferrando and Ruggieri (2018), using firm-level data for 1995–2011, find that the elasticity of total factor productivity with respect to financial constrains is negative and significant. They also show that the 2008 financial crisis amplified this effect. Levine and Warusawitharana (2021) find that the presence of frictions in the financial market increases the cost of funding for financially dependent firms, thus reducing their investment in innovative projects. This heightened the sensitivity of productivity growth to the use of external finance under a higher level of financial frictions.

Another channel which weakens the productivity-enhancing link between credit access and productivity is the presence of frictions in the financial market which limit productive firms' access to external financing. Caballero at al. (2008) shows that the tendency of Japanese banks to support large but close to insolvency firms by providing loans to them prompted a productivity decline in industries dominated by such firms. Schivardi at al. (2017) analyzing firm-bank relations in Italy shows that an increased input misallocation during the 2008 crisis arose from a situation where weak banks confronted with economic agents' limited investment opportunities during recessions, tended to lend to low productive and financially weak firms. Some other authors (Benigno et al. 2015; Borio et al. 2016) argue that credit booms accompanied by relaxing credit conditions can also lead to the misallocation of resources towards less efficient market players.

Law et al. (2018), using country-level data, demonstrate that the link between financial development and innovation is not linear. Moreover, its form depends on the level of institutional development of a country. Thus, a certain level of institutional quality is required for financial development to start to have a positive impact on innovation activities. In countries with a weak financial system, the relationship between credit access and productivity growth or investment in innovation could be less pronounced. At the same time Acemoglu et al. (2006) show that the higher the level of development of a country the more it requires investment in frontier innovation to support sustainable growth and technological catch-up. These findings highlight that countries' different levels of institutional and financial development can result in different mechanisms behind finance-productivity or finance-innovation links.

Access to finance and exit of low and high productive firms

Theoretical models predict that in the absence of various types of frictions, markets select the most productive firms and that low efficient players are forced to exit the market during recessions. However, this argumentation was questioned in a number of papers showing that the productivity level is not the only parameter affecting the probability of a firm's exit. Certain studies find that limited access to credit may result in higher exit rates for firms with growth potential. For example, Musso and Schiavo (2008) argue that the probability of a firm to exit the market increases significantly if it faces financial constraints.

One direction of research in this area shows that the presence of financial frictions mainly affects the finance-productivity link through firm dynamics rather than through the reallocation of resources among firms. Andrews and Cingano (2014) do not confirm a relationship between allocative efficiency and financial development. Rather, they attribute the positive link between financial development and average productivity to net firm entry, which finally reduces the share of inefficient firms on the market. Anderson et al. (2019) find that low credit access after the 2008 financial crisis increased firms' exit rates in the UK. But the cleansing effect was not found in this period – the authors suggest that limited credit access led to the failure of companies which were more productive than those managing to survive. The authors demonstrate that distressed banks tend to protect financially weak and low productive businesses from failure. Liu and Li (2017), using data on Chinese firms, find that financial constraints do not only negatively affect firms' survival but also influence the market selection mechanism, reducing inefficient firms' incentives to exit, which appeared to be especially true of state-owned enterprises and large companies.

Innovation behaviour and exit

The economic literature draws attention to the role of innovation behaviour of firms, especially young ones, in their subsequent survival and performance years. Pèrez et al. (2004) show that firms engaged in R&D activities manage to survive longer. Coad and Rao (2008) find that innovation is of crucial importance in the group of fast-growth firms. Cefis and Marsili (2006) confirm that small and young firms exit the market sooner but the effect of size and age could be mitigated by these firms' engagement in innovative activities. According to Cefis and Marsili (2006), the estimate of the innovation premium for small and young firms is the highest in all company groups. Innovation, unless it is a mere imitation, positively affects survival, also improving other characteristics of firms' performance. Colombelli et al. (2016) show that startups involved in both product and process innovation survive better than their non-innovative counterparts. The study emphasises the key role of more sophisticated process innovation. Research using developing countries' data does not usually find a strong connection between innovation behaviour and firms' performance. This could be due to the fact that in a large number of developing countries innovation is mostly based on mere imitation and new equipment acquisition rather than on a firm's involvement in R&D activities of its own (Crespi and Zuniga, 2012, for Latin American countries).

Innovation activities, in general, reduce the risk of exit, this effect being especially pronounced for small and young firms. At the same time, more sophisticated innovation requires external financing, while only large and mature companies can afford to finance

R&D projects on their own. Thus, the presence of financial frictions, which reduce access to credit for young firms, suppresses their innovation activity and may force their premature exit from the market.

3. Data

Our study uses firm-level data which comes from several sources. Our key data source is the Business Environment and Enterprise Performance Survey, round V (BEESPS V), which was conducted in Russia in 2011–2012. This sample is comprised of 4,220 private sector firms. It is stratified by sector, size and region. The survey covers a broad range of issues, including access to finance and innovation activity. The data is collected during face-to-face interviews with top managers of firms participating in the survey.

For the purpose of this study, we explore the BEESPS V questions from the sections dedicated to access to finance and innovation activities. In our study, we analyse the impact of debt finance on the productivity of an enterprise in the coming years. As discussed in the literature review, access to external financing can have an impact on productivity through the possibility of additional financing for innovative activities, including innovation that requires fixed investment. Therefore, this study uses two sets of variables which reflect the opportunities of access to finance for an individual enterprise. First, we build a variable which reflects whether a given company took a loan before the date of the survey, and if it did, whether it was a short-term loan (up to one year) or a long-term one. Second, we consider the sources used to finance the purchase of fixed assets in a year prior to the survey and identify enterprises which financed fixed investment from internal funds and those which took bank loans for the purpose of such investment. The share of other sources is rather small, less than 5% each, and therefore we do not analyse them separately in our study.

From the part of the questionnaire dealing with innovation we use questions related to involvement in six types of innovative activity, namely a new product or service; a product or service new for at least one market; process innovation; new organizational or management practices; marketing innovation; and research and development activities.

For analysing the relationship between debt finance and innovation activity and their combined effects on a firm's performance we need to add information on firms' productivity and exits from the market from other sources which cover years after the survey.

Thus, another part of our data is firms' financials in the 2011–2015 period, derived from the Ruslana database. The advantage of the Ruslana database is the availability of labour data for periods prior to 2017. We use the Ruslana database to estimate firm-level labour productivity for years subsequent to the BEEPS V. To estimate labour productivity, we use data on revenue and the number of employees from firms' balance sheets. Revenue is deflated by the producer price index in manufacturing and by the value added deflator in other sectors. We calculate output-based labour productivity as revenue per employee.

We divide our sample into 290 narrowly defined industries, with most of the industries aggregated at a 3- or 4-digit level of OKVED2 classification, which is close to NACE2

classification. We calculate 99.5 and 0.05 percentiles of log labour productivity distribution in each industry. We exclude firms whose labour productivity is above or below these thresholds. We assume that 5% of firms with the highest level of log labour productivity in each industry operate at the production frontier. The distance to the frontier is defined as the difference between the median of log labour productivity of firms operating at the frontier and the log labour productivity of firms in the industry.

In each narrowly defined industry, we identify three groups of firms based on their distance to the production frontier. The productivity leaders are 20% of firms operating at the closest distance to the industry production frontier. The followers are firms which are one step behind leaders. The distance to the industry production frontier is greater than in the leaders' group, while the followers operate at the distance closer than the median distance to the industry production frontier. The laggards are the least productive firms operating at the distance greater than the median distance to the industry production frontier. Efficiency groups were calculated based on 2012 data, i.e. at the time of the survey.

The third data source is the SPARK-Interfax database, from which we have obtained information on a firm's liquidation date. While the database does not provide the labour data for periods prior to 2017, its advantage is the high frequency of data updates. Information about the date and cause of liquidation provided in this database is obtained from the Unified State Register of Legal Entities (USRLE). In 2017, a sharp increase in exits was seen in the USRLE, explained by the Federal Tax Service's revision to the SME register undertaken in 2016. This means that the exit could have occurred earlier and only recorded in 2017. To take into account this revision we reassign the exit year based on the fact of the disappearance of balance sheet data from the Ruslana dataset.

Some enterprises may re-register for various reasons (for example, to be granted tax breaks or change the ownership structure), but not de facto leave the market. To take this fact into account, we checked the information on the enterprises that took part in the survey and are recorded as liquidated according to the USRLE. If an enterprise officially left the market, but a company with a similar set of owners and a similar field of activity appeared in the same year and at the same actual or legal address, then we regarded this enterprise as staying on in the market.

As a result, we supplement the data from the business environment survey with the data on liquidation provided by SPARK-Interfax and that on firms' efficiency in terms of their labour productivity from the Ruslana database. The resulting dataset contains just over 2,000 firms. The description of the variables and summary statistics for this dataset are presented in Table 1.

4. Estimation strategy

This study investigates the relationship between innovation and debt finance and their impact on firms' performance. We analyse separately the effect of long-term financing and that of fixed investment financed through bank loans.

Table 1. Summary statistics for the merged dataset

Variable	Description	obs.	mean	st.dev.	min	max
Productivity growth in 2013	Output based labour productivity growth in 2013, authors estimates based on Ruslana dataset	1,956	-0.133	0.362	-1.997	0.991
Average productivity growth in 2013-2015	Average output based labour productivity growth in 2013-2015, authors estimates based on Ruslana dataset	2,029	-0.203	0.372	-1.997	0.952
All innovation	Dummy for all types of innovation activities. Based on BEEPSV dataset, as of 2012	1,956	0.432	0.495	0	1
Product innovation	Dummy for product innovation. Based on BEEPSV dataset, as of 2012	1,956	0.243	0.429	0	1
Product innovation new for market	Dummy for product innovation new for market.Based on BEEPSV dataset, as of 2012	1,791	0.194	0.396	0	1
Process innovation	Dummy for process innovation. Based on BEEPSV dataset, as of 2012	1,952	0.206	0.404	0	1
Organisational innovation	Dummy for introduction of new organisational or management practices or structures. Based on BEEPSV dataset, as of 2012	1,949	0.262	0.440	0	1
Marketing innovation	Dummy for new marketing methods. Based on BEEPSV dataset, as of 2012	1,946	0.245	0.430	0	1
R&D activities	Dummy for research and developmet activitties. Based on BEEPSV dataset, as of 2012	1,941	0.149	0.356	0	1
Long-term loan	Dummy for firms having a bank loan with original maturity of more than 12 mothns. Based on BEEPSV dataset, as of 2012	1,860	0.099	0.299	0	1
Short-term loan	Dummy for firms having a bank loan with original maturity of less than 12 mothns. Based on BEEPSV dataset, as of 2012	1,860	0.112	0.316	0	1
Exit	Dummy for firms that exited from a market in 2013-2017. Based on Spark-Interfax dataset	2,222	0.298	0.458	0	1
Fixed investment from bank loans	Dummy for firms that finace purshacing of fixed asstes from bank credits. Based on BEEPSV dataset, as of 2012	1,956	0.053	0.224	0	1
Fixed investment from internal funds	Dummy for firms that finace purshacing of fixed asstes from internal funds or retained earnings. Based on BEEPSV dataset, as of 2012	1,956	0.327	0.469	0	1
Employment	Logarithm of number of employees. Ruslana dataset, Employment	1,956	3.82	0.781	2.16	8.58
Efficiency dummies	Dummies for efficientcy groups. Authors estimates of a firm's productivity gap with industry frontier based on Ruslana dataset, as of 2012					
	Laggards (below median)	1,956	0.425	0.494	0	1
	Followers (above median, but not belonging to leaders)	1,956	0.385	0.487	0	1
	Leaders (top 20%)	1,956	0.191	0.393	0	1
Age dummies	Dummies for firms' age. Based on BEEPSV dataset, as of 2012					
	less than 3 years	1,956	0.213	0.409	0	1
	4-15 years	1,956	0.552	0.497	0	1
	more than 15 years	1,956	0.235	0.424	0	1
Sector dummies	Sector dummies from Ruslana dataset					
	Manufacturing	1,956	0.188	0.390	0	1
	Retail	1,956	0.514	0.500	0	1
	Services	1,956	0.145	0.353	0	1
	Construction	1,956	0.153	0.360	0	1

First, we investigate the impact of long-term bank loans on productivity growth per se and in interaction with innovation activities. In this case, we cannot conduct OLS estimations because estimates based on our dataset as well as other studies of the distribution of credit among Russian firms with different productivity levels (see, for example, Bessonova et al., 2021) show that more efficient companies receive a significant proportion of all loans. Thus, the selection bias of the quantity of bank loans towards firms in higher deciles of productivity distribution is observed in the data. Therefore, we have to

employ the treatment effect techniques to account for this bias in estimating the impact of debt finance on productivity growth. In this study, we use inverse-probability-weighted regression-adjustment (IPWRA) estimators to evaluate the impact of long-term loans on productivity growth. IPWRA estimators use the reciprocals of the estimated treatment probability as weights to estimate the missing-data-corrected-regression coefficients which are subsequently used to compute the average-treatment effect on the treated (ATET). The Stata16 software package was used for these estimations.

Next, we analyse the effect of innovation and fixed investment on subsequent productivity growth using the OLS approach where we regress productivity growth rates on the lagged variables of interest.

$$\begin{aligned} &Productivity\ growth \\ &\quad = a_1 Innovation\ activity \\ &\quad + a_2\ Fixed\ asset\ financing\ from\ internal\ funds \\ &\quad + a_3 Fixed\ asset\ financing\ by\ bank\ loan + controls + \varepsilon_i \end{aligned} \qquad (1)$$

We estimate the effect for both next-year and three-year average productivity growth, i.e., labour productivity growth in 2013 and in 2013–2015. The first period is the last year of recovery growth after the global financial crisis, the second period include a sharp slowdown in economic growth in Russia caused by geopolitical developments. Also, in this specification, we distinguish two main sources of financing for the purchase of fixed assets - from internal funds and from a bank loan.

In addition, we estimate the specification with the interactions of innovation activity dummies and dummies for fixed investment financing sources.

$$\begin{aligned} &Productivity\ growth \\ &\quad = a_1 Innovation\ activity \\ &\quad + a_2\ Fixed\ asset\ financing\ by\ bank\ loan \\ &\quad + a_3 Innovation\ activitity \times Fixed\ asset\ financing\ by\ bank\ loan \\ &\quad + a_4 Fixed\ asset\ financing\ from\ internal\ fundsF + controls + \varepsilon_i \end{aligned} \qquad (2a)$$

$$\begin{aligned} &Productivity\ growth \\ &\quad = a_1 Innovation\ activity \\ &\quad + a_2\ Fixed\ asset\ financing\ from\ internal\ funds \\ &\quad + a_3 Innovation\ activitity \times Fixed\ asset\ financing\ from\ internal\ funds \\ &\quad + a_4 Fixed\ asset\ financing\ by\ bank\ loan + controls + \varepsilon_i \end{aligned} \qquad (2b)$$

The above types of innovation activities are highly correlated, therefore, we estimate equation (1) and (2a)-(2b) separately for six types of innovation activities.

Control variables include the logarithm of the number of employees, firms' age dummies and sector dummies. The economic literature devoted to the analysis of the dynamics of productivity (Bessonova and Tsvetkova, 2019; Cette et al., 2018; Griffith et al., 2009; Bournakis and Mallick, 2018) emphasize the fact that the rate of productivity growth depends on the initial level of productivity. Firms operating at the production possibility frontier tend to show lower productivity growth rates than those found far from it. Therefore, we have to control for the original performance level in the regressions. But the enterprises

in the sample belong to different industries and we cannot simply include the level of labour productivity in the regression, since labour productivity indicators are incomparable between industries due to different production technologies. Therefore, within each industry, we have identified three groups of enterprises based on their productivity level (leaders, followers, laggards) and include efficiency groups' dummies in the control variables instead of initial labour productivity levels.

Finally, we analyse another firm performance characteristic – exit from the market. We investigate the effects of innovation, investment, and debt finance on the probability of a firm's exit from the market using the logit model.

$$\begin{aligned}\Pr(Exit|X) = G\{&a_1 Long\ term\ loan \\ &+ a_2\, Short\ term\ loan + a_3 Fixed\ assets\ financing\ from\ internal\ funds \\ &+ a_4 Fixed\ assets\ financing\ by\ bank\ loans + a_5 Innovation\ Actitivy \\ &+ controls\ \} \qquad (3)\end{aligned}$$

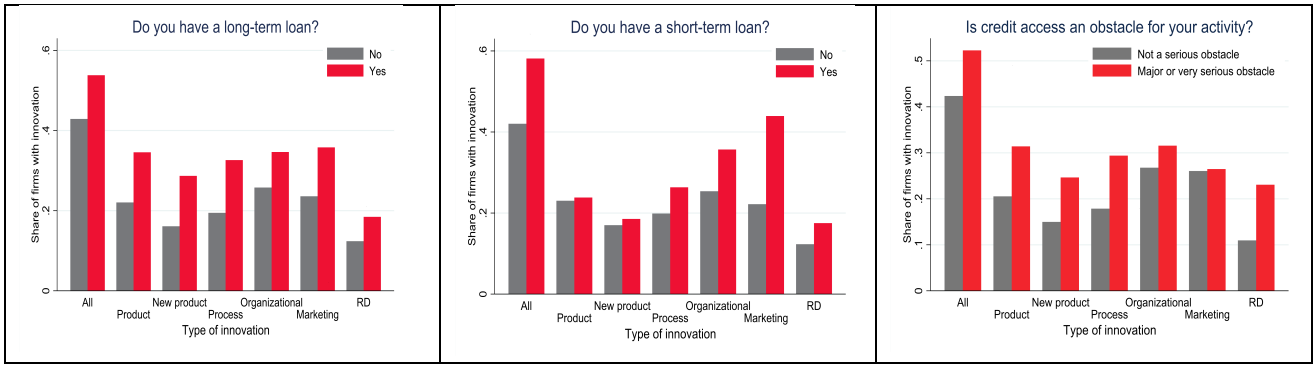
where X is the vector of all explanatory variables and G(z)=exp(z)/(1+exp(z)). The set of control variables remains the same as in the specifications described above.

In a number of specifications with firms' exits, we also include the cross-terms of the variables of interest. The results for these specifications are presented in a graphical form for easier interpretation.

5. Results

The link between productivity growth and debt finance is usually explained by a greater opportunity for a company with external sources of finance to invest in innovation. Indeed, estimates based on the BEEPS V data show that among enterprises which have taken bank loans, short-term and long-term alike, the share of enterprises engaged in innovation is higher than among firms without bank loans. At the same time, we see that enterprises involved in innovation are more likely to complain of problems with access to finance (see Figure 3). Thus, it appears that more active businesses face funding constraints and are unable to realize their growth potential.

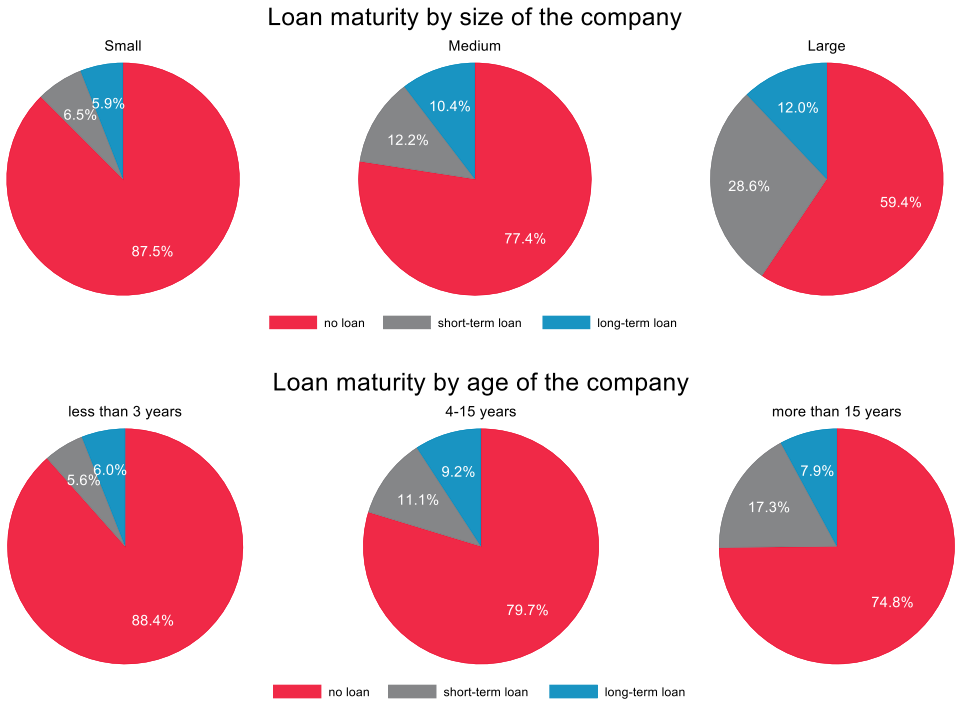
Figure 3. Access to finance and innovation



Source: BEEPS V, authors' estimates

The BEEPS V data also show that small and young companies are much less likely to have access to funding than large and older businesses (see Figure 4). On the other hand, research in productivity dynamics suggests that the main growth momentum is concentrated in the group of young, fast-growing enterprises (Bessonova et. al., 2020; Haltiwanger et al., 2013; Decker et al., 2016). If such enterprises do not have sufficient access to external financing, they will not be able to realize their potential and will be forced out of the market. At the same time, the share of Russian enterprises which have access to long-term loans is not very high, even among large and old companies.

Figure 4. Loan maturity by firms' size and age



Source: BEEPS V, authors' estimates

5.1. Long-term loans, innovation and productivity growth

In this section, we start with the analysis of the impact of long-term loans on firms' productivity patterns. Bessonova et al. (2021) in their study on the structure of loans based on the credit registry of Russian companies show that the majority of debt finance in terms of both amounts and the number of loans goes to firms belonging to the top productivity deciles. Thus, there is a strong selection bias with respect to productivity for Russian companies with bank loans. To account for this selection bias, we use the inverse-probability-weighted regression adjustment (IWPRA) approach to estimate average treatment effects of long-term loans on productivity growth.

Table 2 presents the regression estimations of the IWPRA approach for both labour productivity growth in 2013 and average labour productivity growth in 2013–2015, which will be used for treatment effects evaluation. The treatment regressions indeed show that more efficient companies obtain bank loans more often.

Table 2. Inverse-probability-weighted regression adjustment estimations. Base specification

	Productivity growth in 2013 (base specification)			Agerage productivity growth in 2013-2015 (base specification)		
VARIABLES	Outcome regression on control group	Outcome regression on treated group	Treatment regression	Outcome regression on control group	Outcome regression on treated group	Treatment regression
Age[I]: less than 3 years	0.019	0.141**	-0.062	0.037	0.072	-0.048
	(0.035)	(0.067)	(0.205)	(0.035)	(0.070)	(0.192)
Age: more than 15 years	-0.045	0.044	-0.114	-0.050	-0.088	-0.077
	(0.057)	(0.053)	(0.150)	(0.039)	(0.092)	(0.147)
Fixed investment from bank loans	-0.018	0.065		0.013	0.128**	
	(0.046)	(0.042)		(0.045)	(0.054)	
Fixed investment from internal funds	-0.044*	0.097**		-0.052*	0.045	
	(0.025)	(0.043)		(0.030)	(0.053)	
Employment	0.091***	0.027	0.024	0.096***	0.073*	0.009
	(0.032)	(0.030)	(0.085)	(0.029)	(0.038)	(0.086)
Efficiency[II]: followers	-0.005	-0.042	0.488***	0.003	0.007	0.469***
	(0.044)	(0.055)	(0.138)	(0.032)	(0.053)	(0.133)
Efficiency: leaders	-0.001	-0.030	0.619**	-0.006	-0.068	0.541*
	(0.048)	(0.052)	(0.279)	(0.042)	(0.097)	(0.276)
Sector[III]: retail	-0.045	-0.025	-0.338	-0.058**	-0.132**	-0.404*
	(0.034)	(0.049)	(0.219)	(0.029)	(0.065)	(0.218)
Sector: services	-0.070**	-0.075	-0.521*	-0.029	-0.260***	-0.583**
	(0.033)	(0.061)	(0.267)	(0.034)	(0.080)	(0.261)
Sector: construction	-0.113	0.178	-1.034***	-0.210	0.103	-1.085***
	(0.087)	(0.173)	(0.308)	(0.167)	(0.070)	(0.294)
Constant	-0.486***	-0.399***	-1.220***	-0.486***	-0.399***	-1.220***
	(0.117)	(0.130)	(0.407)	(0.117)	(0.130)	(0.407)
Observations	1,868	1,868	1,868	1,940	1,940	1,940

Note: [I] Omitted category 4-15 years; [II] Omitted category laggards; [III] Omitted category manufacturing
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The evaluated average treatment effects on the treated (ATET) are presented in Table 3. The base specification reveals that external financing using long-term bank loans does not have a statistically significant impact either on next-year productivity growth or on three-year productivity growth. To investigate this result in more detail, we evaluate ATET for subgroups of companies with and without innovation activities, as well as for different size groups.

In evaluating the effect separately for enterprises which are involved in various types of innovation activities and those which did not innovate during three years prior to the survey, long-term bank loans are found to have a positive impact on productivity only for innovative enterprises. Table 3 shows that in the short run, long-term bank loans have a positive effect on labour productivity growth in firms which have released a new product, both for this enterprise and for the market, have carried out marketing innovations or have been involved in R&D. In the longer term, the positive effect of long-term bank loans on productivity growth is registered only for enterprises which have introduced new products or have undertaken process innovation. Thus, in the short term, which saw a relatively stable economic situation, the impact of a long-term bank loan is more pronounced than in a longer period, during which the 2014 crisis occurred.

For enterprises which were not involved in innovation activity, none of the specifications showed a statistically significant effect of long-term bank loans. Since the share of such enterprises in the sample is rather large, accounting for more than half of them, this explains the absence of a positive impact of long-term loans on productivity in the sample as a whole.

We also analyse how the impact of obtaining long-term bank financing differs for firms of different sizes (see Table 3). A statistically significant positive impact is only found for medium-sized enterprises. Neither small enterprises, which rarely take long-term loans, nor large companies, which obtain loans more often than others, show a positive effect of external long-term financing on labour productivity growth.

Table 3. Impact of long-term loans on productivity growth. Average treatment effect on treated (ATET). Various specifications

Base												
	2013	AVG 2013-2015										
	base specification	base specification										
ATET	0.040	0.019										
	(0.036)	(0.041)										
Observation	1,868	1,940										
Innovation												
	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013
	Product	Product	Product new for market	Product new for market	Process	Process	Organizational	Organizational	Marketing	Marketing	R&D	R&D
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
ATET	0.199**	-0.007	0.177**	-0.005	0.110	0.021	0.111	0.009	0.143*	0.000	0.187*	0.022
	(0.085)	(0.040)	(0.074)	(0.040)	(0.069)	(0.041)	(0.073)	(0.041)	(0.087)	(0.038)	(0.105)	(0.034)
Obs.	475	1,385	317	1,393	447	1,414	455	1,404	465	1,392	220	1,632
Innovation												
	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015
	Product	Product	Product new for market	Product new for market	Process	Process	Organizational	Organizational	Marketing	Marketing	R&D	R&D
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
ATET	0.151*	-0.026	0.164*	-0.026	0.133*	-0.016	0.050	-0.014	0.064	-0.026	0.187	-0.002
	(0.090)	(0.041)	(0.098)	(0.041)	(0.080)	(0.043)	(0.097)	(0.037)	(0.085)	(0.037)	(0.125)	(0.036)
Obs.	500	1,432	335	1,440	463	1,470	470	1,460	479	1,449	227	1,696
Firm size												
	2013	2013	2013	AVG 2013-2015	AVG 2013-2015	AVG 2013-2015						
	Small	Medium	Large	Small	Medium	Large						
ATET	-0.059	0.084**	0.085	-0.030	0.080*	-0.035						
	(0.050)	(0.041)	(0.060)	(0.046)	(0.042)	(0.125)						
Obs.	929	684	254	978	701	260						

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To understand the importance of the maturity of bank loans for productivity growth, we use the same methodology to assess the impact of short-term bank loans on productivity growth. The estimates obtained indicate that, unlike long-term loans, short-term bank financing does not affect the productivity growth of innovative firms, either in the short or in the long run (see Table 4). A positive impact of short-term bank loans on labour productivity growth is only found in the case of marketing innovations. At the same time, in the absence of innovation, short-term financing can in some cases even have a negative impact on labour productivity growth in the unstable period of 2013–2015. Thus, only long-term loans and only at enterprises involved in innovative activities have a positive effect on labour productivity growth.

Table 4. Impact of short-term loans on productivity growth. Average treatment effect on treated (ATET). Various specifications

Base												
	2013	AVG 2013-										
	base specification	base specification										
ATET	-0.116	-0.015										
	(0.188)	(0.097)										
Obs.	1,868	1,940										
Innovation												
	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013
	Product	Product	Product new for market	Product new for market	Process	Process	Organizational	Organizational	Marketing	Marketing	R&D	R&D
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
ATET	0.057	-0.242	0.073	-0.238	0.042	-0.248	0.100	-0.263	0.316**	-0.281	0.044	-0.236
	(0.057)	(0.226)	(0.053)	(0.226)	(0.049)	(0.237)	(0.066)	(0.227)	(0.147)	(0.223)	(0.104)	(0.209)
Obs.	475	1,385	317	1,393	447	1,414	455	1,404	465	1,392	220	1,632
Innovation												
	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-	AVG 2013-
	Product	Product	Product new for market	Product new for market	Process	Process	Organizational	Organizational	Marketing	Marketing	R&D	R&D
	Yes	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
ATET	0.036	-0.122	0.023	-0.122	0.036	-0.125	0.110	-0.136*	0.195***	-0.143**	-0.058	-0.094
	(0.065)	(0.102)	(0.083)	(0.102)	(0.051)	(0.098)	(0.117)	(0.080)	(0.075)	(0.062)	(0.063)	(0.098)
Obs.	500	1,432	335	1,440	463	1,470	470	1,460	479	1,449	227	1,696

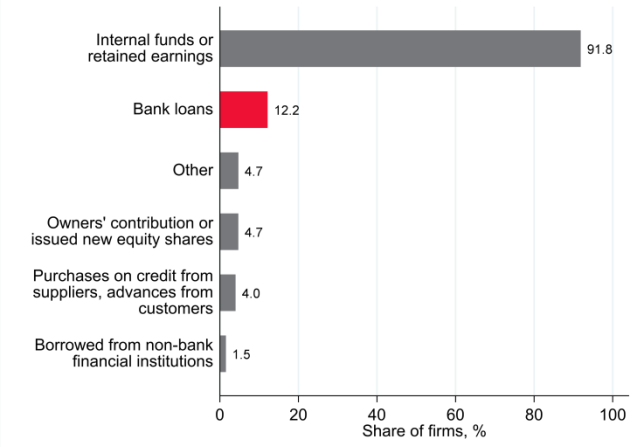
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2. Fixed investment, innovation and productivity growth

Various types of innovation are usually closely related to investment in new equipment and/or new production technologies. Organizational innovation could also be accompanied by the reorganization of a production process, which also requires investment in fixed assets. In the face of financial frictions, a company has a limited opportunity to obtain funding from external sources. In this case, the scope of innovation shrinks, and firms confine their innovation activities to a mere imitation of products or services already present in the market.

The survey data shows that Russian firms rely mostly on internal funds to finance fixed investment. In our sample, 38.4% of companies invested in fixed assets, with 91.8% of them financing this investment by retained earnings. At the same time, only 12.2% of firms used bank loans for acquiring fixed assets (see Figure 5).

Figure 5. Fixed investment; sources of financing



Source: BEEPS V, authors' estimates

To evaluate the effect of innovation activities and fixed investment on productivity growth in subsequent years we use standard OLS estimation techniques. The results are presented in Table 5. As in the previous subsection, we analyse both the immediate impact of innovation on next-year productivity growth and a prolonged effect on three-year average productivity growth. In the regression for productivity growth, we include various indicators of innovative activity. In addition, we use two variables: that for investment in fixed assets financed from internal funds and that financed through bank loans.

The regressions results show that innovation does not have a positive effect on productivity growth in either the short or long run. Fixed investment financed by internal funds also does not have a positive impact on productivity growth in subsequent years. However, investment in fixed assets financed by bank loans has a significant positive impact on productivity growth in the long term. Although the share of enterprises which take bank loans to finance the purchase of fixed assets is small – 4% of the total number of enterprises, or 12.2% of the number of firms which invest in fixed assets, such investment sems to have a positive effect on productivity and reduce the rate of its decline amid an unstable economic situation. In 2013–2015, the average annual productivity decline was one third less steep if the enterprise was able to obtain bank financing for the acquisition of

fixed assets, even if this financing did not fully cover the costs and a significant part was still financed by internal funds.

The analysis of engagement in innovation and productivity growth suggests that innovating firms do not show stronger productivity growth than companies which do not innovate. For almost all types of innovation, its impact on productivity growth is not statistically significant, with one rather unexpected exception: regression estimates for the short-run specification come up with the negative and significant coefficient for organizational innovation.

Noteworthy is the result that amid an unstable economic situation, old companies show higher rates of productivity decline than other enterprises, although it is the enterprises in this group that have greater access to both short-term and long-term loans. This may be a sign that older firms are reluctant to use external funding for innovation and related investment in fixed assets.

At the same time, the other control variables have expected sings. Larger companies post higher productivity growth rates. Firms in retail and services show lower productivity growth rates than those in manufacturing.

Table 5. Productivity growth, fixed investment, and innovation. OLS estimates

VARIABLES	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015
Product innovation	-0.016						0.022					
	(0.042)						(0.049)					
Product innovation (new to the market)		-0.025						0.033				
		(0.049)						(0.055)				
Process innovation			-0.024						0.008			
			(0.046)						(0.052)			
Organisational innovation				-0.069*						-0.017		
				(0.035)						(0.052)		
Marketing innovation					-0.019						-0.041	
					(0.038)						(0.063)	
R&D activities						0.033						0.061
						(0.054)						(0.058)
Fixed investment from bank loans	0.034	0.039	0.039	0.042	0.032	0.028	0.078*	0.081**	0.080**	0.083*	0.088*	0.076**
	(0.035)	(0.037)	(0.036)	(0.038)	(0.037)	(0.033)	(0.040)	(0.040)	(0.040)	(0.047)	(0.051)	(0.038)
Fixed investment from internal funds	-0.025	-0.019	-0.021	-0.012	-0.022	-0.027	-0.043	-0.046	-0.042	-0.037	-0.037	-0.045
	(0.030)	(0.031)	(0.031)	(0.027)	(0.027)	(0.030)	(0.044)	(0.045)	(0.046)	(0.033)	(0.035)	(0.043)
Employment	0.089**	0.086*	0.087*	0.091**	0.087**	0.084*	0.060	0.058	0.061	0.061	0.063	0.057
	(0.044)	(0.047)	(0.045)	(0.043)	(0.043)	(0.044)	(0.052)	(0.054)	(0.052)	(0.047)	(0.048)	(0.053)
Age: less than 3 years	0.024	0.030	0.030	0.022	0.027	0.030	0.043	0.049	0.041	0.040	0.036	0.046
	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)	(0.034)	(0.031)	(0.032)	(0.032)	(0.029)	(0.029)	(0.031)
Age: more than 15 years	-0.126	-0.131	-0.123	-0.124	-0.122	-0.122	-0.108*	-0.119*	-0.109*	-0.110*	-0.107*	-0.106*
	(0.092)	(0.100)	(0.093)	(0.092)	(0.092)	(0.092)	(0.059)	(0.065)	(0.059)	(0.061)	(0.058)	(0.059)
Efficiency: followers	-0.022	-0.029	-0.014	-0.007	-0.016	-0.018	-0.036	-0.049	-0.035	-0.033	-0.032	-0.035
	(0.034)	(0.036)	(0.035)	(0.034)	(0.034)	(0.035)	(0.029)	(0.031)	(0.029)	(0.027)	(0.027)	(0.028)
Efficiency: leaders	-0.007	-0.012	-0.001	0.006	-0.000	-0.002	-0.001	-0.010	-0.001	0.001	0.001	-0.004
	(0.040)	(0.041)	(0.040)	(0.040)	(0.041)	(0.041)	(0.052)	(0.052)	(0.051)	(0.059)	(0.055)	(0.052)
Sector: retail	-0.067	-0.074	-0.072*	-0.074*	-0.070*	-0.063	-0.086***	-0.088***	-0.090***	-0.091***	-0.097***	-0.084***
	(0.042)	(0.045)	(0.043)	(0.043)	(0.042)	(0.044)	(0.031)	(0.034)	(0.032)	(0.033)	(0.038)	(0.032)
Sector: services	-0.074**	-0.094***	-0.075**	-0.076**	-0.074**	-0.065**	-0.042	-0.054*	-0.044	-0.048	-0.054	-0.036
	(0.030)	(0.032)	(0.031)	(0.031)	(0.032)	(0.033)	(0.029)	(0.032)	(0.030)	(0.033)	(0.038)	(0.030)
Sector: construction	-0.111	-0.119*	-0.114	-0.115	-0.111	-0.101	-0.166	-0.175	-0.171	-0.175	-0.182	-0.161
	(0.069)	(0.072)	(0.071)	(0.072)	(0.076)	(0.070)	(0.113)	(0.117)	(0.116)	(0.128)	(0.133)	(0.116)
Constant	-0.362**	-0.346*	-0.360**	-0.369**	-0.364**	-0.366**	-0.318	-0.299	-0.315	-0.310	-0.306	-0.313
	(0.173)	(0.182)	(0.174)	(0.170)	(0.172)	(0.170)	(0.211)	(0.224)	(0.213)	(0.214)	(0.221)	(0.217)
Observations	1,956	1,800	1,958	1,956	1,954	1,948	2,029	1,866	2,031	2,028	2,026	2,020
R-squared	0.055	0.054	0.053	0.058	0.052	0.053	0.051	0.056	0.051	0.051	0.053	0.054

Note: [I] Omitted category 4-15 years; [II] Omitted category laggards; [III] Omitted category manufacturing

OLS estimates. Robust standard errors in parentheses

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

If we consider the interaction of innovative activity and the acquisition of fixed assets using bank loans, it turns out that in the long term, the positive effect of some types of innovative activity (organizational and marketing innovation) is statistically significant if it is accompanied by investment in fixed assets financed through bank loans (see Table 6).

Table 6. Productivity growth, fixed investment, and innovation. OLS estimates. Specification with interaction

VARIABLES	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015
Fixed investment from bank loans	-0.013	-0.010	-0.000	-0.033	0.004	0.007	0.028	0.030	0.042	0.025	0.014	0.063
	(0.044)	(0.044)	(0.047)	(0.044)	(0.040)	(0.041)	(0.061)	(0.061)	(0.062)	(0.045)	(0.048)	(0.062)
Product innovation	-0.022						0.015					
	(0.045)						(0.052)					
Product innovation (new to the market)		-0.034						0.024				
		(0.052)						(0.059)				
Process innovation			-0.030						0.003			
			(0.049)						(0.056)			
Organisational innovation				-0.079**						-0.025		
				(0.037)						(0.053)		
Marketing innovation					-0.024						-0.053	
					(0.039)						(0.066)	
R&D activities						0.026						0.057
						(0.060)						(0.066)
Product innovation X	0.092						0.100					
Fixed investment from bank loans	(0.066)						(0.077)					
Product new to the market X		0.110						0.117				
Fixed investment from bank loans		(0.073)						(0.089)				
Process innovation X			0.071						0.073			
Fixed investment from bank loans			(0.069)						(0.083)			
Organisational innovation X				0.135**						0.105*		
Fixed investment from bank loans				(0.056)						(0.062)		
Marketing innovation X					0.055						0.147**	
Fixed investment from bank loans					(0.059)						(0.068)	
R&D activities X						0.064						0.039
Fixed investment from bank loans						(0.081)						(0.117)
Observations	1,956	1,800	1,958	1,956	1,954	1,948	2,029	1,866	2,031	2,028	2,026	2,020
R-squared	0.055	0.054	0.053	0.058	0.052	0.053	0.051	0.056	0.051	0.051	0.053	0.054

Note: OLS estimates. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

An analysis of the interaction of investment in fixed assets financed by internal funds (and this is the main source of financing for enterprises which took part in the survey) and various types of innovations shows that the joint effect can be positive, but only for product innovation (see Table 7). For other types of innovation (which is more sophisticated, such as process innovation, organizational innovation and R&D activities) investment in fixed assets financed by internal funds does not lead to productivity growth.

Table 7. Productivity growth, fixed investment, and innovation. OLS estimates. Specification with interaction.

VARIABLES	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	LP growth in 2013	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015	Avg LP growth in 2013-2015
Fixed investment from internal funds	-0.046	-0.038	-0.032	-0.013	0.007	-0.033	-0.089	-0.086	-0.077	-0.008	-0.013	-0.069
	(0.040)	(0.039)	(0.039)	(0.034)	(0.033)	(0.036)	(0.062)	(0.059)	(0.061)	(0.032)	(0.030)	(0.052)
Product innovation	-0.047						-0.051					
	(0.057)						(0.044)					
Product innovation (new to the market)		-0.063						-0.050				
		(0.066)						(0.054)				
Process innovation			-0.046						-0.067			
			(0.064)						(0.047)			
Organisational innovation				-0.070						0.027		
				(0.044)						(0.026)		
Marketing innovation					0.025						-0.001	
					(0.041)						(0.031)	
R&D activities						0.016						-0.014
						(0.080)						(0.068)
Product innovation X	0.075						0.165*					
Fixed investment from internal funds	(0.078)						(0.087)					
Product new to the market X		0.088						0.179*				
Fixed investment from internal funds		(0.092)						(0.098)				
Process innovation X			0.047						0.153			
Fixed investment from internal funds			(0.085)						(0.093)			
Organisational innovation X				0.003						-0.094		
Fixed investment from internal funds				(0.083)						(0.115)		
Marketing innovation X					-0.105						-0.092	
Fixed investment from internal funds					(0.089)						(0.141)	
R&D activities X						0.035						0.147
Fixed investment from internal funds						(0.102)						(0.100)
Observations	1,956	1,800	1,958	1,956	1,954	1,948	2,029	1,866	2,031	2,028	2,026	2,020
R-squared	0.057	0.056	0.054	0.058	0.056	0.053	0.059	0.065	0.057	0.054	0.056	0.058

Note: OLS estimates. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Our estimates show that innovation has a positive effect on productivity growth only if it is accompanied by fixed investment, especially where investment is financed through bank loans. Based on economic research, the main source of increasing productivity is

believed to be innovation-related investment. In recent years, frontier innovation has become costly, thus requiring substantial external financing. However, when investing in fixed assets, Russian enterprises rely mainly on their internal funds, which limits the volume of investment substantially and seems to narrow the innovative activities which can be associated with this investment. At the same time, a mere imitation of unsophisticated products or services is an inexpensive and affordable way of innovation for young and small firms. But this type of investment could help firms survive in the market in the short term without significantly improving their productivity in the longer term. Firms facing difficulties with access to debt finance forgo investment opportunities and reduce the scope of innovation activities. Thus, we have not found a strong association of innovation activities with productivity growth for Russian firms in the period before and after the 2014 crisis.

5.3. Exits, innovation and long-term loans

Recent studies on growth have shown that a decline in the pace of productivity growth in the period after the 2008 financial crisis could be due to slowed rates of exits of non-efficient companies and entries of new firms in the market. The source of productivity growth is the turnover of young companies as part of which new firms come to the market and either exit it promptly enough if they are not efficient or stay longer if they manage to realize their productivity growth potential and are capable of competing with the incumbents.

At the same time, young firms are usually smaller than incumbents and cannot rely on their own resources to finance investment in innovation. To realize their growth potential, they need to obtain external financing. With frictions in financial markets, access to debt finance could be limited for young companies. At the same time old and large firms could have better access to external financing but they may lack incentives to innovate to improve their productivity if they do not face competitive pressure from new market players. This may explain a distorted link between loans taken by firms and innovation-enhanced productivity growth which we described in the previous section.

In our sample, about 29% of firms exited the market during the period under review. To estimate the impact of long-term bank financing and innovation activities on the probability of a firm's exit from the market we use a logit specification. The marginal effects for the estimated logit models are presented in Table 8.

The estimations of marginal effects show a predictable result: old firms exit markets less often than young companies do. Also, the probability of exit diminishes with the size of companies. Thus, old and large companies stay in the market longer, and as descriptive statistics show, these companies are more likely to obtain both long-term and short-term bank loans (see Figure 4). In the 2013–2017 period, firms with long-term loans exit the market less often than firms with no loans do, but obtaining short-term loans does not have an impact on the probability of exit.

At the same time, we do not find a statistically significant effect of investment in fixed assets on the probability of a firm leaving the market, regardless of how this investment is financed – through internal funds or bank loans.

The involvement of a firm in innovation does not have a positive effect on its survival in the market. None of the coefficients for different types of innovation are statistically significant in this model specification. Thus, we do not see that firms with innovation exit the markets faster or less often. Innovation, especially if it is advanced, is generally risky, so the effect of its introduction can be ambiguous. If a bank loan is obtained, then risks for an innovative firm can also increase.

Table 8. Exits, innovation, and long-term loans. Logit model. Marginal effects

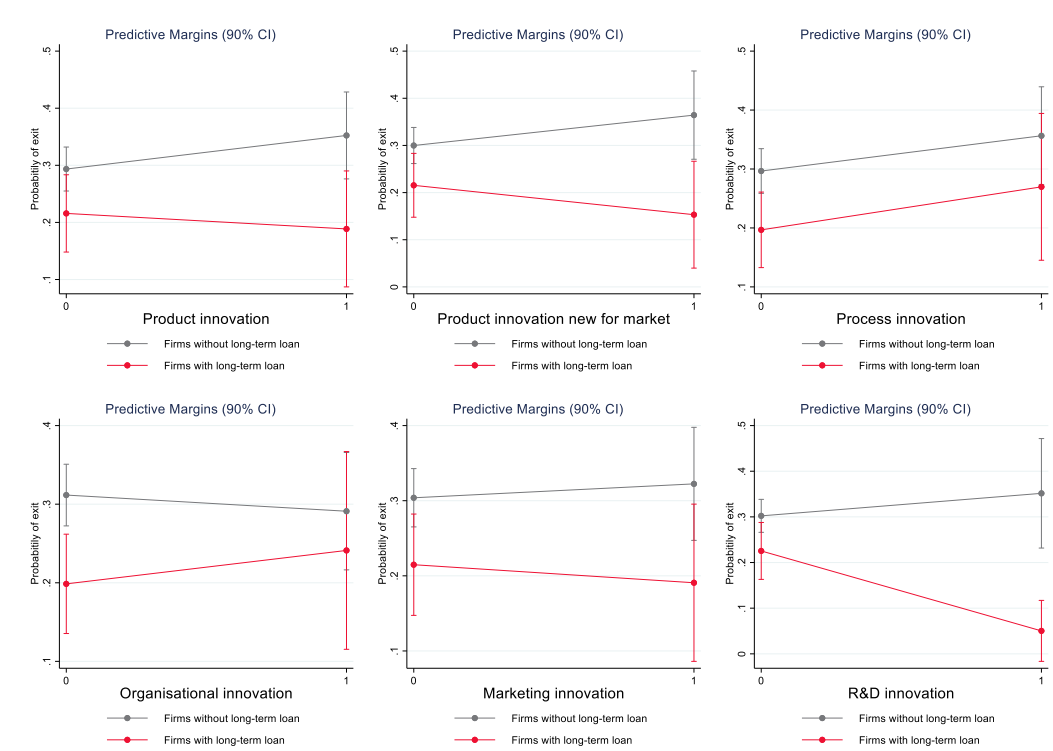
VARIABLES	Exit	Exit	Exit	Exit	Exit	Exit
Long-term loan	-0.105**	-0.116**	-0.105**	-0.106**	-0.106**	-0.102**
	(0.0473)	(0.0494)	(0.0469)	(0.0471)	(0.0473)	(0.0475)
Fixed investment from bank loans	-0.006	0.011	-0.024	-0.006	-0.007	-0.008
	(0.079)	(0.081)	(0.081)	(0.079)	(0.079)	(0.079)
Fixed investment from internal funds	0.024	0.035	0.021	0.033	0.028	0.026
	(0.045)	(0.047)	(0.045)	(0.045)	(0.045)	(0.045)
Product innovation	0.051					
	(0.046)					
Product innovation (new to the market)		0.053				
		(0.055)				
Process innovation			0.060			
			(0.050)			
Organisational innovation				-0.015		
				(0.047)		
Marketing innovation					0.015	
					(0.046)	
R&D activities						0.035
						(0.071)
Short-term loan	0.065	0.055	0.068	0.065	0.064	0.064
	(0.068)	(0.071)	(0.068)	(0.068)	(0.068)	(0.068)
Age[I]: less than 3 years	0.012	0.004	0.018	0.011	0.008	0.009
	(0.055)	(0.057)	(0.056)	(0.056)	(0.056)	(0.055)
Age: more than 15 years	-0.118***	-0.112***	-0.117***	-0.121***	-0.121***	-0.121***
	(0.039)	(0.041)	(0.039)	(0.039)	(0.040)	(0.039)
Efficiency[II]: followers	0.048	0.050	0.048	0.046	0.048	0.046
	(0.042)	(0.043)	(0.042)	(0.043)	(0.042)	(0.041)
Efficiency: leaders	-0.124**	-0.131**	-0.128**	-0.123**	-0.121**	-0.123**
	(0.051)	(0.052)	(0.051)	(0.052)	(0.052)	(0.052)
Employment	-0.212***	-0.219***	-0.208***	-0.206***	-0.209***	-0.213***
	(0.035)	(0.036)	(0.035)	(0.036)	(0.035)	(0.036)
Sector[III]: retail	0.107**	0.102**	0.114***	0.096**	0.100**	0.100**
	(0.044)	(0.047)	(0.044)	(0.044)	(0.044)	(0.046)
Sector: services	-0.001	0.002	0.006	-0.006	-0.004	-0.007
	(0.061)	(0.066)	(0.062)	(0.063)	(0.064)	(0.062)
Sector: construction	0.002	-0.018	0.002	-0.012	-0.007	-0.009
	(0.054)	(0.055)	(0.053)	(0.054)	(0.054)	(0.055)
Observations	2,222	2,042	2,222	2,222	2,218	2,214

Note: [I] Omitted category 4-15 years; [II] Omitted category laggards; [III] Omitted category manufacturing
Logit model. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

On the other hand, descriptive statistics indicate that young companies have more limited access to finance. Therefore, the lack of a positive effect of innovation on the survival of firms in the market may be due to the fact that firms with growth potential do not receive access to external financing and thus cannot realize their potential.

In considering the combined effect of long-term financing and innovation on the likelihood of exit from the market ,we find that with some types of innovation the likelihood of an enterprise's exit from the market may be reduced. The positive effect of innovation on firms' survival is realized when they have obtained long-term loans and only in the case of more sophisticated innovation, such as the introduction of a product which is new not only for the firm but for the market, and involvement in R&D activities (see Figure 6).

Figure 6. Exits, innovation, and long-term loans. Predictive margins with 90% confidence intervals



To assess the impact of innovation and long-term funding on the likelihood of a firm leaving the market depending on the size of the company, we evaluate another specification of the logit model, which includes the interaction of three variables: innovation, long-term bank loans, and an enterprise's size. In this case, for the convenience of interpreting the results, we use a categorical variable for the size of the enterprise (small, medium, large) rather than a continuous one, as in other specifications.

It appears from an analysis of the logit model with the interaction terms of innovation, size group and long-term loan dummies (see Figure 7) that a positive impact of long-term loans on the probability of exit comes from the group of large companies. For small and medium-sized firms, differences in the probability of exit for firms with and without bank loans are not significant.

It is worth noting that small businesses involved in innovation are significantly less likely to obtain loans. The share of such enterprises in the sample is very small. Therefore, for this group of enterprises, the standard errors turn out to be very large and if a positive effect exists for them, it is insignificant. In addition, small businesses are more at risk than larger players in the market, and especially in times of unstable economic situation, they will more often leave the market.

The positive effect of debt finance on the likelihood of staying in the market arises due to the group of large enterprises that are not involved in innovative activities. At the same time, descriptive statistics without controlling for other factors show that the rate of decline in labour productivity at large firm involved in innovation activity is lower than at enterprises which do not carry out innovation. Thus, loans are obtained by enterprises which are not involved in innovation, but these enterprises manage to stay on in the market longer. It could be a sign of an ineffective reallocation of financial resources towards large enterprises not necessarily showing higher productivity growth rates.

Estimated marginal effects show that engagement in innovation activities does not significantly change the probability of exit for firms with long-term bank loans in different size groups. This result could be due to a more fragile position of innovating firms during the crisis. In a certain sense, this highlights the problem of limited access to financing which reduces the scope of innovation activities to those which could be financed with internal funds. This in turn reduces the opportunity for a company to improve its market position and win the competition race.

6. Conclusion

In general, the economic literature predicts that investment associated with innovation has a positive effect on productivity growth. However, this effect could weaken if frictions in the financial market significantly reduce access to external financing for firms with growth potential. Our study finds that innovation activity does not generally lead to stronger productivity growth of Russian firms and does not reduce their probability of exiting the market. Most of the firms in our sample (small, medium-sized, large) rely on their internal funds for fixed investment. However, because innovation has become costly in recent decades, limited access to debt finance may reduce the scope of innovation, and innovation activity may become a mere replication of existing products. It is quite difficult to finance more sophisticated innovation from internal funds without easy and cheap access to debt finance.

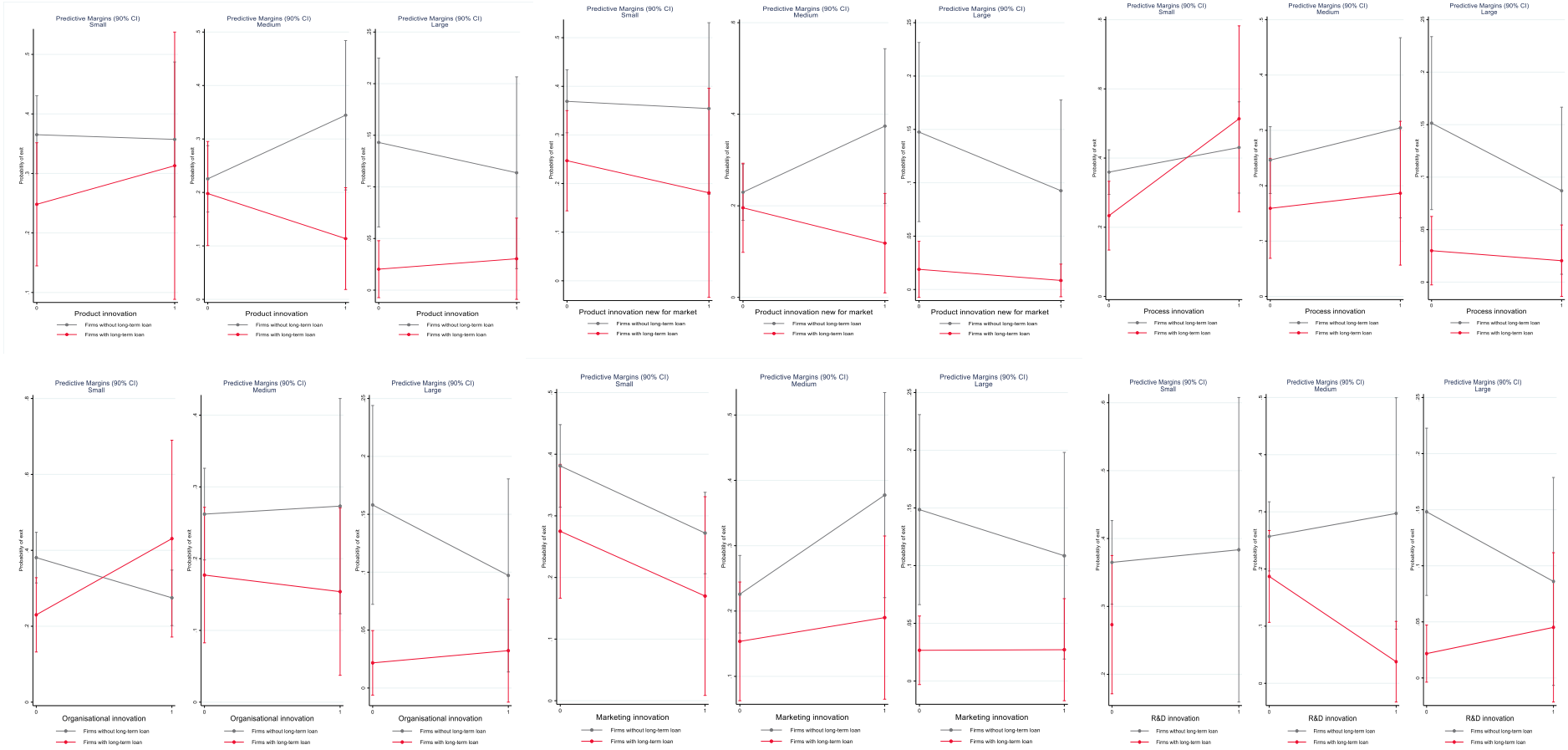
We find that obtaining a long-term bank loan help firms improve productivity but only if they engage in innovation activity. Otherwise, debt finance does not have a positive effect on a firm's performance per se.

The positive effect of debt finance on the likelihood of staying in the market arises due to the group of large enterprises which are not involved in innovative activities. It could be a sign of an ineffective reallocation of financial resources towards large enterprises not necessarily showing higher productivity growth rates.

Firms engaged in more sophisticated innovation stay in the market longer if they manage to obtain long-term loans. However, for other types of innovation the positive effect on firms' survival is not found.

Thus, the presence of financial frictions in the Russian economy reduces the effect of access to finance on productivity through reducing innovation-related investment. Firms facing difficulties with access to debt finance forgo investment opportunities and reduce the scope of innovation activities. As a result, the link between innovation and productivity growth has become weak in the Russian economy.

Figure 7. Exits, firms' size, and long-term loans. Predictive margins with 90% confidence intervals



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