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Firms’ Efficiency, Exits and Government Procurement Contracts

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Abstract

This study provides evidence that productivity growth trends in Russia are similar to those in other countries where technology leaders enjoy productivity growth with a gap increasing between them and other companies. The survival analysis suggests that the most efficient firms quit the market at a faster rate than firms in other efficiency groups in the Russian economy. Survival functions of the least efficient firm do not always differ significantly from those of other companies. Results based on public procurement data provide evidence that additional financing from government contracts helps both the most and the least efficient firms to survive and shelters them from competitive pressure. In the short run, the positive effect of winning government procurement contracts for leaders seems in to be only observed in their home regions, providing indirect evidence that the public procurement system does not support all types of firms with growth potential but only those affiliated with local authorities. Intervention in the mechanism of market selection through the system of public procurement could have a strong negative effect on economic growth as it provides incentives for inefficient firms without growth potential to stay in the market longer.

Keywords: TFP growth, efficiency, productivity gap, government procurement contracts, firms' exits

Introduction

In recent years, studies examining productivity trends have provided evidence that productivity growth has slowed at the aggregate level after the 2008 crisis. This was found to be true of various countries differing in the level of economic development. Research based on data for developed countries suggests that this trend emerged even before the 2008 crisis. Estimations using aggregated data (see, for example, Voskoboynikov, 2017) show similar trends in the Russian economy. Since 2010, various industries in the Russian economy have seen a decline in both labour and total factor productivity growth rates.

Recent cross-country studies based on firm level data attribute this productivity growth slowdown to the increasing gap in productivity levels between the most and least efficient firms within the same industries rather than to a decline in the rate of technological progress. Researches provide a number of explanations for this phenomenon, one of them being that the nature of technological progress has changed, innovation now involves greater costs, and inefficient firms do not have enough resources for innovation.

This explanation invites two questions. First, why has technological diffusion from leading companies to the less efficient ones slowed down and why has it become more difficult for the less efficient firms to replicate best practices? Second, why do inefficient firms not exit the market, continuing to use scarce production factors in their operations? This study concentrates on the analysis of firm dynamics in the Russian economy and the factors enabling inefficient firms to stay in the market. Recent research in productivity trends for developed countries quite often explains the presence of inefficient firms in the market by their access to cheap credit thanks to low interest rates after the 2008 crisis. This is not very relevant to Russia, where the levels of interest rates remained much higher than in developed countries over the period under study. The existence of a large share of inefficient firms in the market seems to arise from other factors.

In my research, I regard the public procurement system as a possible source of supporting inefficient companies in various industries. Government procurement contracts are widely used to support domestic firms via increasing demand. They are commonly oriented to various types of firms (for example, SMEs) or sectors of the economy, and are in this sense employed as an instrument of industrial policy. Studies based on data for the less developed countries quite often find that involvement in the public procurement system has a positive effect on growth, especially in lagging regions. In Russia, government purchasing contracts accounted for 21% of GDP in 2018,[1] with a significant share of firms (about 35% in my sample) involved in public procurement. Thus, government financial support through public procurement is quite substantial and could have a considerable impact on the Russian economy.

The contribution of this study to the literature on the government procurement system's efficiency and firm dynamics is that it evaluates the effect of getting additional support via the public procurement system on the performance of firms with various efficiency levels.

I use the stochastic frontier approach to evaluate TFP growth and the efficiency level for each firm. This allows identifying three groups of companies in my sample: the leaders, the baseline group and the laggards, and conducting the analysis by comparing exit hazards for each group, as well as evaluating the effect of winning government procurement contracts on the performance of firms with different efficiency levels.

I have found that the most efficient firms exit the market at a faster pace than firms from the other efficiency groups. It may reflect the fact that regional markets are isolated in Russia, and less efficient firms operate in local markets with weaker competition, while leaders are capable of entering national and international markets which see a stronger competitive pressure and a higher firm turnover.

At the same time, lagging companies quit market less frequently than leaders, and their survival function quite often does not significantly differ from that of the baseline group firms. This suggests that the market mechanism of selecting the most efficient firms is not itself efficient enough in the Russian economy.

I show that the government procurement system indeed helps firms involved in it to stay in the market longer but does not necessarily support the most efficient firms with growth potential. My results provide evidence that additional financing via government contracts helps inefficient firms survive and shelters them from competition with more efficient enterprises. The manner in which the government procurement system operates therefore supports a negative trend towards

[1] In absolute terms, 6.8 trillion rubles under Federal Law No. 44 and 14.7 trillion rubles under Federal Law No. 223 in 2018.

increasing the productivity gap. This system features intransparent procedures, allowing less efficient companies to take advantage of this.

For leaders, the positive effect of winning government procurement contracts is in the short run observed only in their home regions, suggesting that the public procurement system does not support all types of firms with growth potential but gives preference to those affiliated with local authorities.

The rest of the paper is structured as follows. The second section discusses the related literature. Section 3 dwells on the data used in the analysis. Section 4 is devoted to the empirical strategy. The results are described in section 5. Section 6 concludes.

Related literature

My study is related to two strands of literature on recent productivity growth trends and public procurement as an instrument of industrial policy. First, a number of studies provide evidence of an increasing productivity gap among firms within industries, provoking a discussion about whether this has an effect on firms' entry and exit rates and slows aggregate GDP growth. The second line of the recent literature which has a bearing on my research focuses on the efficiency of support for various types of firms via industrial policy or the public procurement system and its effect on firm dynamics.

Productivity trends on the micro level

Increasing availability of firm-level data has made it possible to analyse in detail the heterogeneity in the pattern of firms' productivity growth. Research suggests that productivity dispersion has been increasing in various countries. This became evident even before the 2008 financial crisis and has persisted beyond that point. A number of recent studies find that only a small share of the most productive firms enjoy productivity growth, while other companies fail to catch up with the technological leaders (Andrews et al. (2016) and Berlingieri et al. (2017) for OECD countries, Decker et al. (2016) for the US, Gamberoni et al. (2016) for EU countries). The authors argue that the nature of technological diffusion has changed. The less efficient firms cannot adopt new technologies or new ways of organising their business from the leaders promptly enough. At the same time, competition mechanism does not force inefficient firms to exit the market. Various explanations have been offered, but the there is no predominant hypothesis to account for the persisting productivity gap between more advanced firms and other market players and for this change in firm dynamics.

This study checks whether similar trends are observed for the Russian economy, which is known for high entry costs and a rather monopolised industrial structure, especially on the regional level. These features were inherited from the Soviet economy and have not been completely overcome after the twenty odd years of market reforms.

Hypothesis 1. Firms' exit rates vary with their efficiency levels, but laggard firms do not necessarily exit the market at a faster pace than more efficient players do.

Public procurement system and firm dynamics

In recent years, both theoretical and empirical literature has focused on the influence of industrial policy and the issue of its efficiency in supporting firms with growth potential. In the theoretical general equilibrium model, Acemoglu et al. (2018) show that an optimal industrial policy should be designed in such a way as to allow resources from the low-type firms move freely to the innovation activity of high-type firms, and this can be brought about by motivating low-productivity firms to exit the market. In the empirical paper on China, Aghion et al. (2015) demonstrate that sectoral government support promotes productivity growth more effectively where it focuses on more competitive sectors, and especially when it is not confined to just one or a handful of firms within the sector. Andrews et al. (2016), in their research on OECD countries, arrive at a conclusion that the increase in productivity gap was larger in sectors where market reforms fostering competition were less comprehensive. Thus, current research in this area shows that industrial policy should be targeted in such a way as to support the most efficient players.

One common goal of the public procurement system is to support various types of firms through boosting demand. Hence the influence of a public procurement system on firm dynamics could, in a certain sense, also be regarded as an instrument of industrial policy.

Empirical studies dealing with government procurement and firm growth often find that government purchases help firms expand sales, introduce new products to markets and enter new markets. Recent papers on developing economies suggest that public procurement in general improves growth rates of firms which obtain government contracts. Ferraz et al. (2015) analysing government purchasing auctions in Brazil show that government purchases via auctions could alleviate constraints on growth owed to lack of access to markets, letting firms know of potential markets or lowering barriers to sell in larger markets.

The effect of government purchases could be different for different types of firms. Hoekman and Sanfilippo (2018) found a robust direct relationship between government demand (by public agencies) and the performance of firms in the low-income Sub-Saharan Africa countries. They show that there exists a substantial heterogeneity across firms, and the relationship between sales to government entities and performance is more pronounced for firms at the lower bound of the productivity distribution. Fadic (2018) using data on Equador's public procurement auctions demonstrates that positive demand shocks associated with government contracts are seen as short-term ones.

In all countries, the public procurement system is used to support certain types of firms or firms in targeted industries. At the same time, government support could be ineffective if the underlying mechanisms allow inefficient firms to receive support via the public procurement system and help them survive in the market. By supporting all firms with no regard for their efficiency level and potential of productivity growth, local authorities or the federal government could, under certain circumstances, act as an additional impediment to creative destruction.

If the public procurement system protects an inefficient firm, reducing competitive pressure in a specific industry, then inefficient incumbents stay in the market longer, preventing the entry of new, more innovative and productive companies. In the Russian case, procedures for allocating government procurement contracts are not always transparent, helping to keep afloat less efficient firms which would otherwise exit the market.

Hypothesis 2. Involvement in public procurement helps inefficient firms stay in the market longer.

In addition, local authorities' objectives (supporting employment in incumbent companies or corruption schemes in the public procurement system) may run counter to mechanisms fostering economic growth. In low-income regions, the local government could act as a monopolist in the market, and in this case, its willingness to award contracts to local companies could have a discouraging effect on the creative destruction process.

Hypothesis 3. Local authorities have more incentives to support firms in the home region and thus intervene in the market mechanism of creative destruction.

Data

To conduct this study, three databases were combined: firm level data from balance sheets used to estimate productivity growth and the efficiency level for each firm, data on each firm's entry in and exit from the market, and information on participation of a firm in government procurement auctions.

Firm level data

The stochastic frontier analysis uses data from the RUSLANA database. In this study, the estimations are conducted using data from Russian firms' balance sheets for eight years from 2008 to 2015. The RUSLANA dataset contains information on firms' sales, fixed assets, the number of employees, and the cost of goods sold. For the purposes of my research I limit the sample to the non-farm non-financial sectors to be able to estimate stochastic production functions using a standard set of output (value added) and inputs (labour and capital).

The RUSLANA database does not include data on the payroll fund for the entire period of observation. At the same time, Rosstat collects data on average wages separately for each of the Russian Federation's regions, providing a fairly detailed breakdown by industry. This allows proxying the labour costs by multiplying the number of the firm's employees by average wages in the region's relevant industry. Therefore, value added for a firm is calculated as the difference between total sales and the cost of goods sold plus labour costs.

To estimate the parameters of the production functions, this study uses data on value added, capital and labour. For capital and labour inputs, the real fixed assets and the number of employees are used.

The value added numbers are deflated by industrial PPIs for mining and quarrying, manufacturing, and electricity, gas and water supply, and by the SNA deflators for the other sectors. The deflators for capital are obtained from the data on nominal capital stocks and volume indices of capital stocks which are published by Rosstat at the sectoral level. Since all methods of estimating the production possibility frontiers are very sensitive to outliers, I exclude from the sample 0.5% of firms with the largest total sales and 0.5% of those with the lowest sales each year.

The final sample ranges from 127,570 firms in 2008 to 187,960 in 2015 and fairly accurately represents the industrial structure as shown by Rosstat data, with a slight bias towards manufacturing at the expense of business and personal services.

Data on exits and entries

The panel based on the RUSLANA database is unbalanced, and data for a certain part of firms are not available for the entire period of observation. If a firm stops reporting in a certain year it does not necessarily mean that it has exited the market. For this reason, in the next step, I combine my estimations of firms' efficiency levels with information on the dates of a firm's incorporation and its removal from the Unified State Register of Legal Entities.

Most firms established in the Soviet period went through mass privatisations in 1992–1994 and were supposed to reregister as part of the privatisation process. For these firms, the date of incorporation will reflect the date of privatisation rather than that of establishment. The share of such firms in the sample is 9.5%. A large part of firms in the Russian economy (41%) were established in the 2000–2007 period of economic growth, and a third of the firms were established after the 2008 crisis.

Since the productivity and efficiency indicators are estimated for the 2008–2015 period, the companies liquidated before the year 2008 are excluded from the analysis. As of 2016, 3.5% of the firms in the sample exited the market (see Table 1). The average age of a firm is 11 years. The maximum age at exit for the firms in the sample is 24 years.

[Table 1 about here]

Government Procurement Contracts

The data on the winners of government procurement contracts are taken from the SPARK Marketing dataset. This dataset contains information on public procurement purchases with very detailed data for each contract since 2011. Public procurement is governed by two laws in the Russian Federation: Federal Law 44 and Federal Law 223.[2] The former details the entire procurement process, from planning to the performance of contracts. The latter only addresses certain types of suppliers and contracts and is less strict in the sense that it only governs the general principles of the procurement process. According to the official statistics,[3] in 2015, most contracts signed under Federal Law 44 provided for purchases from a sole supplier, open tender, requests for quoting price, or an electronic auction. Under Federal Law 223, the most popular types of contracts in 2015 were purchasing from a sole supplier and requests for quotation.

In my analysis, I use information on the auction winner, the date of the contract, and the contract customer's region for the 2011–2015 period.

The dataset on government procurement contracts was linked to firm level data on productivity growth using information on the winner identification code (INN). One third of the firms from my

[2] Federal Law No. 44-FZ "A Contract System for the Procurement of Goods, Works, and Services to Meet Government and Municipal Needs" of April 5, 2013; Federal Law No. 223-FZ "Purchasing Goods, Works, and Services by Certain Types of Legal Entities" of July 18, 2011.
[3] http://zakupki.gov.ru/epz/main/public/home.html

sample participated in government procurement (see Table 2) in 2011–2015. Among firms that were awarded government contracts during these years, 24% obtained contracts under Federal Law 223, 34% won contracts under Federal Law 44 and a large share of firms (41%) were awarded contracts under both laws. Since a very significant share of firms in the sample were awarded government contracts under rules set forth in both laws on public procurement, I do not make a distinction between them in my analysis.

The SPARK Marketing dataset also contains basic information on contract customers, and in some specifications, I limit the sample to firms located in the same region as the contract customer.

[Table 2 about here]

Empirical Strategy

This study is comprised of two steps. In the first step, I estimate productivity growth and efficiency at the firm level. In the second step, I estimate survival functions for firms belonging to different efficiency groups and analyze the effect of involvement in the public procurement system on firm dynamics taking into consideration firms' efficiency level.

Estimation of TFP growth and the efficiency level

I use the stochastic frontier approach to evaluate TFP growth and the efficiency level for each firm. The deterministic part of the production function is modelled as a translog function of three parameters – labour (L), capital (K), and time (t). The inefficiency term is modelled as a function of firm-specific variables and time following Battese and Coelli (1995). Under these assumptions, TFP growth could be decomposed at the firm level into three components (see Kumbhakar and Lovell (2003)): technological progress (shift of the production frontier between two periods), change in technical efficiency (change in the distance to the frontier which is moving itself) and the return to scale term.

Another feature of the stochastic frontier estimations is that under this approach the group of leaders which define the stochastic frontier is determined taking into account the position of the firm over the entire period of observation, which makes this group quite stable. Firms enter this group but rather rarely exit it. This contrasts with other methods of identifying efficient firms in an industry, under which entries in and exits from this group occur more often and firms which have only temporary efficiency gains can be assigned to the group of technological leaders.

Stochastic production functions are estimated separately for 282 industries,[4] mainly for three- or four-digit industries under NACE 1.1 classification. Using the estimated parameters of the stochastic frontier, the TFP growth rates and technical efficiency (defined as the distance to the industry-specific frontier) for each firm are computed.

Exits and government procurement contracts

[4] The estimation results for each industry are not reported in the paper for space considerations but are available on request.

The second part of the paper uses the survival analysis to look at whether a firm's exit from the market depends on its efficiency level. In the survival analysis, the hazard rate at age t is the conditional probability of exit at age t after having survived until that age, and the survival rate at age t is the probability of surviving until age t. In this study, the age of a firm is measured in years and calculated as the year of observation minus the year of incorporation of a firm.

I use a proportional hazard specification in which the hazard function is a product of the baseline hazard and a term that shifts the baseline hazard in accordance with the influence of various covariates. The baseline hazard is a function of a firm's age:

$$\gamma(t, x, \beta, \gamma_b) = \phi(x, \beta)\gamma_b(t),$$

where γ is the hazard rate, γ_b is the base hazard function, corresponding to $\phi(\cdot) = 1$, $\phi(x, \beta) = e^{x'\beta}$, x is the vector of explanatory variables, and β is estimated coefficients. My estimations are based on Cox proportional hazard model. This is a semi-parametrical approach under which the parametrical form of the base hazard function is left unspecified.

The baseline model estimates the effect of a firm's efficiency level on the hazard ratios. Then I analyse how access to additional financing from government procurement contracts affects hazard ratios. To test this hypothesis, a dummy for obtaining a government contract and a cross-term of this variable with a firm's efficiency level are added to the regression.

Involvement in public procurement may have an immediate effect on firm dynamics, whereby winning a government contract helps a firm to survive in the year when the contract was awarded. But it could also have a prolonged effect, i.e., the position of a firm in the market in terms of its survival rate improves for a longer period after winning the government contract. To estimate these effects, two explanatory variables are constructed.

In analyzing the immediate effects, the dummy for a government contract equals 1 if a firm wins a government procurement contract at least once in each year from 2011 to 2016 and 0 otherwise. In this case, the failure event is an exit from the market in the year subsequent to the year of obtaining the contract. This approach also relies on the features of longitudinal data, allowing the time variant covariates (firms' efficiency levels in different years) to be included in the model.

In analyzing the prolonged effects, the dummy for a government contract is defined in a slightly different way. It equals 1 if a firm obtained a government procurement contract at least once in the 2011–2015 period and 0 otherwise. Under this setup, the failure event is an exit by the end of the period (i.e., 2016). In this case, the estimations for the last observable year were used for the efficiency level of a firm. Summary statistics and regression results are reported for both setups.

In addition, the effect of winning the contract in the home region was tested. In this case, the group of firms which obtained contracts in other regions than those where they were registered or both in home and some other regions were excluded from the sample. The corresponding group is the same as in the other specifications – firms that did not win government contracts during the period under study.

In all the estimations I control for the sector in which a firm operates and the size of the firm by including the corresponding sector and size dummies. The distribution of firms by sector and size is reported in Table 2.

Results

Productivity trends based on micro level estimations

The average TFP growth rates estimated under the stochastic frontier approach remained negative over the entire period of observation (see the left panel in Figure 1). After the 2008 crisis, a productivity decline was quite significant at about 5–7% each year over the 2009–2011 period. In the following years, the rate of TFP decline was slower, with growth remaining negative until the end of the period under analysis. At the same time, it can be seen from the decomposition of the TFP growth rates that the Russian economy currently sees technological progress, with the rate of technical change remaining positive and even continuing to accelerate over the 2009–2015 period (see Figure 1).

The stochastic frontier approach reveals that the negative average TFP growth rates stem from a significant negative impact of the inefficiency component[5] rather than lack of technological progress. As can be seen from Figure 1, the change in technical efficiency was negative, with the average efficiency level falling 12%–13% annually. This means that the stochastic frontier is moving up because the most efficient firms in the sample are improving their productivity but other firms are not catching up with them and the distance to the frontier keeps increasing.

Thus, productivity growth trends for Russia are similar to the results obtained for other countries (see Andrews et al. (2016) and Berlingieri et al. (2017) for OECD countries, Decker et al. (2016) for US, Gamberoni et al. (2016) for EU countries). The Russian specific is that the average productivity growth rates are lower (staying in negative territory over the entire period of observation) than in developed countries where very low but positive productivity growth rates are reported. It could reflect the fact that the gap between more efficient and less efficient firms is larger in the Russian economy and the slowdown due to the negative impact of laggards is stronger.

TFP growth in efficiency groups

Using the estimations of the efficiency level for each firm from stochastic frontier analysis the sample was divided into three categories to compare productivity trends in the efficiency groups

- Leaders. Top 10% of firms with the highest technological efficiency (closest to the frontier in the industry)
- Baseline group. Firms with an efficiency level of 20% to 90%
- Laggards. Bottom 20% of firms with the lowest technical efficiency.

These groups are defined within each industry for which the stochastic frontier functions were estimated. The accumulated TFP growth rates for each group are presented in Figure 2.

[5] The input of the third component, return to scale term, is close to zero.

Trends presented in Figure 2 reveal that the gap between leaders and the other groups kept widening in 2009–2015. Comparison between trends based on simple averages and weighed by value added average TFP growth rates provides evidence that more efficient firms not only grow faster but also increase their market shares. At the same time, the market share of laggards is shrinking but they do not exit the market.

Efficiency, exit rates and government purchasing contracts

Exits by efficiency groups

In the next step, I analyze firm dynamics, comparing survival functions for different efficiency groups. The nonparametric Kaplan-Meier survival estimates are presented in Figure 3. In the entire period sample, where the efficiency levels are taken from the last year observed, the unrestricted survival estimates for laggards are higher than those for the baseline group and leaders. When I estimate the immediate effect of efficiency levels on exit using a yearly sample, the difference between laggards and the baseline group is no longer so pronounced.

Regression analysis using the Cox proportional hazard model does not show lower hazard rates for less efficient firms (see Table 3). If the control variables for the firm's size and sector are included in the analysis in the entire period setup, the differences in conditional probabilities of exit for all three efficiency are not significant. In the short run, the hazard ratios are higher for both leaders and laggards than for the baseline group of enterprises.

[Table 3 about here]

It is interesting that under both setups the conditional probability of exit is higher for a leader than for the other groups, though not always significantly. There may be two different interpretations of this fact. One is that the leaders may operate in markets with a stronger competitive pressure and more intense firm dynamics. The other is that a fast growing but not a big enough leader could attract attention of large companies or firms affiliated with regional authorities and go through a friendly or hostile acquisition, which means that it does not exit the market but changes the tax identification code and is not seen as a separate entity in the sample.

In the short run, the hazard ratios are higher for the least efficient firms than for the baseline group. In examining the prolonged effects, the hazard ratios for laggerds are not significantly different from those of the baseline group and the group of leaders.

In the Russian economy, the creative destruction mechanism seems to work in the way opposite to what is conventionally expected. The relationship between a firm's efficiency level and conditional probability of its exit is counterintuitive. The most efficient companies quit markets at a faster pace than average companies in the economy. At the same time, the conditional probability of exit of laggards is in the short run comparable with that of leaders and in the long run the hazard ratios for the least efficient firms do not differ from those for the more efficient groups.

Government purchasing contracts

This section analyzes the impact of government purchasing contracts on exit rates. In Russia, the public procurement system accounts for a significant part of GDP, and a large number of firms are involved in it. In my sample, 35% percent of firms were involved in public procurement in 2011–2016 (see Table 4). After the sanctions were imposed on Russia, the role of public procurement as an instrument of economic policy to support enterprises affected by the sanctions became more evident. The effectiveness of this economic policy may be questionable if it affects firm dynamics through changing market mechanism of selection of more productive firms.

[Table 4 about here]

What kind of firms obtain government contracts

It can also be seen from Table 4 that that the percentage of firms with government contracts is higher among the most efficient firms (44%) and lower among laggards. Still, a quarter of the least efficient companies were awarded government contracts in 2011–2016. I also check which types of firms obtain government purchasing contracts more often than other companies using a simple logit model. Here the dummy for winning a government contract at least once in the period from 2011 to 2016 is used as a dependent variable. Estimation results are presented in Table 5.

[Table 5 about here]

The results of the regression analysis are in line with the summary statistics. The probability of being awarded a government contract is 2.6% higher for leaders and 7.2% lower for laggards in comparison with firms form the baseline group. The corresponding coefficients are significant although the magnitude of the effect is not that large, especially for leaders.

The probability of getting a government contract increases with a firm's size. Thus, the probability of being involved in public procurement in 2011–2016 was 42% higher for large companies than for micro firms. Sectoral distribution of the government purchasing contracts also agrees with intuition. Firms in the electricity, gas and water supply sector win government contracts 39% more often than those in the wholesale and retail sector. The probability of being involved in public procurement is also slightly higher for manufacturing firms and companies from the business services sector than for those in trade. Firms from the extractive sector, hotels and restaurants, as well as the transport and communications sectors obtain government contracts less often than companies from the wholesale and retail sector.

Exits and involvement in public procurement

Here I move on to the analysis of how involvement in government procurement system affects the survival functions of firms with different efficiency levels. In this section, the conditional probability of exit at a certain age is explained by both the level of efficiency and winning government contracts. The non-parametric estimations of hazard ratios show that the probability of exit is lower for firms with government purchase contracts in all efficiency groups (see Figures 4 and 5). It can also be seen that for laggards the gap in hazard ratios between firms with and without government contracts increases with the age at exit. Inefficient firms without government contracts exit the market more often than leaders and firms from the baseline group but differences in the hazard ratios between different efficiency groups diminish for firms with government contracts. Figures 4 and 5 also show that if leaders are not involved in the government procurement system the hazard ratios for them are slightly higher than in the baseline group.

These patterns are similar for both immediate and prolonged effects. Also, in the yearly setup for the group of leaders, there is an additional decrease in exit hazards for firms with government contracts among mature companies. In sum, the non-parametric estimations reveal a lower conditional probability of exit for mature inefficient firms with government contracts in both setups and a lower conditional probability of exit for mature firms with government contracts in the group of leaders in the entire period setup.

The results of the estimates of Cox proportional hazard model are presented in Table 6 (see columns (7)-(8) for the prolonged effects specification, and columns (9)-(10) for the immediate effects specification). As expected, winning a government contract reduces the immediate exit hazards by 59.5 percentage points, bringing down the prolonged exit hazards by 62.6 percentage points.

[Table 6 about here]

The coefficient by the cross-term for the leaders dummy and the government contract dummy is not significant in the yearly setup and negative and significant in the entire period setup. Thus the immediate effect of winning a government contract is not observed but in the long run involvement in the government procurement system helps the leaders to stay in the market longer and reduces the exit hazards for this group to the level of the other efficiency groups.

For laggards, winning a government contract reduces the conditional probability of exit in both the short run and the long run (the coefficient at the cross-term for the laggards dummy and the government contract dummy is negative and significant in both specifications). The exit ratios are already not much lower for the least efficient enterprises in comparison with the other efficiency groups but winning a government purchasing contract makes this difference in exit hazards statistically insignificant.

These results are illustrated in Figures 6 and 7, where the survival functions by efficiency group based on the Cox proportional hazard model are presented for the yearly and entire period setups, respectively. In the yearly setup (see Figure 6), if firms which do not win a government contract in the year under consideration are regarded, then the survival functions for leaders and laggards are below the survival function for the baseline group. For the firms with a government contract, the situation is the opposite: the laggards stay in the market longer than firms in the baseline group and the survival functions for leaders and baseline group firms are very similar.

In the entire period setup (see Figure 7) the survival functions for laggards and the baseline group are similar, and leaders quit the market at a faster pace than firms from the other efficiency groups. If firms which win a government contract at least once during the period under study are considered, then the most and least efficient firms stay in the market longer than firms from the baseline group.

I also check the effect of involvement in the government procurement system on firms' exits using a subsample of firms which win government contracts only in their home regions. The regression result for this specification for the yearly setup is presented in Table 6 (see columns (11)-(12)). It can be seen from the table that the exit hazards for leaders oriented to local markets are 27.4 percentage points higher than those in the baseline group. A possible interpretation is that if a leading company cannot go beyond the the borders of the local market it quits the market at a faster rate. At the same time, the effect of obtaining a government contract on leaders is positive and significant in this specification. And in total it offsets the negative coefficient at the dummy for leaders in this specification. The exit hazard is lower for laggards with government contracts in their home region, than for firms in the baseline group, and the magnitude of this effect is close to the estimates for the entire period sample.

The survival functions for the Cox proportional hazard model are presented in Figure 8. If firms are not involved in the government procurement system then the survival functions for leaders and laggards are below the survival function for the baseline group, with the leaders showing a worse performance than firms from the other groups.

Where firms manage to win a government contract in their home regions (and do not have them in other regions), the conditional exit probabilities for all efficiency groups become very similar, with laggards performing slightly better than companies from the other efficiency groups.

Comparison of different specifications suggests that the exit hazards are higher for the most efficient firms than for companies from the other efficiency groups. It may imply that leaders operate in more competitive markets and/or more often go through various types of mergers and acquisitions. Upon limiting my sample to firms with a government contract in their home regions I find that involvement in the government procurement system reduces exit hazards of the most efficient firms. A possible explanation is that leading companies are affiliated with local administrations, which may protect them from a stronger competitive pressure and hostile acquisitions, thus influencing the creative destruction mechanism in local markets.

This study also shows that the conditional probability of exit for inefficient firms is not always higher than for those from the baseline group. In some specifications, the difference between these two groups is statistically insignificant. Thus, the survival analysis does not support the hypothesis that the exit rate for the least efficient firms, (20% from the bottom of the distribution) is lower in the Russian economy if involvement in the government procurement system is not taken into account. Comparison of the exit hazards among firms with a government contract shows that inefficient firms with government contracts stay in the market longer than companies from the other efficiency groups.

There could be two explanations for the finding that financing via a government contract helps inefficient firms stay in the market. First, laggard firms could be affiliated with authorities, and government contracts shelter these companies from competition. Second, local and regional governments may seek to replace social policy with support for laggard firms to avoid high unemployment in the region. In either case, additional government support reduces incentives for inefficient firms to innovate to win competition with more efficient market players and maintain a status quo with a high share of inefficient companies in the economy.

Conclusion

The results obtained confirm that productivity growth trends in Russia are similar to those in other countries with technological growth among leaders and an increasing productivity gap between leaders and other companies. The analysis of TFP growth dynamics provides indirect evidence that a significant share of inefficient enterprises in the Russian economy do not exit the market, continuing to use production factors inefficiently.

The survival analysis shows that the most efficient firms quit the market at a faster pace than firms from the other efficiency groups in the Russian economy. At the same time, inefficient enterprises do not face higher exit hazards in all the specifications and it often appeared that survival functions of the least efficient firm do not differ significantly from the baseline group companies.

I also show that involvement in the public procurement system significantly reduces exit hazards in all the efficiency groups. My analysis of government purchasing contracts suggests that local authorities support both leaders and laggards. In both cases, the strategy of local authorities intervenes in the market mechanisms and affects firm dynamics. Results based on public procurement data provide evidence that additional financing from government contracts helps both the most and least efficient firms to survive and shelters them from competitive pressure.

The positive effect of winning government procurement contract for leaders in the short run is observed only for home region which seems to suggest that the public procurement system does not support all types of firms with growth potential but only those that are affiliated with local authorities.

Intervention in the mechanism of market selection through the system of public procurement may have a strong negative effect on economic growth, as it provides incentives for inefficient firms without growth potential to stay in the market longer, maintaining the gap in productivity between the leaders and other companies. After the sanctions were imposed on Russia, the role of public procurement as an instrument of economic policy to support enterprises affected by sanctions became more evident. My analysis shows that the efficiency of such economic policy is questionable if it affects firm dynamics through changing market mechanism of selection of more productive firms.

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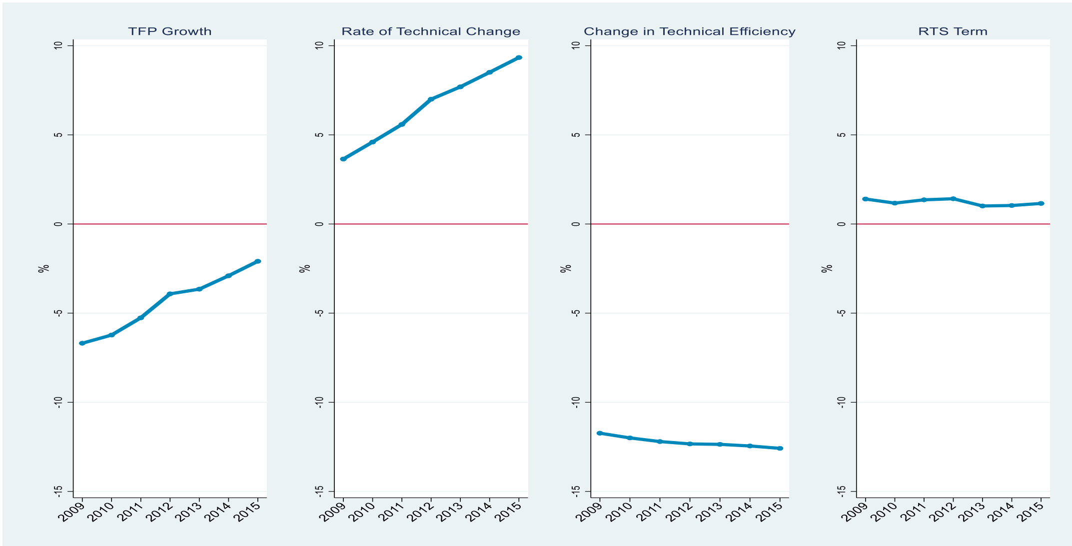

Figure 1. Average TFP growth and its decomposition.
Source: author calculations based on the stochastic frontier estimations.

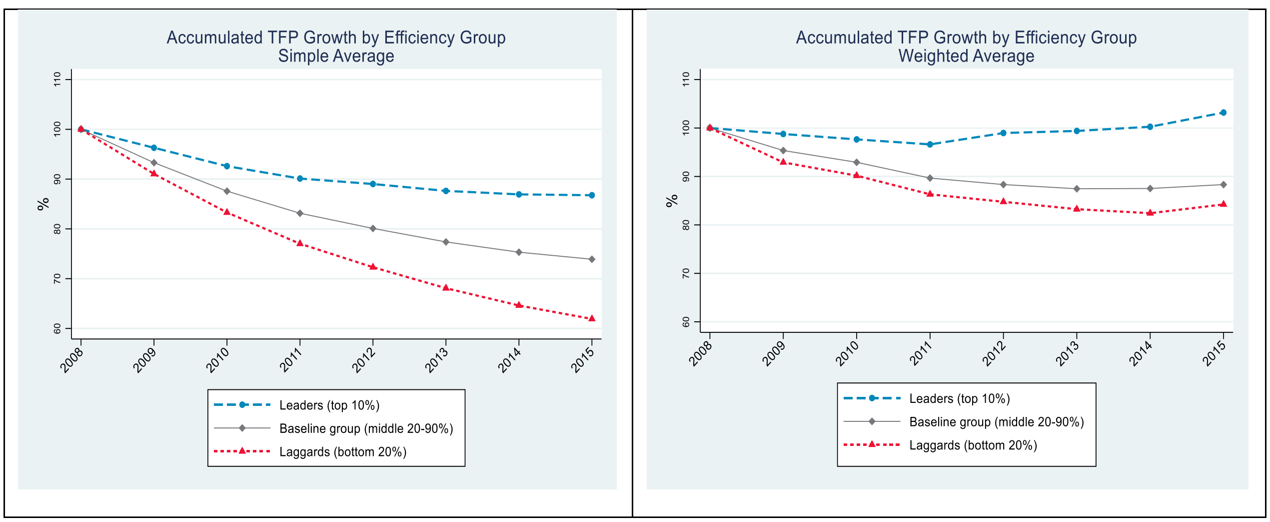

Figure 2. Accumulated TFP growth by efficiency group.
Source: author calculations based on the stochastic frontier estimations.

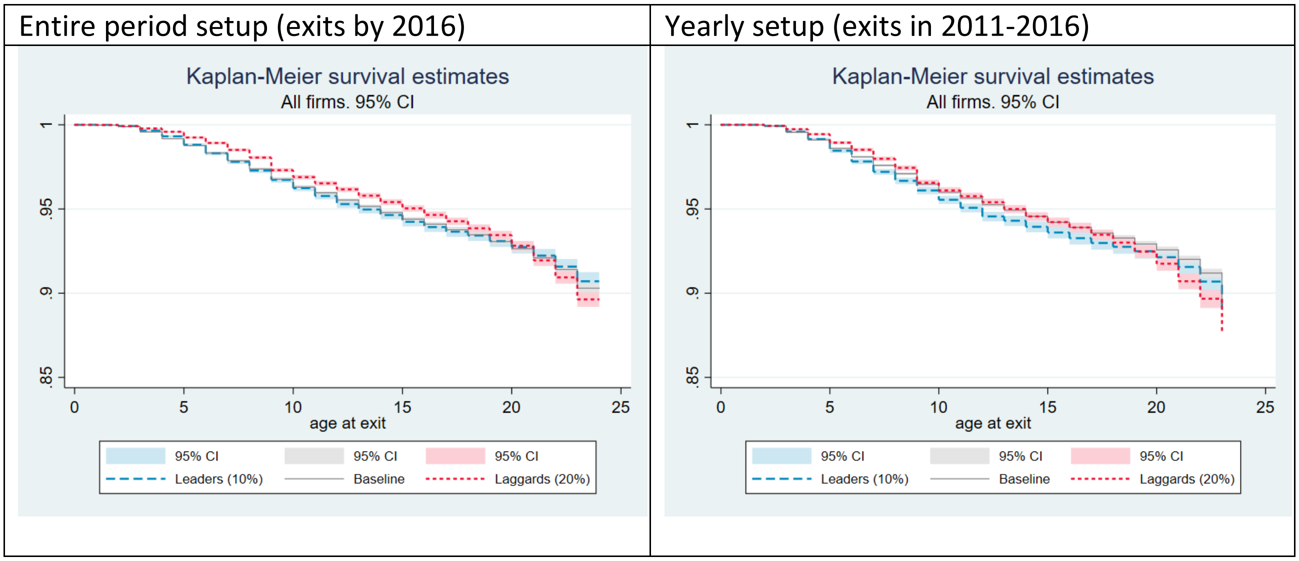

Figure 3. Survival functions by efficiency groups. Kaplan-Meir survival estimates with 95% confidence intervals.
Source: author calculations.

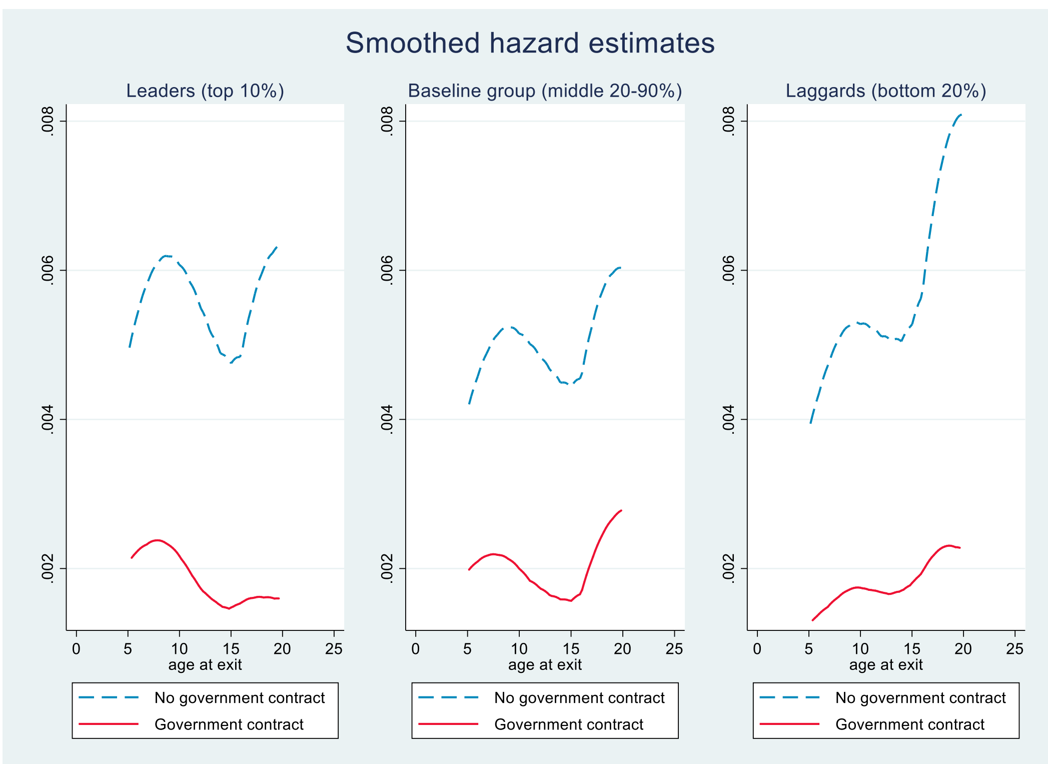

Figure 4. Smoothed hazard estimates by efficiency groups (yearly setup). Immediate effects.
Source: author calculations.

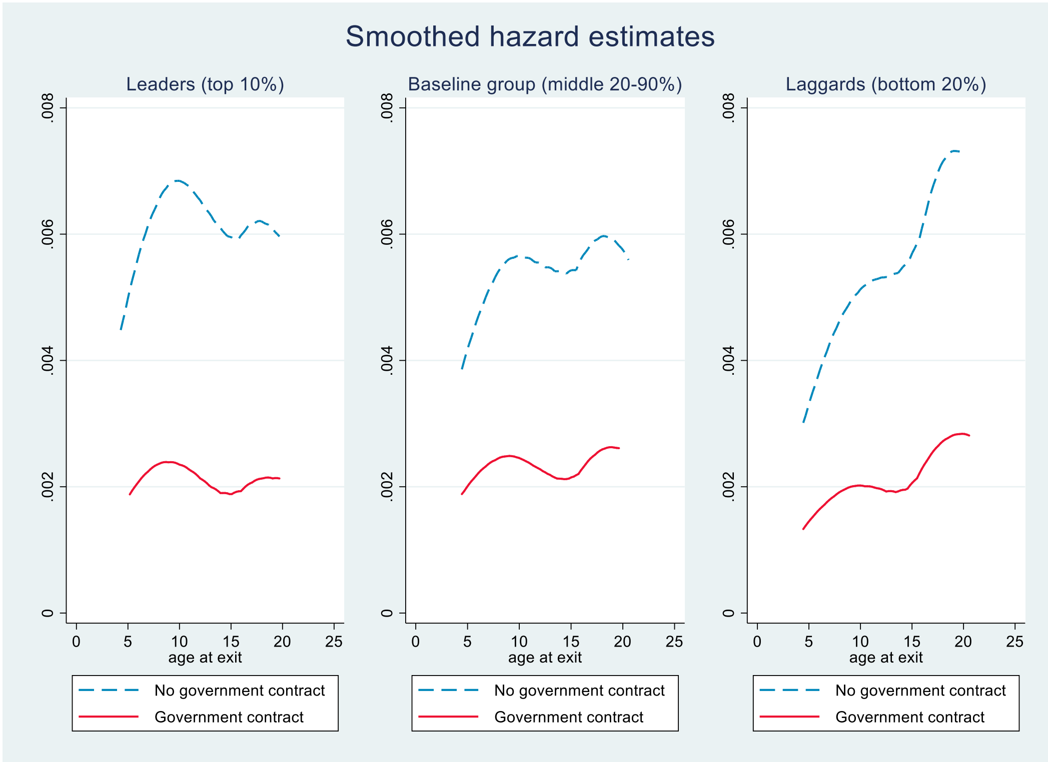

Figure 5. Smoothed hazard estimates by efficiency groups (entire period setup). Prolong effects.
Source: author calculations.

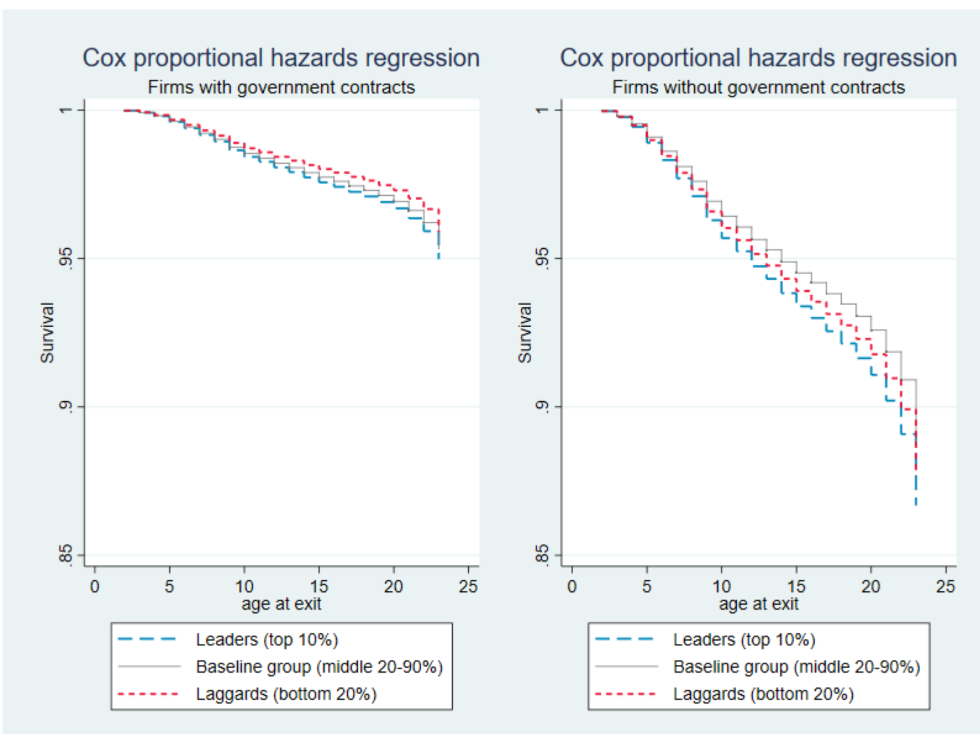

Figure 6. Survival function after Cox proportional hazard regression by efficiency groups (yearly setup).
Source: author calculations.

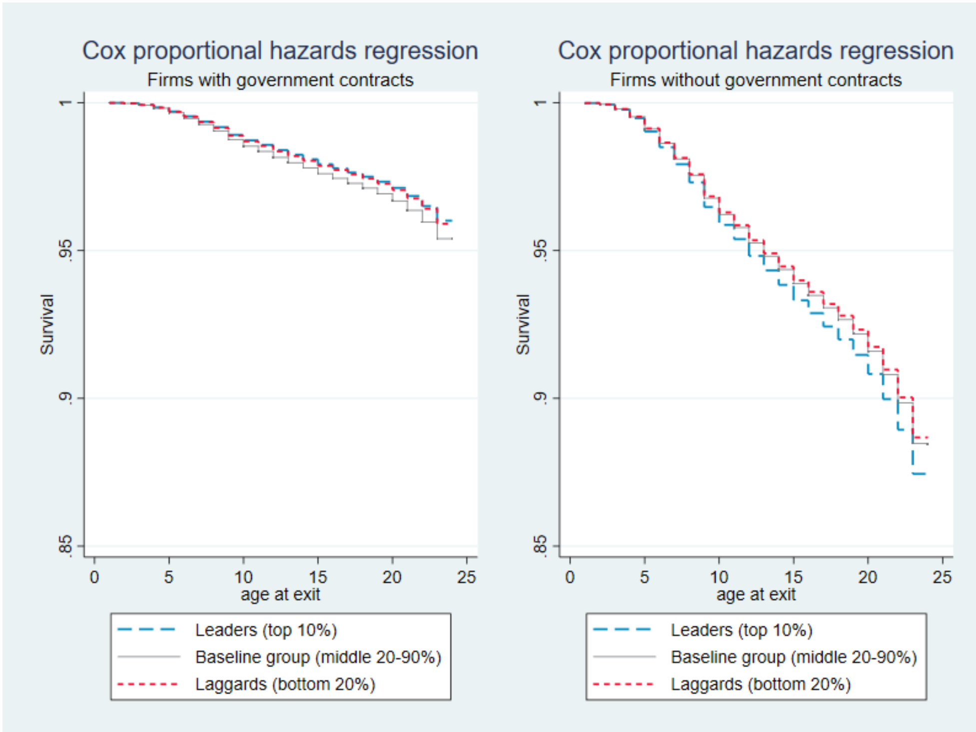

Figure 7. Survival function after Cox proportional hazard regression by efficiency groups (entire period setup).
Source: author calculations.

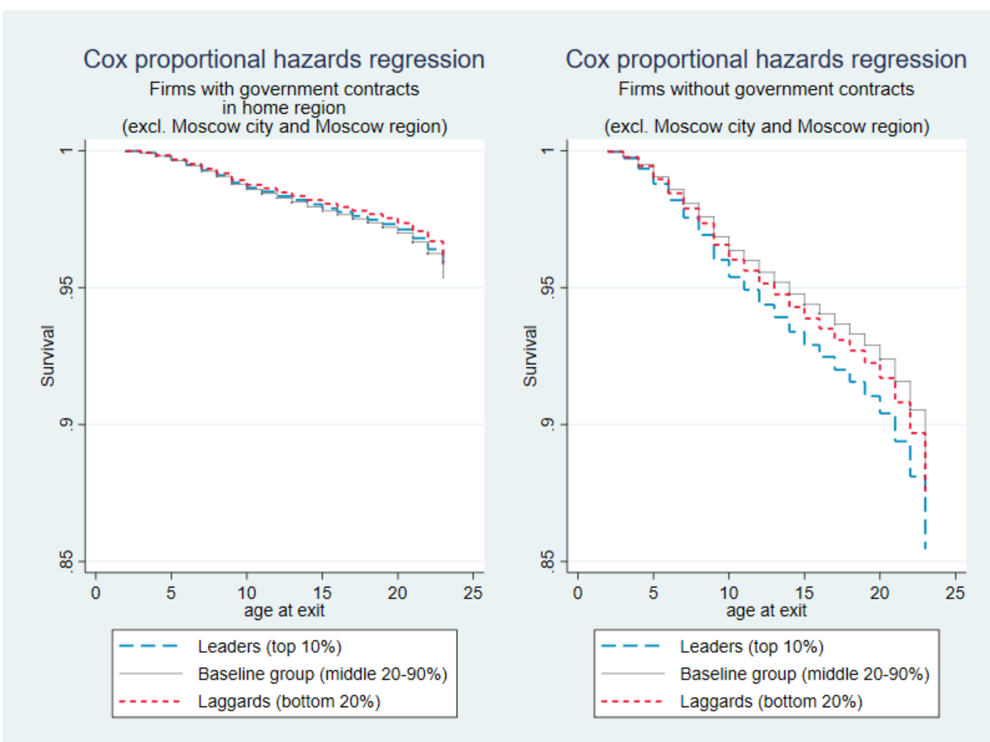

Figure 8. Survival function after Cox proportional hazard regression by efficiency groups for firms with government contract in the home region (yearly setup).
Source: author calculations.

Table 1

	Entire period setup (exit by 2016)				Yearly setup (exits in 2011-2016)			
	obs.	mean	min	max	obs.	mean	min	max
Number of firms	381389				289358			
Number of records	381389	1	1	1	1069862	3.7	1	4
Exits	13488	0.035	0	1	10281	0.036	0	1
Age at exit		11.1	1	24		10.4	2	23

Table 2

Variable	Desription		Entire period setup (exit by 2016) percent of firms	Yearly setup (exits in 2011-2016) psercent of firms
Efficiency groups	Efficiency level groups based on the author estimations of distance of a firm to stochastic production posibilities frontier. Efficiency level varies from 0 (least efficient) to 1 (most efficient). Efficiency groups were defined within each indistry	Leaders (top 10%)	15.6	14.9
		Baseline group (middle 20-90%)	62.8	67.4
		Laggards (bottom 20%)	21.7	17.7
Government contract dummy	1 if the firm won government procurement contract at least once (i) in the period 2011-2016 for the whole period sample or (ii) in each year from 2011 to 2016 for yearly sample; 0 otherwise	0	64.8	83.2
		1	35.3	16.8
Government contract in home region dummy	1 if the firm won government procurement contract in home region at least once in each year from 2011 to 2016 in yearly sample; 0 otherwise	0		85.7
		1		14.3
Size dummies	Based on employment size groups in SPARK database: less than 10 employees - microfirms, 11-100 employees - small firms, 101-250 employees - medium firms, more than 250 employees - large firms	Micro	74.7	69.8
		Small	20.0	23.5
		Medium	3.1	3.9
		Large	2.2	2.8
Sector dummies	Sectors according NACE Rev. 1.1	Sector C	1.0	1.1
	Section C. Mining and quarrying	Sector D	17.9	18.7
	Section D. Manufacturing	Sector E	1.8	1.8
	Section E. Electricity, gas and water supply	Sector G	47.8	48.0
	Section G. Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	Sector H	4.2	4.4
	Section H. Hotels and restaurants	Sector I	7.2	7.2
	Section I. Transport, storage and communications	Sector K	17.9	16.5
	Section K. Real estate, renting and business activities	Sector O	2.3	2.4
	Section O. Other community, social and personal service activities (in subsections 92 "Recreational, cultural and sporting activities" and 93 "Other service activities")			

Table 3

Dependent variable: firm age at exit	Entire period setup (exit by 2016)		Yearly setup (exits in 2011-2016)	
	Coef.	*Hazard ratios*	*Coef.*	*Hazard ratios*
	(1)	(2)	(3)	(4)
Efficiency level[i], Leaders - top 10%	0.017	1.017	0.182***	1.200***
	(0.025)	(0.026)	(0.029)	(0.035)
Efficiency level, Laggards - bottom 20%	0.009	1.009	0.124***	1.132***
	(0.021)	(0.021)	(0.025)	(0.029)
Firm size[ii], Small	0.432***	1.540***	0.231***	1.260***
	(0.020)	(0.031)	(0.023)	(0.029)
Firm size, Medium	0.564***	1.758***	0.267***	1.306***
	(0.039)	(0.068)	(0.045)	(0.059)
Firm size, Large	-0.026	0.975	-0.341***	0.711***
	(0.057)	(0.056)	(0.067)	(0.048)
Sector dummies[iii]				
Sector C. Mining and quarrying	-0.564***	0.569***	-0.762***	0.467***
	(0.096)	(0.055)	(0.119)	(0.055)
Sector D. Manufacturing	-0.369***	0.692***	-0.429***	0.651***
	(0.024)	(0.017)	(0.028)	(0.018)
Sector E. Utilities	-0.195***	0.822***	-0.404***	0.667***
	(0.062)	(0.051)	(0.079)	(0.053)
Sector H. Hotels and restaurants	-0.636***	0.529***	-0.629***	0.533***
	(0.052)	(0.028)	(0.058)	(0.031)
Sector I. Transport and communications	-0.368***	0.692***	-0.380***	0.684***
	(0.037)	(0.025)	(0.042)	(0.029)
Sector K. Business services	-0.601***	0.549***	-0.599***	0.550***
	(0.026)	(0.014)	(0.031)	(0.017)
Sector O. Private services	-0.929***	0.395***	-0.948***	0.388***
	(0.071)	(0.028)	(0.080)	(0.031)
Number of observations	381,389	381,389	1,069,862	1,069,862

Cox proportional hazards model. Standard errors are in parentheses
[i]Omitted category: Baseline group (efficiency level between 20-90%). [ii]Omitted category: Micro firms. [iii]Omitted category: Sector G. Wholesale and retail trade
*** p<0.01, ** p<0.05, * p<0.1

Table 4

	Entire period setup (exit by 2016) Government contract		Yearly setup (exits in 2011-2016) Government contract	
	no	*yes*	*no*	*yes*
All firms	64.8	35.3	83.2	16.8
Leaders (top 10%)	56.0	44.0	78.4	21.6
Baseline group (middle 20-90%)	64.0	36.0	82.7	17.3
Laggards (bottom 20%)	73.1	26.9	89.1	10.9

Table 5

Dependent variable: Government contract in 2011-2016 (yes 1, no 0)	Entire period setup *Coef.* (5)	*Marginal effects* (6)
Efficiency level[i], Leaders - top 10%	0.118***	0.026***
	(0.010)	(0.002)
Efficiency level, Laggards - bottom 20%	-0.354***	-0.072***
	(0.009)	(0.002)
Firm size[ii], Small	0.874***	0.200***
	(0.009)	(0.002)
Firm size, Medium	1.375***	0.321***
	(0.020)	(0.005)
Firm size, Large	1.825***	0.419***
	(0.026)	(0.005)
Sector dummies[iii]		
Sector C. Mining and quarrying	-0.448***	-0.088***
	(0.037)	(0.007)
Sector D. Manufacturing	0.131***	0.028***
	(0.010)	(0.002)
Sector E. Utilities	1.768***	0.393***
	(0.032)	(0.006)
Sector H. Hotels and restaurants	-0.614***	-0.117***
	(0.020)	(0.003)
Sector I. Transport and communications	-0.027*	-0.006*
	(0.014)	(0.003)
Sector K. Business services	0.096***	0.021***
	(0.010)	(0.002)
Sector O. Private services	-0.027	-0.006
	(0.024)	(0.005)
Constant	-0.874***	
	(0.006)	
Number of observations	381,389	381,389

Logit model. Standard errors are in parentheses
[i]Omitted category: Baseline group (efficiency level between 20-90%). [ii]Omitted category: Micro firms. [iii]Omitted category: Sector G. Wholesale and retail trade
*** p<0.01, ** p<0.05, * p<0.1

Table 6

Dependent variable: firm age at exit	Entire period setup (exit by 2016) All contracts		Yearly setup (exits in 2011-2016) All contracts		Yearly setup (exits in 2011-2016) Contracts in home region	
	Coef.	*Hazard ratios*	*Coef.*	*Hazard ratios*	*Coef.*	*Hazard ratios*
	(7)	(8)	(9)	(10)	(11)	(12)
Efficiency level[i], Leaders - top 10%	0.091***	1.096***	0.193***	1.213***	0.242***	1.274***
	(0.029)	(0.032)	(0.031)	(0.038)	(0.038)	(0.048)
Efficiency level, Laggards - bottom 20%	-0.019	0.981	0.109***	1.115***	0.090***	1.095***
	(0.023)	(0.022)	(0.026)	(0.029)	(0.028)	(0.031)
Government contract dummy	-0.956***	0.384***	-0.903***	0.405***	-0.954***	0.385***
	(0.027)	(0.011)	(0.043)	(0.018)	(0.053)	(0.020)
Leaders X Government contract	-0.236***	0.790***	-0.118	0.889	-0.286**	0.751**
	(0.058)	(0.046)	(0.096)	(0.085)	(0.130)	(0.098)
Laggards X Government contract	-0.100*	0.905*	-0.239**	0.787**	-0.220*	0.803*
	(0.056)	(0.051)	(0.115)	(0.091)	(0.132)	(0.106)
Firm size[ii], Small	0.630***	1.877***	0.326***	1.385***	0.169***	1.184***
	(0.020)	(0.038)	(0.023)	(0.032)	(0.026)	(0.031)
Firm size, Medium	0.927***	2.527***	0.442***	1.556***	0.298***	1.347***
	(0.040)	(0.100)	(0.046)	(0.071)	(0.054)	(0.073)
Firm size, Large	0.432***	1.541***	-0.099	0.906	-0.349***	0.706***
	(0.058)	(0.090)	(0.068)	(0.061)	(0.083)	(0.059)
Sector dummies	yes	yes	yes	yes	yes	yes
Observations	381,389	381,389	1,069,862	1,069,862	785,820	785,820

Cox proportional hazards model. Standard errors are in parentheses

[i]Omitted category: Baseline group (efficiency level between 20-90%). [ii]Omitted category: Micro firms

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