Can the Growth of Competitive Pressure and Hardening of Budget Constraints Reduce the Efficiency Loss due to State Ownership?[1]

Evguenia Bessonova, *Bank of Russia, HSE University*
bessonovaev@mail.cbr.ru
Ksenia Gonchar, *HSE University*
kgonchar@hse.ru

This paper studies how market structure and subsidisation affect the productivity gap between state-owned enterprises (SOEs) and private enterprises in the specific context of an economy with a long history of state involvement in industry and continued government intervention after the completion of privatisation. The results suggest that private firms are 7–8 percentage points closer to the sectoral technical frontier and their total factor productivity grows 0.5 points faster than that of SOEs. This difference persists at all levels of competition, while neither ownership type is superior in concentrated markets. When competition levels are more than moderate, SOEs show greater response to further growth of competition than private firms do. High subsidies reduce the productivity advantages of private firms, but harder budget constraints do not make government firms more efficient.

Keywords:
ownership, competition, subsidies, productivity
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1. Introduction

This paper studies the relative efficiency of government and private firms depending on the level of competition and hardness of budget constraints. This issue remains significant, because in many countries governments continue to own and manage companies that define the industrial structure of national economies.

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Financial services, public utilities and mining are among sectors that are often dominated by state-owned firms (SOEs). According to OECD estimates, 22 of the world's largest 100 firms are currently under effective state control, while in emerging economies the government sector accounts for 20–30% of economic activity and the figure is higher in resource-dependent countries (OECD, 2016).[2] State ownership may significantly undermine productivity and growth when SOEs charge higher prices and accept inefficiencies.

On the other hand, in economies characterised by a weak market allocative mechanism, SOEs may play an important role in development and learning in order to overcome this weakness (Trubek, 2010; Lin and Monga, 2010). It would, therefore, be interesting to study how the productivity of SOEs and private firms in an economy that has retained a large measure of monopolisation and where subsidies remain extensive reacts to changes in the level of protection and subsidisation after a privatisation programme had been completed. The main research question would be: can the growth of competitive pressure and hardening of budget constraints in such an economy reduce the efficiency loss due to state ownership, if such an efficiency loss is confirmed?

The efficiency of government firms in Russia, a country with a long history of state involvement in the economy, is a major question. Post-Soviet market-oriented and institutional reforms resulted in the emergence of a large private sector practically from scratch, and SOEs were largely displaced by private firms as holders of equity capital. Between 1990 and 2018, the share of government-owned fixed capital was reduced from 91% to 23%.[3] The economic outcome of privatisation in Russia was inferior to the results achieved in Central and Eastern European countries. The economic effect of Russia's privatisation as such has been estimated as negative or insignificant for domestic owners and slightly positive or insignificant for foreign owners (see literature survey in Estrin et al., 2009). Nevertheless, as Aslund (2018) concluded, privatisation was vital, and it was more important that it was accepted politically than that it was economically efficient.

Today state and private firms coexist and compete in most sectors of the Russian economy. State ownership in Russia remains economically and fiscally important: according to Rosstat data, in 2016 about 311,000 state-owned organisations were registered (including publicly run institutions), employing more than 18 million people. The exact size and sectoral distribution of output in firms where the government is an owner/manager is a matter of debate, mostly

[2] In this paper we use 'state', 'public', or 'government' ownership as interchangeable terms, referring to a situation where federal, regional and municipal governments are involved in productive activities as owners/managers of entities in non-financial sectors. Additionally we use 'enterprise', 'firm', and 'company' as interchangeable terms, while an enterprise is a unit of analysis in our data.

[3] Data of the Federal State Statistics Service (Rosstat). The reserves of the Bank of Russia and national reserves are included in government-owned fixed capital.

because measuring output of government firms is often difficult, especially if the output is not sold or is not measured in units that can be summed (particularly in services). Inconsistency of definitions of the public sector also plays a role. Particularly in the 1990s, governments in transition countries used definitions that maximised the size of the private sector in order to demonstrate progress in reforms (Brada, 1996).

There is huge variation in expert perceptions and figures reported by official government statistics regarding the scale of state ownership in Russia today. A study by the Centre for Strategic Research (Radygin et al., 2018) puts the state share in GDP at 46% in 2016 and reports that SOEs dominate in transport, utilities, and mining, where they produce more than 70% of output. However, according to Rosstat data, SOEs produce only 31.2% of output in utilities, 11.4% in electricity, 2.4% in manufacturing, and just 0.1% in mining.[4] Estimates by the International Monetary Fund for 2016 and the European Bank for Reconstruction and Development for 2005–2010 (Di Bella et al., 2019) report a 32–33% share of the Russian state in output. This figure does not look overly large by the standards of emerging economies endowed with natural resources.

There is already a vast literature on market distortions arising from state ownership and consequences of privatisation. However, the present paper will address the issues in a different way, enquiring whether relative efficiency of SOEs in the post-privatisation economy is increased by growth of competition and reduction of subsidisation, which are the two most important factors conditioning the performance gap between private and government firms. The relationship between firms, markets and the institutional context remains an understudied and controversial topic in the literature, and liable to arouse political sensitivities. The usual conclusion is that private ownership as such is not sufficient to generate economic gains compared with public ownership (Estrin and Pelletier, 2018). Complementary political and social components of market exchange are needed to overcome the inertia of organisational resources and to transform the institutional context of social action (Kogut and Spicer, 2002).

This paper provides estimates of how ownership type impacts comparative productivity using unbalanced panel data for more than 270,000 Russian firms across all sectors except for agriculture, finance, and some government services (including education and healthcare) in the period 2008–2015. This is more than twenty times larger than the biggest Russian data sample used by the previous relevant literature. Of 826,868 total firm/years sampled, 4% are represented by government firms, including 3% wholly-owned by the government. The data was extracted from the Ruslana database (Bureau van Dijk). We study heterogeneity in the effects of ownership on productivity depending on the power of competitive pressure across disaggregated sectors and differences in soft budget constraints

[4] See at: https://gks.ru/bgd/regl/b19_48/Main.htm (in Russian).

across subnational regions. This is an issue, which has not received much attention in previous empirical research. According to the Russian Federal Antimonopoly Service (2017), market structure in Russia is 'unhealthy' in the sense that, in some sectors, high industry concentration impedes the disciplining effects of competition, failing to generate incentives to innovation and growth. Relatively weak competition in Russia is reported in the relevant literature (Di Bella et al., 2019; Guriev and Rachinsky, 2005). It is important to note that the Russian government reacted to the crisis shocks of 2008 and 2014 by increasing subsidies and placing limitations on competition.

We draw upon earlier publications regarding state ownership in Russia, which, as a rule, use much smaller datasets for the earlier transition years and exclude the service and mining industry from their analysis. The theoretical background of this paper is the fundamental 'irrelevance theorem' of Sappington and Stiglitz (1987), which postulates neutrality of ownership in competitive markets with hard budget constraints.

The results suggest that the association between ownership, technical efficiency level, and growth of total factor productivity (TFP growth) is significant. Private firms display superior technical efficiency in all years of observation and across all sectors studied. For TFP growth, the results vary across sectors. In a number of sectors, TFP growth in private enterprises is higher, but in some service sectors, SOEs show higher growth rates than private enterprises do. There is no statistically significant difference in productivity growth in manufacturing.

The relative inefficiency of SOEs persists at all levels of competition, with the exception of extremely concentrated markets. When the level of competition is more than moderate the effects of competition on technical efficiency level among SOEs is even higher than among private firms, from which we can conclude that higher-than-moderate competition helps reduce the efficiency gap between government and private firms. There is no significant difference in productivity-subsidies effects across forms of ownership, except for very high levels of subsidies, when the subsidies reduce the productivity advantages of private firms and benefit government firms. We do not find that harder budget constraints make government firms more efficient.

Thus, our research builds on previous studies on the transition of state-owned enterprises after privatisation is completed by estimating much larger sample and allowing for additional critical factors – competition and subsidisation in particular – that influence performance gap between state and private firms.

The present paper is organised in five sections. Section 2 reviews the literature on the comparative efficiency of private and public firms, focusing on the role of competition and subsidies which may serve as the underlying mechanism behind management of private industry. Section 3 describes the research design and data. Section 4 presents the findings. Section 5 concludes.

2. Literature background

In this research, we draw on literature, which suggests that ownership effects should be viewed in a wider context, depending on the market, regulatory and institutional environment.

Our background theory (Sappington and Stiglitz, 1987) says that when the owner delegates authority over production activities, some transaction costs arise. Private ownership may be a better solution to the delegation problem compared to SOEs, in spite of the emerging agency cost, provided that certain conditions are met, including (but not limited to): competitive environment, a functioning capital market to mitigate risks, better informed agents, and no difference in regulation between private and government firms.

The literature establishes that the link between ownership type, incentive structure and firm efficiency is complex and that different outcomes are possible. If firms compete freely and if regulation does not provide advantages to SOEs, ownership should not be a strong determinant of performance. However, if these conditions are not met, private ownership may not generate economic gains. When the government keeps some control over market structure, prices and subsidies in a predominantly private economy, the difference in economic performance implied by public and private ownership depends on the degree of regulation and quality of solving the regulation problems (Vickers and Yarrow, 1991).

The results of previous empirical research on firm performance in Russia by ownership type are inconsistent (see literature surveys in Djankov and Murell, 2002; Estrin et al., 2009; Iwasaki et al., 2018). The most recent meta-analysis of twenty-nine publications on the Russian data concludes that private firms in Russia are somewhat better than SOEs in terms of performance and restructuring, though the effect is conditioned by details of the ownership type, being the lowest for domestic outsider ownership and the highest for foreign ownership (Iwasaki et al., 2018). However, there are concerns that the surveyed papers use samples that are too small, making it difficult to extend the findings to the entire economy.

The most relevant paper for the purposes of our analysis is Brown et al. (2006), which makes a comparative study of TFP effects of privatisation in four transition countries, including Russia, using information for 1985–2002 on about 14,600 large Russian manufacturing firms. The authors report negative impact of privatisation on productivity for domestic investors, with a range from minus 3% to minus 5% for TFP, with some upturn starting more than five years after privatisation. A later study by Moser (2016) identifies SOEs as the best performers in the Russian oil industry over the long period between 1992 and 2012 and explains the result by the specificity of Russia's institutions and business environment. Vanteeva and Hickson (2016) report positive effects of mixed state and private ownership compared to wholly-owned SOEs among listed Russian firms, especially in the energy and utility sectors, manufacturing and steel industry, and nil effect in the

food, retail, and communication industries. The study measured performance through the Tobin's Q proxy (equity to assets ratio).

Other empirical studies find productivity disadvantages of SOEs in Russia. For example, Earle and Estrin (2003) use the survey data of 394 industrial firms for 1990 and 1994 and report that privatisation increases labour productivity. Abramov et al. (2017) use a small sample of the 114 largest firms in Russia and find that labour productivity and profit rates decrease with growth of the government stake and that SOEs are in general less financially efficient than private firms.

Given that the Russian government keeps significant control over market structure and keeps subsidizing firms, it makes sense to assume that we may not find significant differences in economic performance of public and private firms. This argument can be formalised in the following hypothesis.

H1. In a state-heavy economy such as Russia the performance of SOEs is not necessarily inferior to the performance of private firms.

The next concern of the research described here is the differing efficacy of public and private firms in the presence of competition. In general, competitive pressure reduces opportunities for irresponsible managerial behaviour and encourages more efficient decision-making by managers. Consequently, if market concentration exceeds a certain threshold, it lowers technical efficiency for both types of ownership (Caves and Barton, 1990).

An important issue is the difference between the response of private and government firms when competitive pressure creates incentives to cut costs. There are some theoretical grounds for thinking that private firms will achieve greater efficiency gains in a competitive environment than government firms (see the survey in Sheshinsky and López-Calva, 2003). On the other hand, it is not clear which ownership type achieves more efficiency advantages in concentrated markets with market power (Boardman and Vining, 1989). Some authors report that, in such an environment, managerial slack may be the same or even greater in a private monopoly than under government ownership (Willner and Parker, 2007). In recent papers, the finding that competition is more beneficial for private firms is reported by Le et al. (2019) for Vietnamese firms, where the data show that SOEs perform better than private enterprises, although the growth of market competition after Vietnam's World Trade Organisation accession reduced the gaps in efficiency across ownership types.

Empirical papers on interaction between competition and ownership offer conflicting conclusions. Some studies show that competition is more important for efficiency than ownership type, and that private firms are not superior performers in competitive markets (Caves and Christensen, 1980, for railways; Brickley and Van Horn, 2000, for hospitals; Wallsten, 2000, for telecommunications in developing countries; Wallsten and Kosec, 2008, for water utilities in the US). Among recent papers, Mizutani and Nakamura (2017) carry out inefficiency analysis for public utility firms in Japan and report that competition and regulation increase inefficiency.

Other papers argue that private firms are superior performers in the presence of competition (Vining and Boardman, 1992, for the largest Canadian companies; Boardman and Vining, 1989, for the 500 largest manufacturing and mining firms outside the US; Vickers and Yarrow, 1991, for the case of British privatisation in the 1980s). Vining and Boardman (1992) also report that ownership-competition interaction varies significantly across sectors. Superior public efficiency is found for sectors with limited competition and high regulation of private firms, while greater efficiency of private firms appears to obtain in services. Triebs and Pollitt (2019) study privatisation and competition reforms in British electric industry and find that the ownership effect is more important than the competition effect for labour and fuel productivity.

The available research on the Russian data reports that private ownership and competition are complementary. For example, Brown and Earle (2001) find that state ownership in Russia reduces the positive effects of competition on TFP. Earle and Estrin (2003) report that private ownership and competition together enhance productivity. Liljeblom et al. (2020), report, using data on the Russian listed companies with state ownership, that lower competition improves the performance of these SOEs (performance measured as profitability).

These considerations produce a second hypothesis:

H2. Ownership structure in Russia interacts with competitive forces, which mostly reinforce the productivity benefits of private firms and reduce efficiency losses of SOEs.

The second shifter in the ownership-productivity relationship, which we seek to study in the present paper, is so called 'soft budget constraints', usually understood as financial dependence of the firm on the state (Kornai, 1992). Technically the mechanism of soft budget constraints may include budgetary subsidies, softer bank credits (Kornai et al., 2003), as well as preferences in access to public procurement. Our background theory suggests that ownership structure interacts with subsidisation if the government is able to interfere in a firm's decision-making. Subsidisation will undermine private firms' efficiency through higher transaction costs of government intervention. When a firm is both private and regulated, subsidies and price regulation can give rise to problems of underinvestment, especially if the government decides to enforce low prices without allowing the firm to recover its costs (Vickers and Yarrow, 1991).

A theoretical model by Shleifer and Vishny (1994) predicts that government regulation has different consequences for the performance of government and private firms. The greater the financial dependence of public firms, the more attractive public ownership is to politicians and the more firmly SOEs become established. In such an environment, soft budget constraints induce inefficient behaviour by state firms and decrease the productivity benefits of private firms. In a later theoretical paper Guriev (2018) shows that soft budget constraints may lead to higher productivity of state firms compared to private

firms, when preferential treatment of SOEs keeps them afloat and gives them competitive advantages against private firms. Excessive size of SOEs partly explains the preferential treatment and regulatory advantages enjoyed by them (Tybout, 2000).

Will government firms operate more efficiently if they are subject to harder budget constraints? Efficiency gains of government firms due to harder budget constraints has not been confirmed in the literature to date. Notably, the survey by Megginson and Netter (2001) concludes that harmful effects of state intervention have greater impact under state ownership than under state regulation. We have not found empirical papers on Russia, which explore the effects of toughening of budget constraints on the comparative efficiency of ownership types. In general, the previous literature indicates that state loans to SOEs in Russia have been used very inefficiently (Hoff and Stiglitz, 2004), mainly due to failure to monitor how the loans are spent and repaid.

In view of these points, the third hypothesis is proposed:

H3. Tougher budget constraints reduce the efficiency losses of SOEs.

3. Research design and data description

3.1. Research design and econometric strategy

The firms that we analyse remained in the same type of ownership (public or private) through the period of study. Effects occur when changes in the market environment interact with the ownership type. Ownership, competition, and budget constraints are not independent in their efficiency-enhancing role and tend to act together. The research task, therefore, is to define the vector of interactions of ownership with competition and subsidies.

Our econometric strategy includes several steps. First, we apply stochastic frontier analysis, which permits estimation of the production function taking account of technology differences across disaggregated sectors (for details, see Appendix A1 in the online version of the paper).[5] Thus, we obtain two main dependent variables. The first is the level of technical efficiency of the firm (*TE*) relative to the stochastic frontier, which measures the failure of a firm to operate at a production frontier (understood as the maximum output from a combination of inputs for the given technology and input prices). The second dependent variable is the growth rate of total factor productivity (*TFP growth*). The two dependent variables give us a measure of differences in productivity level and TFP growth between firms. *TE* has values from zero to one, where one is the production frontier. The mean *TE* value in the sample is 0.26 while the average annual TFP growth rate is minus 3%.

[5] Stochastic production functions were estimated separately for 282 industries, mainly for three- or four-digit sectors under NACE 1.1 (European Nomenclature of Economic Activities) classification.

Next, we estimate the pooled ordinary least squares (OLS) regression to define comparative efficiency of private firms and SOEs and test how the comparative level of technical efficiency and TFP growth rates change over time and across sectors. The sample for the period from 2008 to 2015 is rather unbalanced. Enterprises can enter the market and exit the market, some enterprises may not provide financial statements in all years of observation, although they do not exit the market according to the Unified State Register of Legal Entities. Therefore, in this study, we used the pooled OLS techniques[6] (see Wooldridge, 2010, chapters 7 and 10 for a comparative description of the properties of various methods of panel data estimation). However, to analyse the robustness of the results, we also evaluated the baseline regressions by random effects. The results obtained almost do not differ from the pooled OLS (see Appendix A3).

To compare the relative efficiency of public and private firms, first we include the ownership dummy in the equation on the full sample, then run the regressions on sectoral subsamples, and finally interact the ownership variable with the year dummies and all of their pairwise combinations. The baseline model is as follows:

$$TE_{it} \text{ or } TFP\ growth_{it} = \beta_0 + \beta_y \ln Y_{it} + \beta_{ot} D_{\substack{owner \\ type}} + \sum_t \beta_t D_t + \sum_{sector} \beta_s D_s + \sum_{sector} \sum_t \beta_{ts} D_t D_s + \varepsilon_{it}, \quad (1)$$

$$TE_{it} \text{ or } TFP\ growth_{it} = \beta_0 + \beta_y \ln Y_{it} + \sum_{\substack{owner \\ type}} \sum_t \beta_{ot,t} D_t \times D_{\substack{owner \\ type}} + \sum_{sector} \beta_s D_s + \varepsilon_{it}, \quad (2)$$

where $D_{owner\ type}$ is the ownership dummy when SOE is equal to one and private ownership to zero; D_t is the year dummy; D_s is the sector dummy; $\ln Y_{it}$ logged value added as a proxy for firm size.

Next, we add competition indicators, measured as a sectoral Herfindal–Hirschman Index (1 – *HHI*), and soft budget constraints, measured as the logged per capita value of regional budget subsidies and transfers. Our data does not allow us to measure financial dependence of firms on the government directly, so we rely on subnational subsidisation data and suggest that high institutional heterogeneity in Russia and bigger financial dependence of some

[6] Under this approach, the problem of endogeneity of explanatory variables may be present in our analysis. However, the time of mass privatisation is quite far from the period under study, when we do not record in our sample a significant number of cases of transition of state enterprises to private ones and vice versa. Therefore, it is unlikely that current performance indicators can have a significant impact on determining the form of ownership in our setup.

Although many factors can affect the performance of enterprises, we believe that if we control for the basic characteristics of an enterprise (value added, number of employees, fixed assets, industry, level of competition), and also take into account macro trends using year dummies, then the influence of other factors should be limited, and their effects hardly lead to the biased estimations.

regions translate into greater opportunity of firms in the latter regions to be subsidised. The mechanism of this process is described in Estrin et al. (2019): the institutional arrangements in some locations, characterised by a state-led governance type, provide SOEs with additional rents and raise the expectation of firms that government will help resolve their financial problems. Technically we interact the indicator of ownership with the measurement of competition and subsidies. The interaction terms account for the differential impact of competition and subsidies on technical efficiency levels and TFP growth rates of public and private firms.

$$TE_{it} \text{ or } TFPGrowth_{it} = \beta_0 + \beta_y \ln Y_{it} + \beta_{ot} D_{ownership\ type} + \beta_{HHI} HHI_{sector,t} + \beta_{ot,HHI} \times D_{owner\ type} \times HHI_{sector,region,t} + \sum_{sector} \beta_s D_s + \varepsilon_{it}. \quad (3)$$

$$TE_{it} \text{ or } TFP\ Growth_{it} = \beta_0 + \beta_y \ln Y_{it} + \beta_{ot} D_{owner\ type} + \beta_{sub} Subsidies_{region,t} + \beta_{ot,sub} \times D_{owner\ type} \times Subsidies_{region,t} + \sum_{sector} \beta_s D_s + \varepsilon_{it}. \quad (4)$$

Additionally, we assume non-linear effects of competition and subsidies on productivity/ownership links and add the quadratic forms of our measurements of competition and subsidies in specification (4).

Year and sectoral dummies are included throughout the analysis to take account of unobserved aggregated and sectoral shocks, which may have affected the productivity gap between state and private firms.

3.2. Data source and descriptive statistics

We use microdata provided by the Ruslana database from Bureau van Dijk, for the period from 2008 to 2015. The data comes from the state registry of enterprises and allows to distinguish private from state ownership based on the identity of firm owners and their share stakes. However, data on exact share stakes has too many gaps, so in one part of the analysis we have to classify firms as state-owned if the state share is 100% and, in the other part, if the government has any stock at all. This approach helps account for the possibly differentiated consequences of partial and 100% state ownership. From the theoretical point of view, it is not clear whether full state ownership is less beneficial than partial state ownership.

The dataset contains balance sheet data on sales, costs of goods sold, number of employees, fixed assets, profit and loss, and material costs. Data on labour costs is scarce, so we approximate labour costs by the mean value of wages in the

sector (four-digit sector under NACE 1.1 classification) in the subnational region. Fixed assets are estimated as mean yearly fixed assets. We also exclude plants with less than 10 employees and trim 1% of the best and worst performing plants as outliers. Sales and costs are deflated to 2008 as the base year using the four-digit sectoral price indexes and deflators of value-added for services, as well as volume indexes for fixed assets.

The resulting unbalanced panel dataset covers 2008–2015 and includes 826,868 active firm/year observations. Most firms in the sample are private: the mean share of SOEs is 4%, including 3% specified as wholly-owned government firms. The sectors with the highest share of SOEs are those of power and energy (28.7% of all observations), followed by utilities (15.5%). Table 1 contains the SOEs shares in employment, sales and value added in the sample. It shows that the share of employment in SOEs decreased slightly during the study period. The government firms' share in sales and value added decreased at a lower rate than employment and remained almost stable during the second half of the study period. At the same time, the variety of representation of SOEs in employment, output and value added between sectors is quite significant across all measured indicators SOEs have a greater presence in such sectors as electricity, gas, and water supply, in the provision of social services, in transport and mining. It should be noted that the largest state-owned companies (such as Gazprom, Russian Railways, Aeroflot, Rosatom) were not included in the final sample, since the largest government firms are often organised as conglomerates while our dataset includes individual enterprises.[7] Moreover, Ruslana database underreports essential statistics needed to calculate the value added for the largest firms. Some observations in this size group were treated as outliers during the estimates of production functions at the first stage of the analysis. However, when assessing the level of competition in the domestic market, superlarge companies were taken into account, because we were able to consider their sales data.

The sample is the largest possible dataset to date, taking account of restriction on observations for our dependent variables and main predictors of interest, and possible large-firm bias due to shortage of accounting and ownership data for small firms in the registry.

Using our final sample and distinguishing private and state ownership, Table 2 provides some preliminary support to our hypothesis and reports comparisons of employment, sales, labour productivity, and value-added productivity for the sampled firms.

[7] These firms should be subject to quantitative analysis with the focus on the ownership structure. However, their remarkable specificity in terms of production processes, organisation, competition, and international integration make them incomparable to the majority of enterprises at the Russian market. Quantitative studies of the largest companies require other approaches to analysis than the one employed in our paper and may be subject for future research.

Table 1. SOEs share in employment, sales, and value added in the sample, by year and by sector, %

Year	Employment	Sales	Value added
2008	10.4	5.4	5.6
2009	9.8	5.0	5.5
2010	9.7	4.5	5.5
2011	8.3	4.2	4.5
2012	7.2	3.3	4.1
2013	6.7	3.2	3.9
2014	6.0	3.2	3.5
2015	5.5	3.0	4.0
Sector	**Employment in 2008**	**Sales in 2008**	**Value added in 2008**
Mining	14	16	15
Manufacturing	4	2	2
Power and energy	59	25	11
Trade	2	1	2
Hotels	9	6	4
Transport	58	17	13
Real estate	16	10	8
Utilities, services	31	39	14

Source: compiled by the authors

Table 2. Employment, sales, and productivity by ownership type in the sample

Year	Number of employees, people			Sales, thousand roubles			Value added productivity, thousand roubles per employee			Output per worker, thousand roubles per employee		
	Private	SOEs	Mean difference, times	Private	SOEs	Mean difference, times	Private	SOEs	Mean difference, times	Private	SOEs	Mean difference, times
2008	82	192	2.3	192.6	219.6	1.1	331.4	215.3	0.65	2,103.7	1,259.9	0.60
2009	78	191	2.5	148.2	199.5	1.3	262.1	185.5	0.71	1,516.3	1,095.5	0.72
2010	79	196	2.5	157.3	204.0	1.3	250.8	176.7	0.70	1,571.0	1,119.1	0.71
2011	78	205	2.6	153.5	213.7	1.4	267.4	174.9	0.65	1,707.6	1,119.8	0.66
2012	88	183	2.1	206.8	204.5	1.0	351.6	175.4	0.50	2,300.8	1,075.0	0.47
2013	79	185	2.3	187.2	206.5	1.1	353.8	173.9	0.49	2,138.4	1,017.7	0.48
2014	70	170	2.4	161.4	190.8	1.2	342.2	168.6	0.49	1,923.0	972.1	0.51
2015	65	114	1.7	139.2	150.8	1.1	316.0	152.0	0.48	1,643.1	829.8	0.51

Source: authors' calculations

Summary statistics quantifying size (number of employees and sales) show that government firms can be considered large only by number of employees. The mean annual employment for SOEs is 180 people compared to 77 for private firms. Nevertheless, average annual real sales for SOEs is only 18% larger than for private firms. The results show a clear trend for private firms to be much more productive than SOEs. The gap in productivity is economically significant: SOEs report annual labour productivity that is lower by 75% (output based) and 74% (value-added based) than that of private firms.

Table 3 summarises descriptive statistics of the dependent and independent variables.

Table 3. Summary statistics

Variables	Definition	Data source	Mean	Standard deviation	Min	Max	Number of observations
TE	Distance to the stochastic frontier in four-digit sector, ranges from zero to one	Authors' calculation on Ruslana data	0.26	0.23	0.00	0.98	826,868
TFP growth	TFP growth rate between 2008 and 2015, %	Authors' calculation on Ruslana data	−0.03	0.10	−21.13	10.74	826,868
Independent variables							
SOE	Dummy for state-owned firm, equals one if the firm reports any government stake and zero if the firm is private	Ruslana	0.04	0.19	0.00	1.00	826,868
Wholly-owned SOE	Dummy for wholly-owned state firm, equals one if the firm reports 100% government stake and zero if the firm is private	Ruslana	0.03	0.17	0.00	1.00	826,868
Competition	Herfindal–Hirshman Index (HHI) at the level of four-digit sector, estimated as (1 – *HHI*): the higher the index, the higher the level of competition	Authors' calculation on full population of Ruslana data	0.946	0.063	0.500	0.997	822,613
Subsidies	Logged per capita sum of subsidies, subventions, federal transfers in the subnational region (constant 2008 prices)	IIMS (Institute for Industrial and Market Studies) regional database	9.00	0.52	6.86	12.16	826,868
Firm size	Logged real value added (constant 2008 prices)	Authors' calculation on Ruslana data	15.60	1.76	7.91	25.36	826,868

Source: compiled by the authors

The results from Table 3 suggest substantial variation in technical efficiency among sampled firms: most efficient firms have *TE* score of 0.98 while the least efficient are at 0.0003, with a 0.26 mean. This is a very poor result, suggesting that most firms are technically inefficient and indicating severe problems in the nature of the production system. These results are in line with the trends described in Bessonova (2018) for the period from 2009 to 2015 and Bessonova and Tsvetkova (2022) for the period from 2011 to 2016. It remains to be seen whether the efficiency loss can be partly attributed to ownership issues.

The TFP growth rate was largely negative in the period of observation (minus 3% on average), ranging from –21% to +10.7%. Most firms are grouped in trade (46.7%) followed by manufacturing and real estate. Summary statistics measuring size (logged real value added) show that our sample is dominated by medium-sized firms.

To gauge competition, we estimate the *HHI* at the four-digit sectoral level from the Ruslana total population dataset in order to measure industry concentration. Ruslana dataset allows this undertaking, since almost all largest enterprises in individual industries are present in this database and sales data is fairly well filled. However, there is a problem with missing observations, when data for individual enterprises may be missing for one or more years. To address this problem, we interpolated the data for the missing observations to avoid sharp fluctuations in the indices.

For ease of interpretation, we measure competition as (1 – *HHI*) in further estimations. The mean value of competition is 0.946 and the scores range from 0.5 to 0.997. Given that the threshold to 'moderate concentration' usually corresponds to 0.15 in the *HHI* distribution (Keil, 2019), we suggest that most of the firms in our dataset operate in an environment that is below the accepted border line of concentration.

In this study, we used the logged per capita value of regional budget subsidies and transfers as a proxy for soft budget constraints. We used Treasury data for all subsidies and transfers from the federal to the regional budgets. To bring the data into real terms, regional producer price indices were used.

Figure 1 shows trends in competition and subsidisation.

The figure shows a slight growth tendency for competition over the 7-year period studied, though the trend is not very well-defined in graphs. The median and 25th percentile levels remain mainly flat, and the 75th percentile increases. However, an important pattern emerges for distribution of firms by ownership types for selected levels of competition. More than half of private firms (50.4%) operate in fairly dispersed markets, but this share is even higher for government firms – 61.9% of the sampled SOEs operate in a competitive environment. The level of subsidisation shows a slight growth trend through the period of observation.

Figure 1. Dynamics of the level of competition and subsidies in our data

a) Level of competition

b) Level of subsidisation

Note: Competition is measured as (1 – *HHI*) at the four-digit sectoral level. Subsidisation is a logged per capita sum of all subsidies, subventions and federal transfers to the subnational region. The graphs display the median, 75th and 25th percentile values over the observation period. The dots refer to observations which scores are outside 1.5 × IQR (interquartile range, the difference between the 75th and 25th percentiles).

Source: authors' calculations

4. Results

4.1. The efficiency gap between SOEs and private firms across sectors and time

This section considers whether private firms are superior performers in a state-heavy economy such as Russia (H1). Table 4 shows our first set of results, estimating equation (1) for *TE* as a dependent variable. It compares productivity of private and

state firms without the interaction variables and with robust standard errors. The first two specifications in this Table 4 use two measurements of state ownership: when the firm has any government stake (column 1) and when it is wholly-owned by the state (column 2). Both specifications contain firm size and sector and time fixed effects as controls. The estimated coefficient on the ownership dummy is economically and statistically significant across both specifications, suggesting that SOEs are 7–8 percentage points (p.p.) behind private firms by *TE*. When we change the model specification for robustness check, the obtained result survives: the random effects estimates provided in Appendix A3, Table A3.1 do not differ from the results in Table 4.

Table 4. State ownership as a determinant of technical efficiency in the full sample and across sectors

	Full sample	Full sample	Mining	Manufacturing	Power and energy	Trade	Hotels	Transport	Real estate	Utilities, services
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SOE	−0.079***		−0.077***	−0.095***	−0.077***	−0.054***	−0.103***	−0.095***	−0.088***	−0.086***
	(0.001)		(0.0 12)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)
Wholly-owned SOE		−0.072***								
		(0.000)								
Firm size	0.082***	0.082***	0.048***	0.071***	0.045***	0.087***	0.115***	0.082***	0.093***	0.098***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
2010	−0.002***	−0.002***	−0.005	−0.005***	0.003	0.003***	0.004	−0.010***	−0.007***	0.005
	(0.001)	(0.001)	(0.008)	(0.002)	(0.006)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
2011	−0.012***	−0.012***	−0.013*	−0.016***	−0.001	−0.005***	−0.001	−0.021***	−0.020***	0.006
	(0.001)	(0.001)	(0.008)	(0.002)	(0.006)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
2012	−0.018***	−0.018***	−0.017**	−0.027***	0.004	−0.006***	−0.001	−0.035***	−0.038***	−0.007
	(0.001)	(0.001)	(0.008)	(0.002)	(0.007)	(0.001)	(0.004)	(0.003)	(0.002)	(0.005)
2013	0.000	0.000	0.002	−0.004**	0.026***	0.007***	0.023***	−0.012***	−0.023***	0.022***
	(0.001)	(0.001)	(0.008)	(0.002)	(0.006)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
2014	0.011***	0.011***	0.005	0.011***	0.038***	0.012***	0.039***	0.003	−0.010***	0.039***
	(0.001)	(0.001)	(0.008)	(0.002)	(0.006)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
2015	0.024***	0.025***	0.006	0.020***	0.055***	0.024***	0.056***	0.012***	0.019***	0.053***
	(0.001)	(0.001)	(0.008)	(0.002)	(0.006)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
Sector controls	included	included								
Sector × Year controls	included	included								
Constant	−1.044***	−1.049***	−0.460***	−0.829***	−0.440***	−1.115***	−1.442***	−0.965***	−1.162***	−1.158***
	(0.006)	(0.000)	(0.015)	(0.004)	(0.013)	(0.003)	(0.009)	(0.008)	(0.005)	(0.011)
Number of observations	826,868	822,273	10,764	171,421	16,989	386,734	32,802	54,067	135,291	18,800
R^2	0.392	0.392	0.214	0.321	0.186	0.408	0.532	0.374	0.459	0.521

Note: This table reports results of pooled OLS regressions of *TE* in the full sample and sectoral subsamples on a dummy variable distinguishing SOEs from privately owned firms and a dummy for wholly-owned SOEs. The set of controls includes logged real value added (Firm size), dummy variables distinguishing industry types, and dummy variables distinguishing years of observation. Robust standard errors are given below the coefficient estimates. Figures for ownership type and accounting statistics are from the Ruslana database. *** – 1%, ** – 5%, and * – 10% level of significance.

Source: authors' calculations

Comparison of columns (1) and (2) reveals that there is no major difference in technical efficiency level depending on the size of the government stake. To test if the gap in technical efficiency level is different in various sectors, we estimate equation (1) on subsamples of eight industrial groups. The results are shown in columns 3–10. The TE of government firms is lower than that of private firms across all sectoral groups, the gap being the highest in manufacturing (9.5 p.p.), hotels (10.3), and transportation (9.5), and the lowest in mining and trade.

Table 4 also shows that, in all specification, the technical efficiency level of both ownership types generally increases with increase of firm size. This correlation confirms the strong link between the economies of scale and technical efficiency.

The *TFP growth* results estimated with the pooled OLS regressions are contained in Table 5. Here again we check the robustness of estimates by changing the model and provide additional results with the random effects in Appendix A3, Table A3.2. The results for *TFP growth* are almost the same as in Table 5 except for significance of the ownership dummy coefficient for transport sector.

Table 5. State ownership as a determinant of the TFP growth rate between 2008 and 2015 in the full sample and across sectors

	Full sample	Full sample	Mining	Manufacturing	Power and energy	Trade	Hotels	Transport	Real estate	Utilities, services
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SOE	−0.005*** (0.000)		−0.014 (0.009)	−0.001 (0.001)	−0.009*** (0.002)	−0.012*** (0.001)	0.009*** (0.001)	0.005*** (0.001)	−0.014*** (0.001)	0.007*** (0.002)
Wholly-owned SOE		−0.004*** (0.000)								
Firm size	0.017*** (0.000)	0.017*** (0.000)	0.008*** (0.001)	0.013*** (0.000)	0.008*** (0.001)	0.023*** (0.000)	0.017*** (0.000)	0.012*** (0.000)	0.014*** (0.000)	0.007*** (0.000)
Sector controls	included	included								
Year controls	included	included	included	included	included	included	included	included	included	included
Sector × Year controls	included	included								
Constant	−0.362*** (0.004)	−0.362*** (0.004)	−0.208*** (0.010)	−0.212*** (0.004)	−0.187*** (0.014)	−0.410*** (0.001)	−0.377*** (0.004)	−0.222*** (0.003)	−0.247*** (0.002)	−0.204*** (0.005)
Number of observations	826,868	822,273	10,764	171,421	16,989	386,734	32,802	54,067	135,291	18,800
R^2	0.169	0.169	0.158	0.044	0.022	0.262	0.175	0.128	0.096	0.087

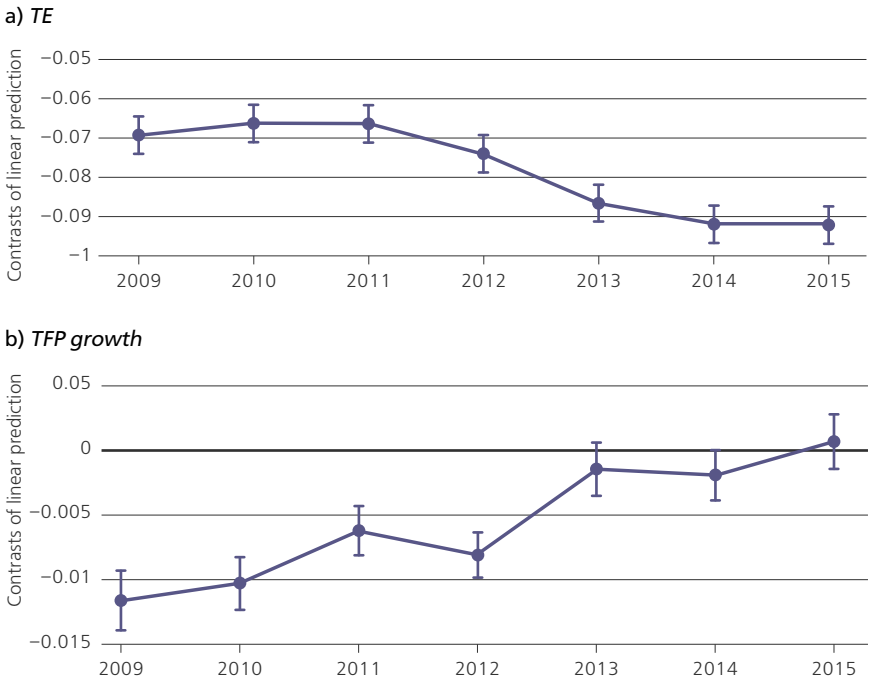
Note: This table reports results of pooled OLS regressions of *TFP growth* in the full sample and sectoral subsamples on a dummy variable distinguishing SOEs from privately owned firms and a dummy for wholly-owned SOEs. The set of controls includes logged real value added (Firm size), dummy variables distinguishing industry types, and dummy variables distinguishing years of observation. Robust standard errors are given below the coefficient estimates. Figures for ownership type and accounting statistics are from the Ruslana database. *** – 1%, ** – 5%, and * – 10% level of significance.

Source: authors' calculations

Superiority of private firms is confirmed for *TFP growth*: the coefficients of SOEs are negative and significant, so TFP seems to grow slower (or decline faster) in the group of government firms than in the group of private firms. TFP growth is also poorer for SOEs compared to private firms if only wholly-owned state firms are considered. However, the results vary considerably across sectors (Table A2 in the Appendix A2). The effect is negative and significant for power and energy, trade and real estate, but is positive and significant for transport, hotels, utilities and services. For manufacturing and mining no statistically significant difference in TFP growth rates between private and government firms is found. Superior efficiency of SOEs in transport and utilities is easy to explain by limited competition and heavy regulation of private firms in these sectors. It is impossible to consider in detail here why private firms in the hospitality industry give surprising results for TFP dynamics.

To find out whether the effects of ownership on technical efficiency level and TFP trends differ in time, we also run regressions containing interaction effects between ownership type, year dummies, and all their pairwise combinations in addition to the other variables. Figure 2 gives a graphic representation of this estimation.

Figure 2. The difference between SOEs and private firms in technical efficiency level and TFP growth rate between 2009 and 2015: average marginal effects



Note: The figure displays the graphical results of pooled OLS regressions (equation (2)). *TE* and *TFP growth* were regressed on ownership types and interaction terms of ownership and year dummies. Vertical lines denote 95% confidence intervals. 'State ownership' means a firm with any government stake.

Source: authors' calculations

The results confirm that SOEs were less efficient than private firms through all years of observation, and the gap increased after 2011 (Figure 2a). The difference in TFP growth rates between SOEs and private firms was statistically significant shortly after the 2008 financial crisis, when SOEs were less dynamic than private firms in their TFP trend (Figure 2b). Since 2013, the differences in TFP growth rates between private and state firms have not been statistically significant.

Taken together, we find that private firms are superior performers in technical efficiency and TFP growth except for some industries. These findings suggest that Russian private firms found their way to more efficient production in spite of market distortions.

4.2. Does higher competition reduce the productivity gap between private and state firms?

As in other sections, we focus here on *TE* and *TFP growth* as dependent variables. Two sets of estimation results are reported. In the first set we test how competition affects firm productivity regardless of ownership type. Columns 1 and 5 of Table 6 show the regression results with the (1 – *HHI*) index as a measure of competition in linear form for *TE* and *TFP growth*. In columns three and seven we include the quadratic form of competition measurement, supposing non-linear effects of competition on productivity. In the second set of regressions, we interact our proxy for competition (again in linear and quadratic form) with the ownership dummy and test the second hypothesis, suggesting that ownership structure interacts with competitive forces and the latter reduces efficiency losses of SOEs.

The evidence in Table 6 backs the expectation that tougher competition should increase a firm's technical efficiency. For the TFP growth rate, the coefficient of competition is significantly negative at 1%. However, the result does not survive the test for non-linearity of correlation between productivity and competition. The outcome – a highly significant coefficient by squared competition – suggests that competition is strongly related to productivity in a nonlinear way and that quadratic form may be more appropriate in this case. The results make clear that the impact of competition on the level and dynamics of firm productivity may be positive or negative depending on the level of competition.

Next, we compare competition effects across ownership categories. To do so, we estimate the same pooled OLS model with effects of interaction between ownership and competition. As before, we estimate the linear and non-linear forms of competition in the ownership-productivity link and show both of the estimated coefficients by the regular and quadratic measurement of competition. The coefficients by interaction term are highly significant, but it is difficult to determine their economic interpretation, especially when the quadratic functional form of competition interacts with the dummy responsible for ownership type.

Table 6. Conditionality of ownership effects on technical efficiency and TFP growth rate by power of competitive pressure

***TE* as dependent variable**				
	Competition	**Interaction of ownership and competition**	**Competition squared**	**Interaction of ownership and competition squared**
	(1)	**(2)**	**(3)**	**(4)**
SOE	−0.079*** (0.001)	−0.139*** (0.017)	−0.080*** (0.001)	0.673*** (0.125)
Competition (1 – *HHI*)	0.033*** (0.003)	0.031*** (0.003)	−0.541*** (0.050)	−0.483*** (0.051)
SOE × competition		0.063*** (0.018)		−1.840*** (0.285)
Competition squared			0.333*** (0.029)	0.298*** (0.029)
SOE × competition squared				1.096*** −0,161
Firm size	0.082*** (0.000)	0.082*** (0.000)	0.082*** (0.000)	0.082*** (0.000)
Sector and year dummies	included			
Constant	−1.078*** (0.004)	−1.076*** (0.004)	−0.835*** (0.022)	−0.858*** (0.022)
Number of observations	822,613	822,613	822,613	822,613
R^2	0.391	0.391	0.391	0.391
***TFP growth* as dependent variable**				
	Competition	**Interaction of ownership and competition**	**Competition squared**	**Interaction of ownership and competition squared**
	(5)	**(6)**	**(7)**	**(8)**
SOE	−0.005*** (0.000)	−0.012* (0.007)	−0.005*** (0.000)	−0.108*** (0.042)
Competition (1 – *HHI*)	−0.040*** (0.002)	−0.040*** (0.002)	0.256*** (0.025)	0.249*** (0.025)
SOE × competition		0.008 (0.007)		0.231** (0.097)
Competition squared			−0.172*** (0.014)	−0.168*** (0.015)
SOE × competition squared				−0.128** (0.056)
Firm size	0.017*** (0.000)	0.017*** (0.000)	0.017*** (0.000)	0.017*** (0.000)
Sector and year dummies	included			
Constant	−0.264*** (0.002)	−0.264*** (0.002)	−0.389*** (0.011)	−0.386*** (0.011)
Number of observations	822,613	822,613	822,613	822,613
R^2	0.221	0.221	0.221	0.221

Note: This table reports results of pooled OLS regressions of *TE* and *TFP growth* in the full sample distinguishing SOEs from privately owned firms with any government stake. The set of controls includes the logged real value added (Firm size), dummy variables distinguishing industry types, and dummy variables distinguishing years of observation. Robust standard errors are given below the coefficient estimates. Figures for ownership type and accounting statistics are from the Ruslana database, competition is calculated from the full population of firms in Ruslana. *** – 1%, ** – 5%, and * – 10% level of significance.

Source: authors' calculations

In order to explore the form and significance of ownership effects on productivity at various levels of competition, we graph the results of estimation of predictive margins of our main dependent variables, as described in Royston (2013), for both ownership types from the regression reported in Table 4 with interaction of ownership and competition in quadratic form. Technically, the margins are estimated at 10 values, equally spaced between the unique values of competition observed in the sample together with the confidence intervals.

The Figure 3a shows that profiles of SOEs and private firms are statistically different over most of the range of competition values, except for very concentrated markets with competition level below 0.6. Private firms are generally more efficient than SOEs by technical efficiency at a given level of competition. We observe that the difference in the levels of technical efficiency between the ownership types is largest at a competition level of about 0.8, which is the point usually identified as a threshold for moderate competition. As regards the TFP growth rate (Figure 3b), private firms generally perform better that SOEs at all levels of competitive pressure, though the difference is biggest when competition is low and is reduced when competition is high.

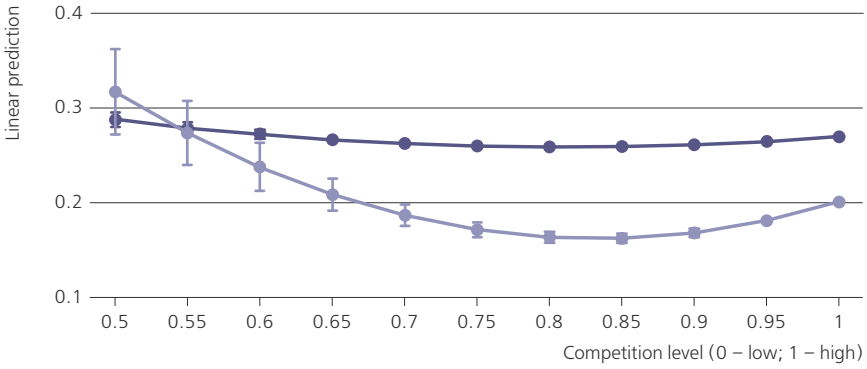
In order to study which ownership type is more sensitive to growth of competitive pressure, we use the graphic analysis of results for interaction of ownership and competition in quadratic form in Figure 4, which shows the OLS line for average marginal effect of selected levels of competition across ownership types. It is clear from the graph that the effect of competition on technical efficiency level differs significantly by ownership type. The effects of low competition are negative for both ownership types up to the value of 0.85, and the negative effect is significantly lower for private firms than for SOEs. At levels of competition above the moderate threshold the effect on technical efficiency level is positive for both ownership types and is substantially higher for SOEs.

The observed regularity for TFP growth rates is significantly different from technical efficiency levels. We cannot say that the effects of competition on the TFP growth rate significantly differ between private and government firms: the lines are almost parallel and confidence intervals overlap, except for very concentrated markets. The only conclusion is that, for both ownership types, effects of competition on the TFP growth rate are positive at a low level of competition and negative at a high level, the threshold being 0.8.

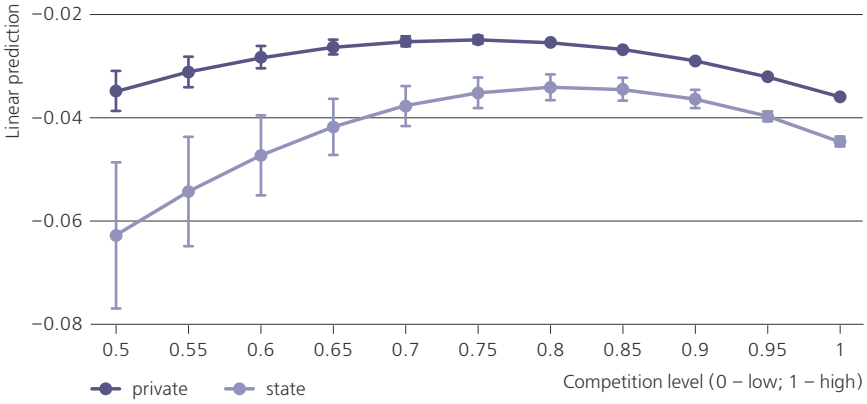
To check the robustness of the results, we also evaluated the regressions separately for industry and services. In spite of smaller subsamples, the estimates obtained do not differ significantly from the regressions for the full sample. Though we have reason to suggest that the resulting effects are more pronounced in the mining and manufacturing industries than in services, where the trends are less straightforward, but they persist (see Figure A4.1 in Appendix A4).

Figure 3. Predictive margins of *TE* and *TFP growth* at various levels of competition for SOEs and private firms with pointwise 95% confidence intervals

a) Competition and *TE*



b) Competition and *TFP growth*



Note: The graph shows results from pooled OLS regression with interactions. Competition levels are equally spaced in ten values over the full range of observed (1 – *HHI*) in the sample. Vertical lines denote 95% confidence intervals.

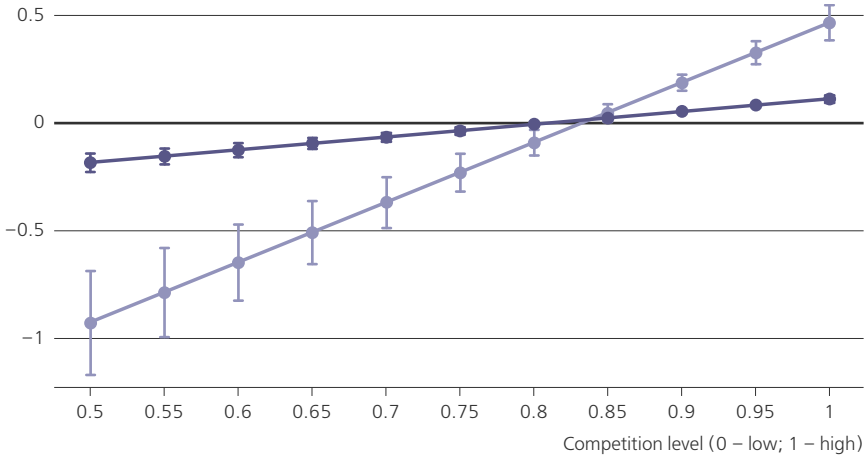
Source: authors' calculations

To summarise, our results offer evidence for strong effects of ownership in the competitive environment. In this respect, our results confirm the finding of the seminal paper by Boardman and Vining (1989) for productivity and profit rates of large listed non-US companies in the competitive environment. The findings support hypothesis H2, which predicted that competitive forces reinforce the productivity benefits of private firms and reduce efficiency losses of SOEs: private ownership shows productivity advantages at all levels of competition except for very concentrated markets. There is some complementarity between private ownership and competition in respect of technical efficiency at moderate and higher levels of competition. The expectation that productivity of SOEs

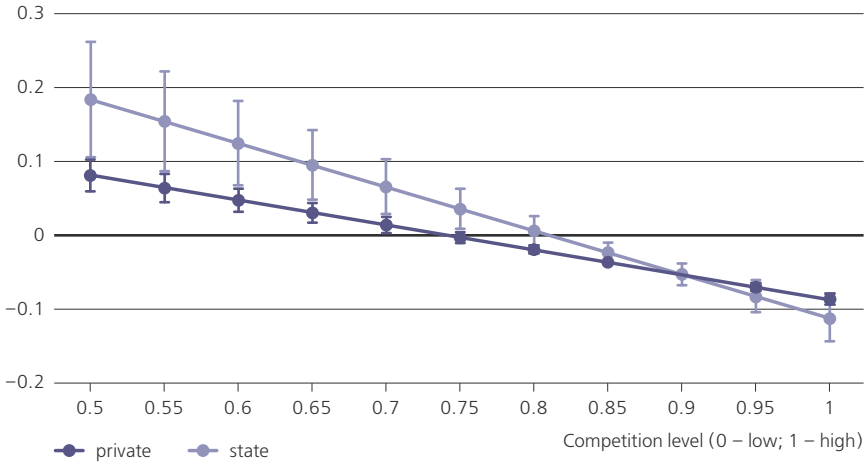
may be improved by growth of competition is also supported in our data: the effects of competition on technical efficiency are positive and significant once a moderate level of competition is reached. But the finding for TFP growth rate as performance measure conflicts with hypothesis H2, and we do not find any complementarity between private ownership and competition in this case.

Figure 4. Graphical analysis of the interaction of ownership structure and competition: average marginal effects for *TE* and *TFP growth*

a) Competition and *TE*



b) Competition and *TFP growth*



Note: The graphs display the results of pooled OLS regressions, when equation (3) is estimated for *TE* and *TFP growth*, and interaction terms of the ownership type and competition (1 – *HHI*) in a quadratic form are included. Vertical lines denote 95% confidence intervals.

Source: authors' calculations

4.3. Will harder budget constraints reduce the efficiency loss for state ownership?

Our next section tests the theoretical prediction in Shleifer and Vishny (1994) that soft budget constraints induce inefficient behaviour of state firms and reduce the productivity benefits of private firms. We examine H3, which suggests that hardening of budget constraints will encourage more productive behaviour of both ownership types.

Table 7 shows the results of estimation of equation (4) for the effects of subsidies on technical efficiency levels and TFP growth rates (columns 1 and 5) and interaction of ownership type with subsidies measured in linear from (columns 2 and 6) and quadratic form (columns 3 and 8).

As before, private firms have benefits over SOEs regarding both technical efficiency level and TFP trends, by 5–8 p.p. depending on specification. Location of the firm in a region with softer budget constraints lowers the technical efficiency level and the TFP growth rate: if per capita subsidies in the region grow by 1% the technical efficiency level of the firm decreases by 0.8 p.p., and TFP growth declines by 0.5 p.p. (columns 1 and 5 for the linear specification).

The answer to the question whether SOEs benefit more than private firms from rents provided by subsidies is not simple. Figure 5 presents the regression results from columns 4 and 8, showing that private firms have technical efficiency advantages over SOEs at all levels of subsidies (Figure 5a). It can be seen that the efficiency gap is minimal at a high level of subsidies. This finding seems to partly confirm the theoretical prediction that soft budget constraints should reduce the productivity benefits of private firms. The expectation that soft budget constraints induce inefficient behaviour by state firms is not confirmed in our data. The conclusion is suggested even more forcefully by the *TFP growth* equation (Figure 5b): private firms have TFP growth advantages over SOEs only up to a certain threshold of high subsidisation, after which the difference between ownership types is not statistically significant.

Further economic interpretation of interaction effects of ownership and squared subsidies within ownership types is provided by Figure 6, which graphs the *TE* and *TFP growth* line for the average marginal effects of selected levels of regional subsidisation, as done before for the interaction of ownership and sectoral competition. The results for *TE* confirm that the effects of subsidies for SOEs are somewhat higher and statistically different from the effects for private enterprises at the mean level of subsidisation, where the majority of observations are located. In this case, the subsidisation effects for SOEs are either zero or positive, and mostly negative for private enterprises. Subsidies significantly reduce technical efficiency at low levels and increase it at high levels, with no statistically significant difference between private and government enterprises at very low and very high levels. Almost the same trends are observed for TFP growth rates (Figure 6b).

Table 7. Conditionality of ownership effects on technical efficiency and TFP growth rate by the hardness of budget constraints

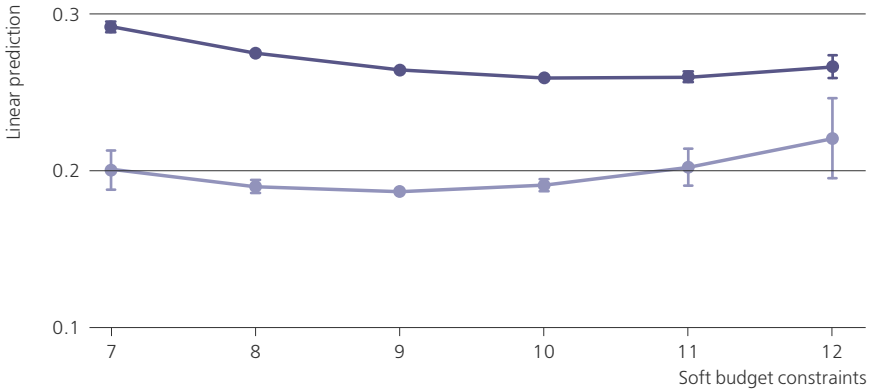
***TE* as dependent variable**				
Variables	**Subsidies**	**Interaction of ownership and subsidies**	**Subsidies squared**	**Interaction of ownership and subsidies squared**
	(1)	**(2)**	**(3)**	**(4)**
SOE	−0.078*** (0.001)	−0.164*** (0.015)	−0.078*** (0.001)	−0.090 (0.120)
Subsidies	−0.008*** (0.000)	−0.008*** (0.000)	−0.062*** (0.007)	−0.059*** (0.007)
SOE × subsidies		0.010*** (0.002)		−0.006 (0.027)
Subsidies squared			0.003*** (0.000)	0.003*** (0.000)
SOE × subsidies squared				0.001 (0.001)
Firm size	0.082*** (0.000)	0.082*** (0.000)	0.082*** (0.000)	0.082*** (0.000)
Sector and year dummies	included			
Constant	−0.246*** (0.025)	−0.975*** (0.005)	−0.971*** (0.005)	−0.737*** (0.030)
Number of observations	826,868	826,868	826,868	826,868
R^2	0.391	0.391	0.391	0.391
***TFP growth* as dependent variable**				
Variables	**Subsidies**	**Interaction of ownership and subsidies**	**Subsidies squared**	**Interaction of ownership and subsidies squared**
	(5)	**(6)**	**(7)**	**(8)**
SOE	−0.005*** (0.000)	−0.048*** (0.006)	−0.005*** (0.000)	−0.036 (0.049)
Subsidies	−0.003*** (0.000)	−0.004*** (0.000)	−0.009* (0.005)	−0.008 (0.005)
SOE × subsidies		0.005*** (0.001)		0.002 (0.011)
Subsidies squared			0.000 (0.000)	0.000 (0.000)
SOE × subsidies squared				0.000 (0.001)
Firm size	0.017*** (0.000)	0.017*** (0.000)	0.017*** (0.000)	0.017*** (0.000)
Sector and year dummies	included			
Constant	−0.269*** (0.003)	−0.267*** (0.003)	−0.243*** (0.023)	−0.246*** (0.025)
Number of observations	826,868	826,868	826,868	826,868
R^2	0.162	0.162	0.162	0.162

Note: This table reports results of pooled OLS regressions of *TE* and *TFP growth* in the full sample distinguishing SOEs from privately owned firms with any government stake. The set of controls includes the logged real value added (Firm size), dummy variables distinguishing industry types, and dummy variables distinguishing years of observation. Robust standard errors are given below the coefficient estimates. Figures for ownership type and accounting statistics are from the Ruslana database, subsidies are the logged per capita sum of all subsidies, subventions and federal transfers to the subnational region calculated using official statistics. *** – 1%, ** – 5%, and * – 10% level of significance.

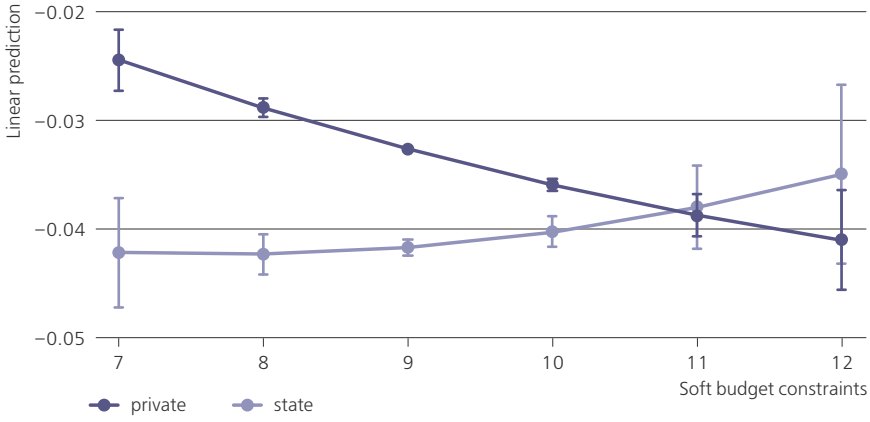
Source: authors' calculations

Figure 5. Predictive margins of *TE* and *TFP growth* at various subsidy levels for SOEs and private firms

a) Soft budget constraints and *TE*



b) Soft budget constraints and *TFP growth*



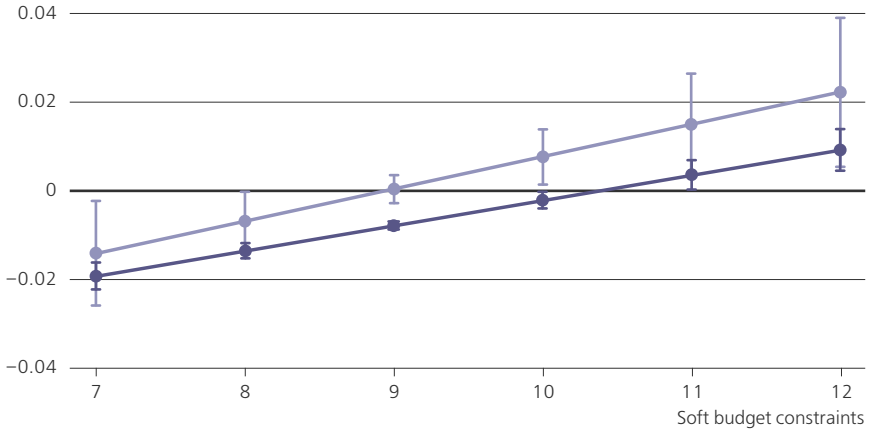
Note: The figure shows the results from pooled OLS regression with interactions. Subsidisation levels are equally spaced in six values over the full range of observed values in the sample. Vertical lines denote 95% confidence intervals.

Source: authors' calculations

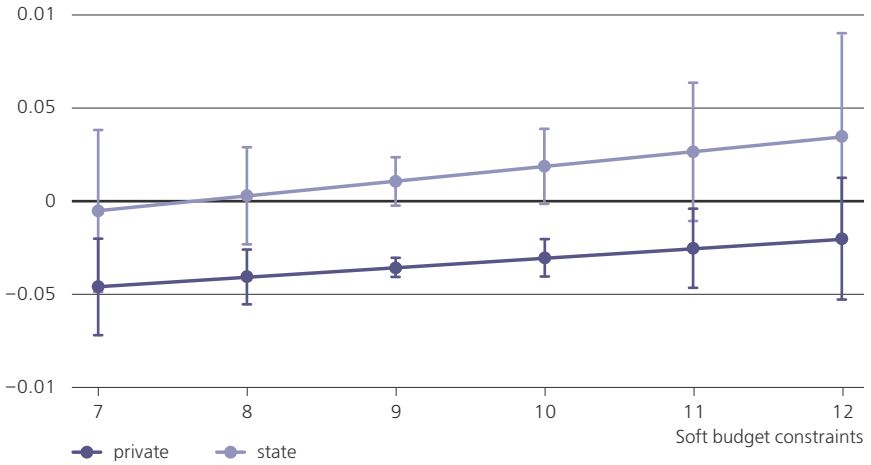
If we consider the mining and manufacturing industries, and the service sector separately, we see that in the extractive and manufacturing industries, an increase in subsidies is negatively associated with *TE* and *TFP growth* for private enterprises. At the same time, the effect on state-owned enterprises does not statistically differ from zero in these industries. It seems that the positive effects of subsidies on efficiency and TFP growth for SOEs at the mean level of subsidisation, reported for the full sample, are mostly driven by the enterprises grouped in services (see Figure A4.2 in Appendix A4).

Figure 6. Graphical analysis of the interaction of the ownership structure with soft budget constraints on *TE* and *TFP growth*

a) Soft budget constraints and *TE*



b) Soft budget constraints and *TFP growth*



Note: The graphs display the results of pooled OLS regressions, when equation (4) is estimated for *TE* and *TFP growth*, and interaction terms of ownership type and subsidies are included. 'State ownership' means a firm with any government stake. Soft budget constraints are the logged per capita sum of all subsidies, federal transfers, and subventions across host regions.

Source: authors' calculations

Summarising, we conclude that SOEs benefit more from regional rents than private enterprises. The efficiency advantages of private enterprises are lowered by soft budget constraints. We did not find sufficient evidence to suggest that harder budget constraints will make SOEs more efficient, as the privatisation literature usually claims. Thus, the hypothesis H3 is not confirmed in our data.

5. Conclusions

This paper contributes to the literature, which seeks ways of organizing government enterprises more successfully in order to reduce efficiency loss from public ownership. The efficiency loss itself is fully confirmed: this research shows superiority of private firms in technical efficiency. The result appears consistent in direction and economically significant across all equations on the full sample, for all years of observation and across all sectors. In the period under study, throughout the entire sample, we also observe lower rates of TFP decline among private enterprises compared to state-owned ones. However, the results for TFP growth vary across sectors. The effect is negative and significant for power and energy, trade and real estate, but is positive and significant for transport, hotels, utilities and services. For manufacturing and mining no statistically significant difference in TFP growth rates between private and government firms is found.

We have answered the question whether more intense competition and harder budget constraints can make SOEs more efficient in the context of a recently privatised economy with a troubled macroeconomic situation, barriers to entry, and growing subsidisation. The study shows that productivity level and trends of SOEs depend on the strength of competition and the size of subsidies. Competition above a medium level is a powerful instrument for improving performance of government firms. On the other hand, from a political perspective, our findings suggest that governments should be cautious about introducing competition in scale-intensive SOE value chains. It seems that competition becomes an effective regulatory tool only at a high level of competitive pressure. Exposure to a minor level of competition may not help achieve efficiency goals.

An important finding is that private ownership superiority is maintained in competitive markets, so the theoretical expectation that ownership may not matter if competition is strong is not confirmed. The findings imply that regulation favouring competition is always a desirable complement to privatisation, making both ownership types more efficient. Our hypothesis regarding subsidies is not confirmed: harder budget constraints will not make government firms more efficient.

The research, which we have carried out, has certain limitations. Our sample does not include the giants like Gasprom, Rosneft, Russian Railways, and other firms organised as conglomerates. Of course, these firms should be subject to quantitative analysis with the focus on the ownership structure. However, their remarkable specificity in terms of production processes, organisation, competition, and international integration make them incomparable to the majority of enterprises at the Russian market. Quantitative studies of the largest companies may be subject for future research.

In addition, our analysis does not address important issues, which may become focal for future research into the economics of SOEs in the post-COVID-19

world. For example, it is difficult to ignore the increased role of government firms as social safety nets for millions of workers in the public sector, with protected jobs and salaries, and the possible trade-off between social safety and efficiency. As regards technicalities, our productivity indicator may be somewhat biased due to mismeasurement of labour costs and price indexes at an over-aggregated level. Thirdly, it would be interesting to test whether the results hold for new sectors, which did not exist in the pre-privatisation period, as they are less path-dependent than mature industries and are probably more immune to the institutional specificities of state-heavy capitalism.

Appendices are available at
https://rjmf.econs.online/en

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