

PRODUCTIVITY TRENDS IN RUSSIAN INDUSTRIES: FIRM-LEVEL EVIDENCE

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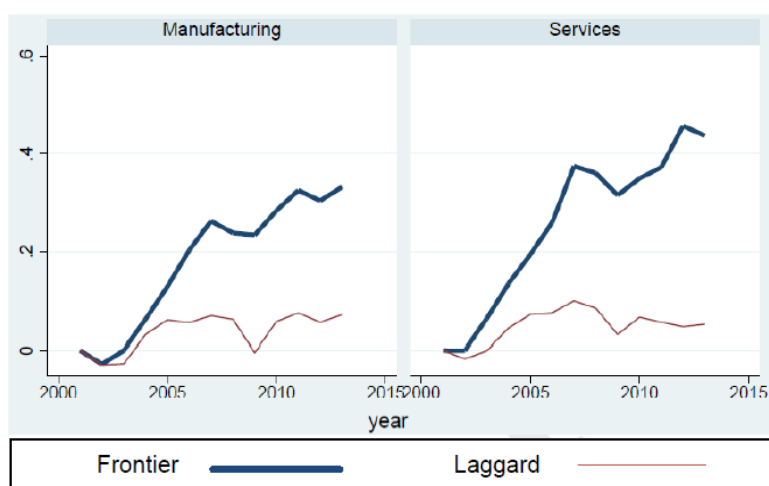
Summary

High productivity heterogeneity can be found in Russian economy even in narrowly defined industries. We show that low productivity firms grow faster than high-productivity ones. However as the catching up impulse is concentrated in small group of low-productivity entrants, it does not lead to closing the gap between productivity leaders and others. Instead the gap to the frontier widens, which we confirm with SFA models. One possible explanation of this result is regional heterogeneity of Russian economy.

1. Increasing gap between productivity leaders and others

Recent studies which analyze Russian productivity micro data (Bessonova, 2018) show the wide gap between productivity leaders and others even in narrowly defined industries. This is not unique for Russia, but also can be found in other countries. As Syverson (2011) shows, productivity is highly heterogeneous not only in emerging countries, but also in advanced countries, such as the USA.

Figure 1. Labour productivity in OECD countries, accumulated growth by efficiency groups



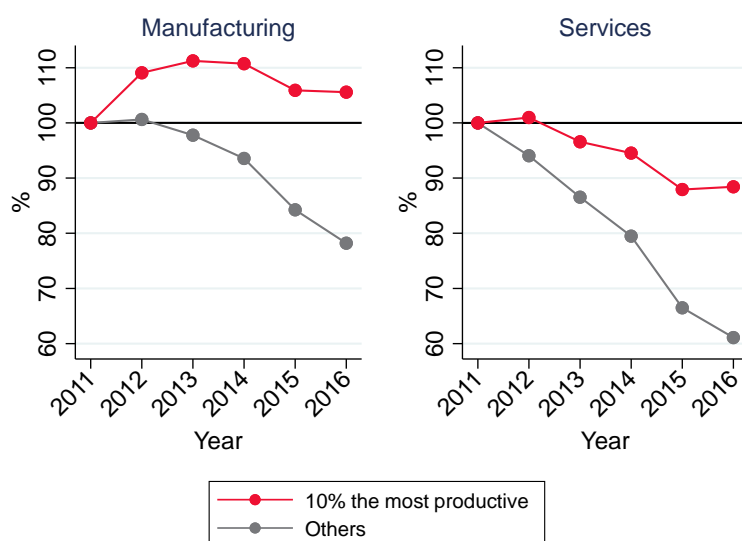
Source: Andrews et al. (2016).

What distinguishes the results obtained in Russia from those presented in the literature is nature of performance in groups of productivity leaders and others. Andrews et al. (2016) present that the gap to productivity frontier widens in OECD countries. This is

result of superior performance of productivity leaders, while the others grow slower or stagnate (Figure 1).

As in OECD countries, in Russia the gap between most productive firms and other widens. However, in OECD countries the group of leaders in service sector is more dynamic, than in manufacturing. In Russia productivity of this group of firms, on the contrary, declines. Moreover in both sectors productivity of other firms decreases (Figure 2).

Figure 2. Labour productivity Russia, accumulated growth by efficiency groups



Source: Research&forecasting department estimates.

In order to analyze gap to productivity frontier in Russian industries we use firm-level data which comes from Ruslana database. We use data on revenue, number of employees, fixed assets, costs of goods sold, labour costs, date of incorporation. As output measure we use value added constructed as revenue less costs of goods sold plus labour costs. As value added deflator we use producer price indices for industrial production and value added deflator for other industries. We construct fixed assets price indices using data on nominal value of fixed assets and its volume.

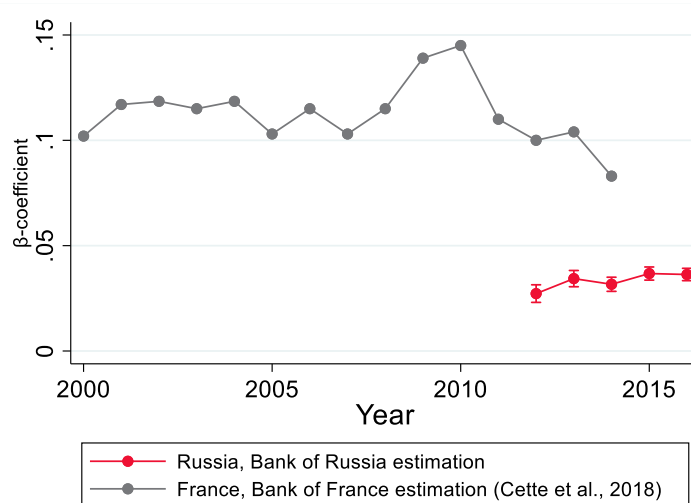
We include into analysis only firms with more than 10 employees from the following sectors: mining and quarrying, manufacturing, utilities, wholesale and retail trade, hotels and restaurants, transportation and communications, business services, other services. Our sample includes increasing number of firms from 34,609 in 2011 to 71,465. On average our sample presents 25% of number of employees reported by Rosstat.

2. Slow β -convergence

There are two main types of productivity convergence analysis. The first type focuses on the dispersion of productivity level. Process of heterogeneity decline is called σ -convergence, while the process of heterogeneity increase is called σ -divergence. From this point of view σ -divergence can be found in Russia as well as in OECD countries (Berlingieri et al. 2017), since the dispersion of productivity level increases.

However there is another type of convergence analysis, which is called β -convergence. The precondition for this type of convergence is faster growth of less productive firms. In other words, if there is positive correlation between productivity growth and the initial distance to the frontier, then it is said, that β -convergence is found.

Figure 3. β -convergence speed in Russia is slower than in France



Source: Cette et al. (2018), research&forecasting department estimates.

In almost all studies on firm-level data β -convergence is found. As Andrews et al. (2016) and Cette et al. (2018) show correlation between the productivity growth and initial distance to the frontier is positive. Less productive firms on average perform better in terms of growth rates.

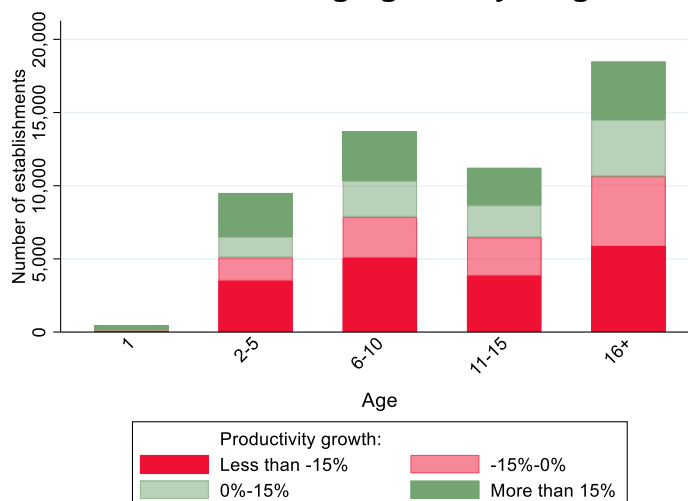
In order to conduct β -convergence analysis we divide our sample into 173 narrow industries, which allow us to assume relatively homogeneous production process within these industries. In each industry we define productivity frontier as median of productivity of 5% of the most productive firms.

Regression analysis shows that the correlation between productivity growth and the initial distance to the frontier is positive which confirms β -convergence. However, the convergence rate is much slower, than in other countries (Figure 3). Our estimates is closer to convergence rate between countries (Abreu et al., 2005), than between firms within one industry in a country with advanced market.

The reason for low convergence rates is concentration of catching up impulse in group of market entering firms. During first years of life their productivity increases rapidly,

however after one year or two the catching up growth dies out. The share of fast growing extremely young firms is small. Moreover, among groups of older firms the share of firms performing stagnation or decline in terms of productivity is significantly greater (Figure 4).

Figure 4. The number of high growth young firms is low



Source: Research&forecasting department estimates.

Since the driver of β -convergence is small group of young firms, their catching up impulse is not enough for firms in all age groups to close the gap to the frontier. As a result despite positive correlation between productivity growth and the initial distance to the frontier, heterogeneity of productivity doesn't decline. On the contrary the distance between productivity leaders and others increases.

3. Productivity divergence

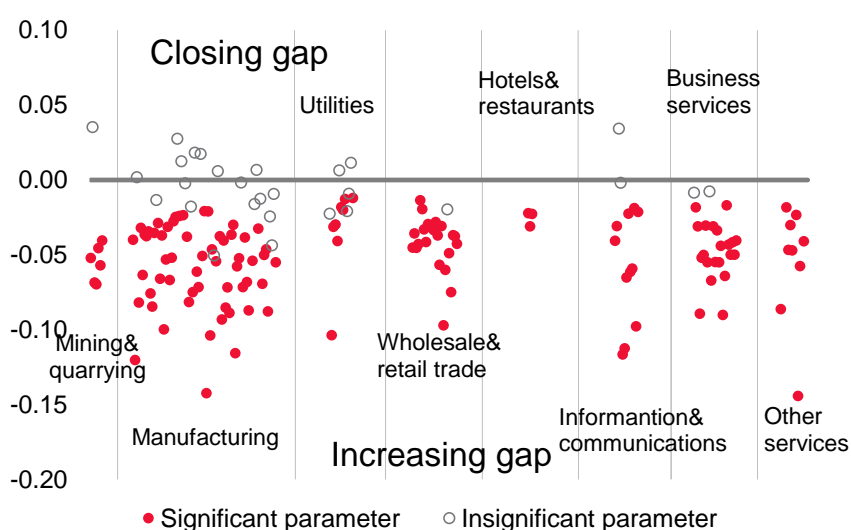
In order to verify whether the distance to the frontier increases despite β -convergence we estimate stochastic frontier models. Applying this type of models we assume that there is production frontier within each narrowly defined industry. In contrasts to productivity frontier, which we use in previous section, it determines the maximum possible level of production given level of both labour and capital inputs. The most productive firms operate on production frontier, fully utilizing their resources. Less effective firms do not fully utilize their resources and produce less output. As consequence there is the gap to the production frontier. The further the firm from the production frontier, the less efficient it is.

Panel data allow us to model how performance changes over time. For production frontier we adopt translog specification. And for inefficiency component - time varying decay specification, following (Battese и Coelli, 1992): $u_{it} = G(t)u_i$, $G(t) = e^{\gamma(t-T)}$, where u_i is the time invariant component of inefficiency, $u_i \sim N^+(0, \sigma_u^2)$, $G(t)$ is the time function, γ is the decay parameter, T is the terminal period. γ is the parameter indicating convergence or divergence. The advantage of this type of models is that we estimate production frontier, the distance to it, and its changes simultaneously.

Results of our stochastic frontier models show that in 32 out of 173 the distance to the frontier does not increase or decrease over sample period. In other words we do not find convergence or divergence. Whereas in 139 out of 173 we find that the distance to the frontier increases over sample period (Figure 5). We confirm that in most industries firms diverge from the production frontier. This indicates increasing productivity heterogeneity even within narrowly defined industries.

Thus our stochastic models estimates confirm the result, that, as in other countries (Andrews et al., 2016, Cette et al., 2018), β -convergence in Russian industries doesn't lead to productivity heterogeneity decline.

Figure 5. Convergence estimates based on SFA analysis



Source: Research & forecasting department estimates.

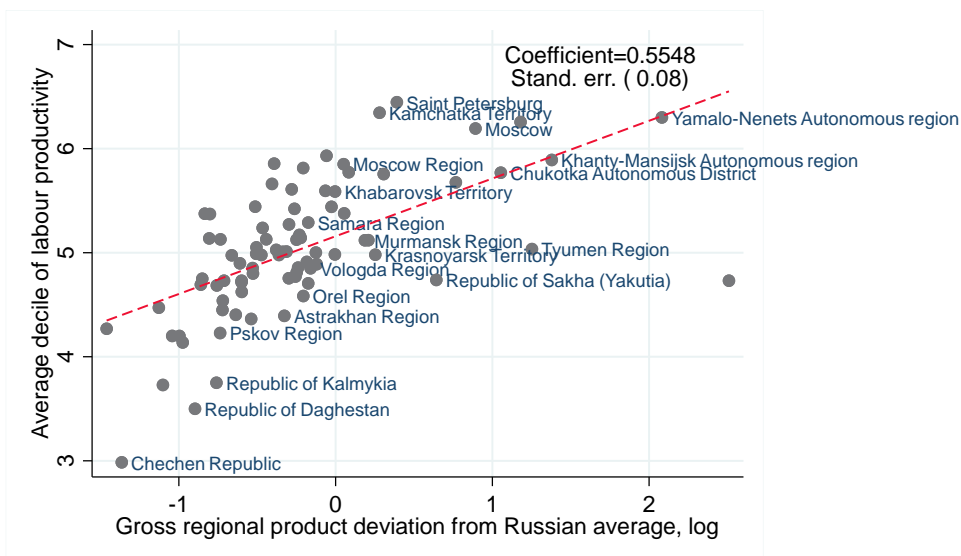
One of the reasons of wide gap between productivity leaders and others in Russian industries may be high regional heterogeneity. The companies might operate only on the local level and face obstacles impeding their expanding to the federal level. Therefore despite less effective firms belong to the same industry as more effective they do not have an opportunity to learn from productivity leaders. They interact only with local competitors, which are also low efficient. As consequence the conditions for lack of convergence of less productive firms to the frontier maintain.

Since the distribution of productivity levels is unique in each narrowly defined industries, we use productivity deciles in order to compare firms from different industries. First decile includes 10% of the firms with the lowest level of labour productivity, while the tenth decile includes 10% with the highest level of productivity. Enterprises from different industries can be compared this way. If the firm belongs to the higher decile than the other, then it can be considered as relatively more productive.

We use the difference between the log gross regional product (GRP) per capita and the log average GRP per capita in Russia as an indicator of the region development. This measure indicates the relative position of region among other regions. We find positive

correlation between relative GRP per capita and productivity decile averaged by all enterprises in region regardless the industry (Figure 6). This indicates that efficient firms tend to be located in economically more developed regions. We may conclude that regional differences might affect the rate of convergence to the productivity frontier.

Figure 6. Positive correlation between region development and firms' performance



Source: Research&Forecasting department estimates.

The productivity heterogeneity is high even in narrowly defined industries. This is true as for Russia, and for other countries (Syverson, 2011). Applying β -convergence approach, we conclude that there is a positive correlation between the productivity growth rate and the initial distance to productivity frontier. However, as in other countries (Andrews et al., 2016, Cette et al., 2018), in Russian industries β -convergence does not allow us to draw a conclusion whether the gap between productivity leaders and others widens or narrows.

Our analysis shows, that among low productivity firms catching up impulse is concentrated in small group of young fast growing firms. As consequence β -convergence we find is not enough to reduce the distance to frontier in the whole industry. On the contrary the gap between the most efficient firms and the others widens. In order to verify this result we apply stochastic frontier models. The advantage of this method is simultaneous estimation of the production frontier, the distance to it, and effectiveness changes over time. We confirm the conclusion that the distance to the frontier increases in the most industries.

One of the reasons why the gap between the productivity leaders and others maintains might be high regional heterogeneity. Our analysis shows that high productivity firms tend to be located in economically more developed regions. It is possible, that the most enterprises operate only at local level, and do not compete with productivity leaders at federal level. The lack of interaction between them makes the convergence of low productivity firms to the frontier difficult.

Literature

1. Bessonova E., (2018) Analysis of Russian firms' TFP growth in 2009-2015. *Voprosy Ekonomiki*, No. 7, pp. 96—118 (In Russian).
2. Abreu, M., De Groot, H. L., and Florax, R. J. (2005). A meta-analysis of β -convergence: The legendary 2%. *Journal of Economic Surveys*, 19(3), 389-420.
3. Andrews, D., Criscuolo, C., and Gal, P. N. (2016). The best versus the rest. OECD Productivity Working Papers, No. 5, OECD Publishing, Paris.
4. Battese, G. E., Coelli, T. J. (1992). Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India. *Journal of productivity analysis*, 3(1-2), 153-169.
5. Berlingieri, G., P. Blanchenay and C. Criscuolo (2017), The great divergence(s), OECD Science, Technology and Industry Policy Papers, No. 39, OECD Publishing, Paris.
6. Cette, G., Corde, S., and Lecat, R. (2018). Firm-level productivity dispersion and convergence. *Economics Letters*, 166, 76-78.
7. Syverson, C. (2011). What determines productivity? *Journal of Economic literature*, 49(2), 326-65.