



Bank of Russia

PRODUCTIVITY TRENDS IN RUSSIAN INDUSTRIES: FIRM-LEVEL EVIDENCE

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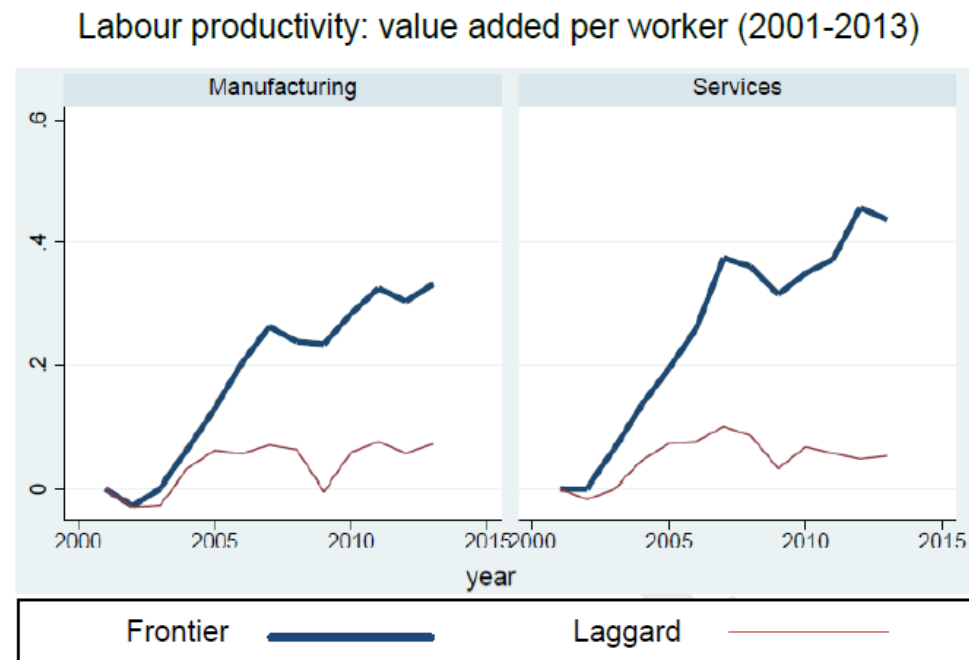
2020



Thanks to access to firm-level data we can analyze what stands behind the aggregate productivity trends

Almost all studies concerning convergence show that productivity growth is negatively correlated with initial level of productivity (Griffith et al. 2009, Andrews et al. (2016) and Cette et al. (2018))

However despite fast growth of laggards the gap between them and leaders is wide and keeps growing (Berlingieri, Blanchenay, Calligaris, Criscuolo, 2017).



Source: Andrews D, Criscuolo C, Gal P (2016) *The best versus the rest: The global productivity slowdown, divergence across firms and the role of public policy*. OECD Productivity Working Papers, No. 5, pp. 1-50



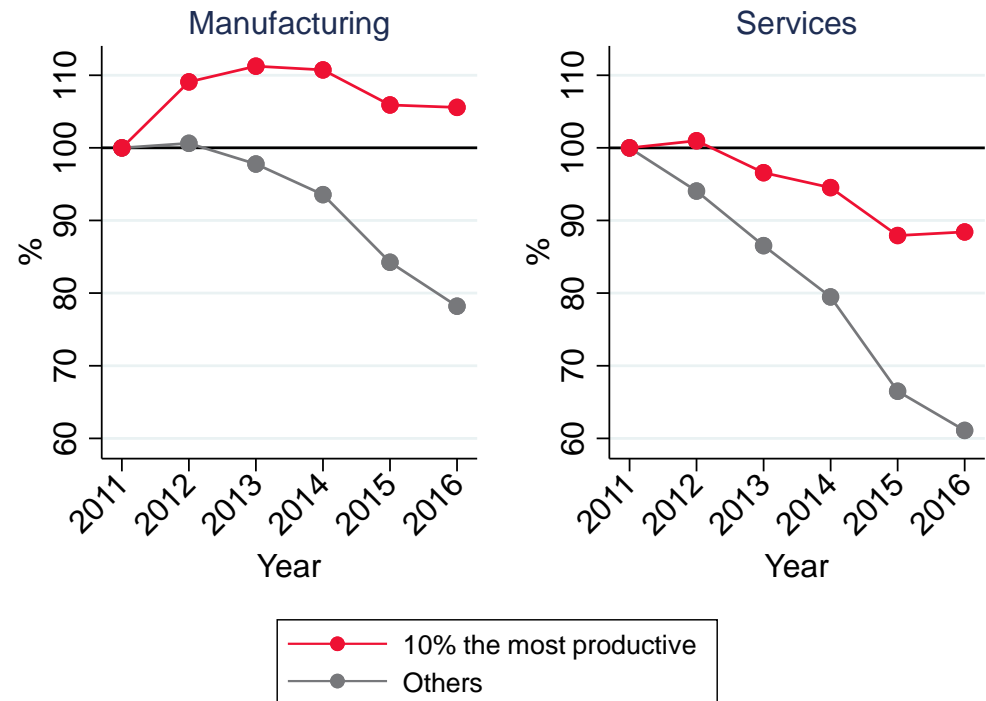
Leaders in Russia do not grow as fast as in OECD countries

We show that the productivity gap between the leaders and other firms in Russia also increases.

However leaders do not grow as fast as in OECD countries, while the productivity of other firms even declines.

We verify our results and confirm divergence by means of SFA.

Labour productivity accumulated growth, %



Data on Russian establishments

- We use Ruslana database, which includes establishments' financials, data on labour
- 2011-2016 data includes: revenue, fixed assets, number of employees, cost of sales, labour cost, date of incorporation

Value added = revenue – cost of sales + labour cost

$$\text{Labour productivity} = \frac{\text{Value added}}{\text{Number of employees}}$$

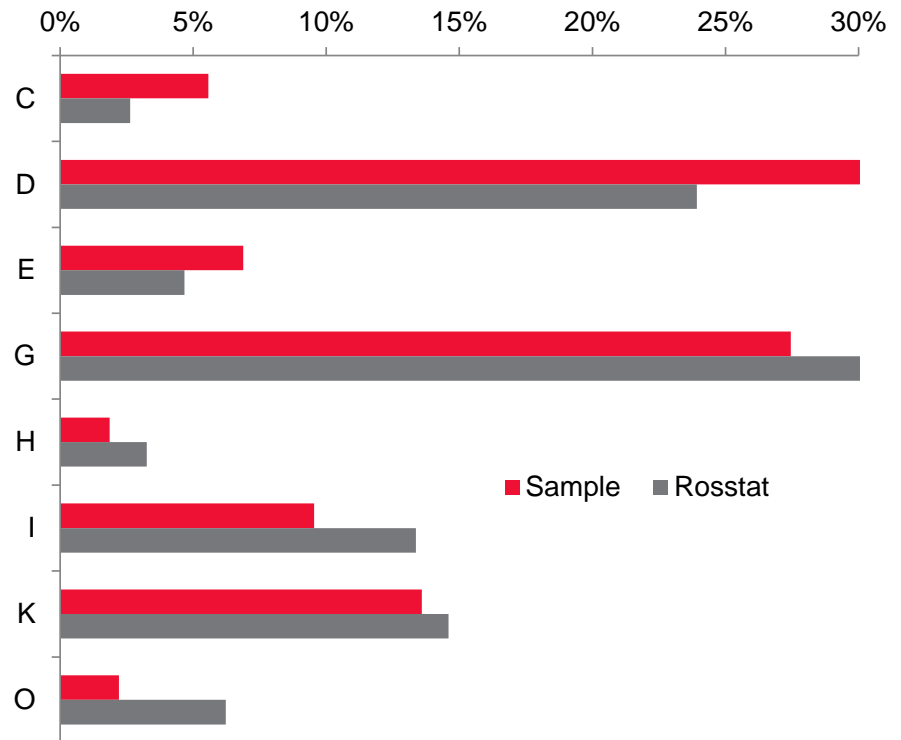
Sector	2011	2012	2013	2014	2015	2016
C Mining	916	960	1 226	1 417	1 508	1 378
D Manufacturing	9 327	9 530	12 707	14 668	15 579	16 376
E Utilities	2 154	2 136	2 829	3 253	3 543	3 680
G Wholesale and retail trade	8 930	10 755	17 417	22 544	24 207	25 633
H Hotels and restaurants	973	978	1 479	1 706	1 875	1 873
I Transportation and communications	3 172	3 384	4 635	5 405	5 820	6 109
K Business services	7 531	7 980	11 412	14 457	16 262	17 705
O Personal and other services	1 606	1 556	2 407	2 671	2 671	2 707
Total	34 609	37 279	54 112	66 121	71 465	75 461



Data on Russian establishments

- We exclude firms with number of employees less than 10
- Unbalanced panel made up of between 34 609 in 2011 and 75 461 in 2016
- On average our sample includes 25% of employees in selected sectors
- Distribution of employees between sectors is very close to Rosstat's
- We divide our sample into 173 industries (at 3-4 four digit level of OKVED). Within each industry we find groups of productivity leaders and estimate SFA models

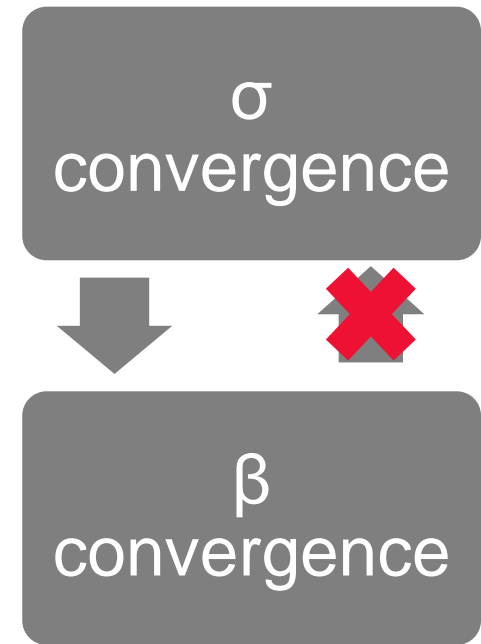
Sectors' shares in total employment





Differences between β - and σ - convergence

	β convergence	σ convergence
When convergence is found	Laggards' productivity grow faster than leaders' productivity	Dispersion of productivity decreases
Sample	Only establishments present in sample for two consecutive years (survival bias)	All establishments
Permutation sensitivity	Permutation is regarded as convergence	Permutation is not regarded as convergence



β -convergence

$$\Delta lp_{it} = \beta_0 + \beta_1 gap_{it-1} + controls$$

Δlp_{it} labour productivity growth

gap_{it-1} distance to frontier (frontier is defined as the average productivity among 10% the most productive firms in each of 173 industries)

Controls include dummies for years, sectors, size; as well as age and age squared

Productivity growth negatively correlated with the initial level of productivity.

This result is robust to different specification, including estimation of multifactor productivity instead of labour productivity

	Δlp	Coef.	Std. Err.	95% Conf. Interval	
gap_{t-1}		0.03***	0.001	0.03	0.04
<i>year</i>					
2013		-0.03***	0.004	-0.03	-0.02
2014		-0.02***	0.004	-0.03	-0.01
2015		-0.08***	0.003	-0.08	-0.07
2016		-0.1***	0.003	-0.02	-0.01
<i>sector</i>					
D		-0.01	0.007	-0.02	0.00
E		-0.02***	0.008	-0.04	-0.01
G		-0.07***	0.007	-0.08	-0.05
H		-0.03***	0.009	-0.05	-0.01
I		-0.02***	0.007	-0.034	-0.005
K		-0.04***	0.007	-0.06	-0.03
O		-0.04***	0.008	-0.06	-0.02
<i>size</i>					
2		0.09***	0.002	0.08	0.09
3		0.09***	0.003	0.08	0.09
<i>age</i>		-0.003***	0.000	-0.003	-0.003
<i>age</i> ²		0.00002***	0.000	0.00001	0.00002
<i>const</i>		-0.10***	0.008	-0.12	-0.09

Number of obs 201,920

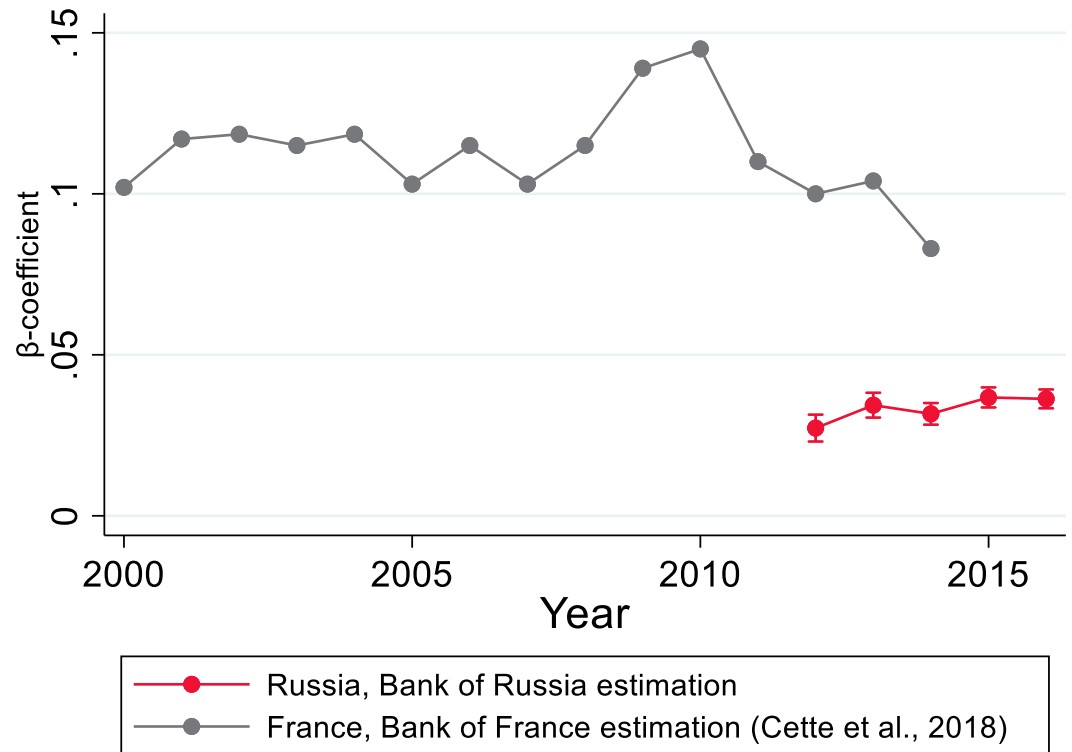
Adj. R-squared 0.023

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



β -convergence

- β_1 is lower than reported estimation for France convergence coefficients
- Estimations are closer to convergence coefficients between countries (famous 2%) than firms within one country.





β- convergence by years and sectors

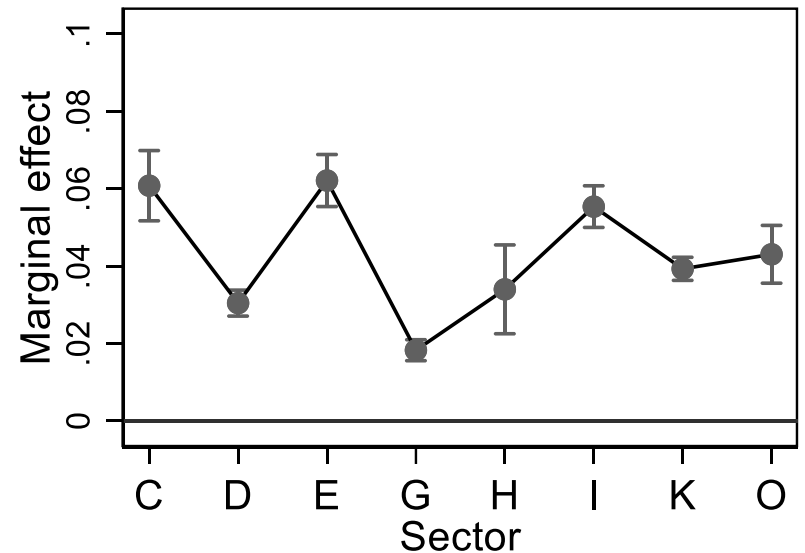
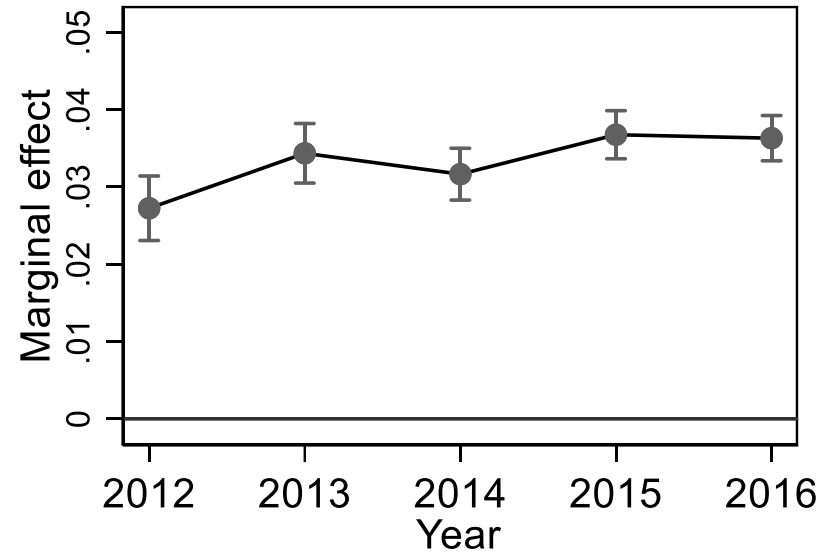
$$\Delta lp_{it} = \beta_0 + \beta_1 gap_{it-1} + controls + \sum_{l=2013}^{2016} \beta_l * Y_l * gap_{it-1} + \sum_{m=2}^8 \beta_m * S_m * gap_{it-1}$$

Δlp_{it} labour productivity growth

gap_{it-1} distance to frontier (frontier is defined as the average productivity among 10% the most productive firms in each of 173 industries)

Y_l - dummy for year l

S_m - dummy for sector m





β - convergence by age

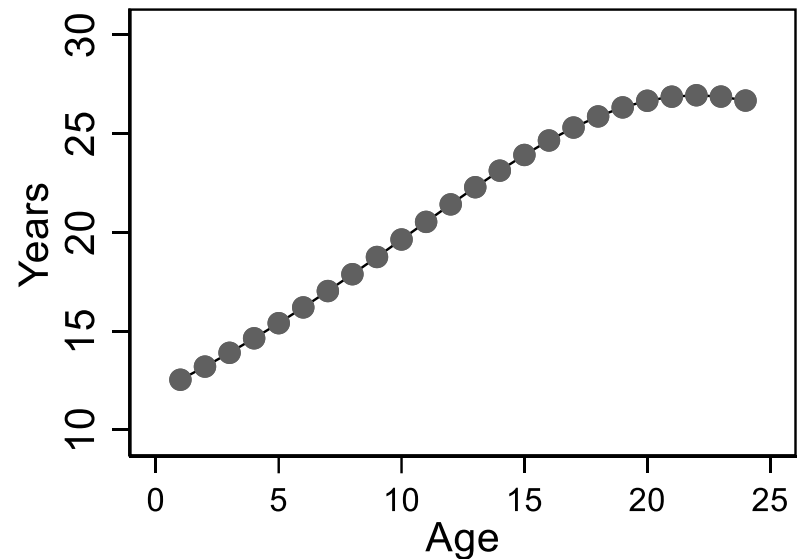
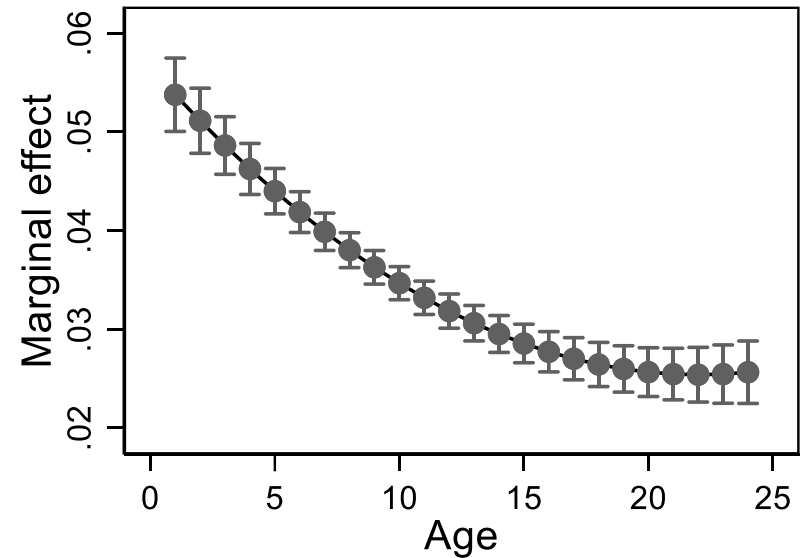
$$\begin{aligned} \Delta p_{it} &= \beta_0 + \beta_1 gap_{it-1} + \beta_2 age_{it} + \beta_3 age_{it}^2 \\ &+ controls + \beta_4 age_{it} * gap_{it-1} + \beta_5 age_{it}^2 \\ &* gap_{it-1} \end{aligned}$$

Δp_{it} labour productivity growth

gap_{it-1} distance to frontier (frontier is defined as the average productivity among 10% the most productive firms in each of 173 industries)

Y_l - dummy for year l

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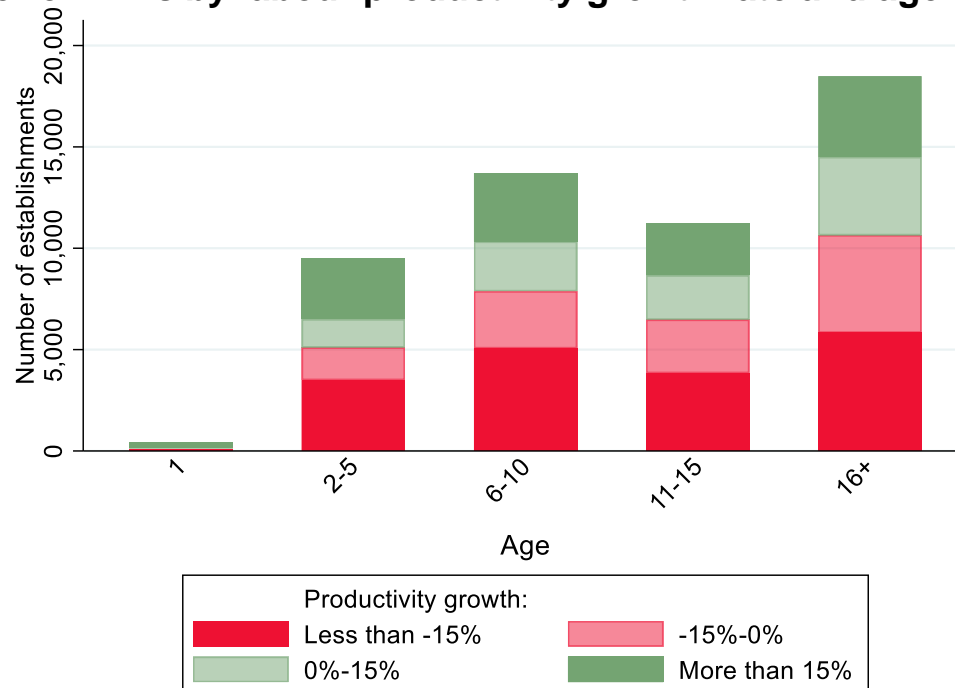




Catching up impulse dies out soon

- Entrants are less productive, than incumbents. As they start their business new firms catch up, but after one or two years they stop.
- The share of growing firms in a group of small firms is 78%, but the share of young firms among all firms is small.
- As consequence the negative contribution of old firms is prevalent.

Number of firms by labour productivity growth rate and age in 2016





Stochastic frontier model for convergence

Methodology:

- Not all establishments are technically efficient, some operates below the production frontier.
- For each industry we estimate the following production function

$$y_{it} = \beta_0 + \beta_1 l_{it} + \beta_2 k_{it} + \beta_3 l_{it} k_{it} + \beta_4 t + \beta_5 l_{it} t + \beta_6 k_{it} t + \beta_7 l_{it}^2 + \beta_8 k_{it}^2 + \beta_9 t^2 + v_{it} - u_{it} = f(k, l, t) + v_{it} - u_{it}$$

$$v_{it} \sim N(0, \sigma_v^2)$$

$$u_{it} \geq 0 \text{ – inefficiency term}$$

- Two specifications for inefficiency term

$$u_{it} = G(t)u_i, u_i \sim N^+(0, \sigma_u^2), G(t) = e^{\gamma(t-T)}$$

$$u_{it} = G(t)u_i, u_i \sim N^+(0, \sigma_u^2), G(t) = [1 + \exp(\sum_{j=2013}^{2016} \beta_j * Y_j)]^{-1}$$

γ – convergence rate, if $\gamma > 0$ establishments converge to the frontier

t – time

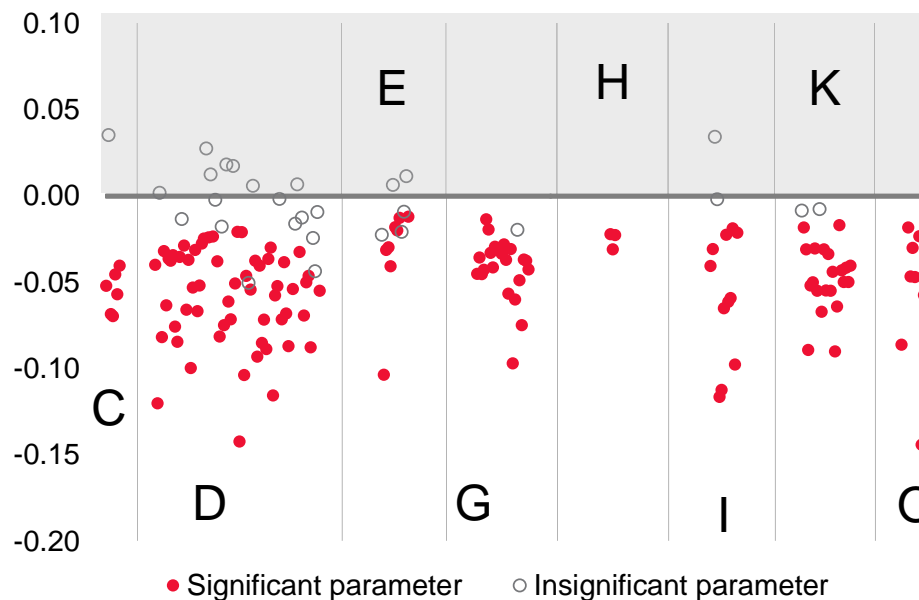
T – terminal period

Y_j - dummy for year j , $\beta_j < 0$ means increasing gap since the first years



Stochastic frontier model results confirm divergence

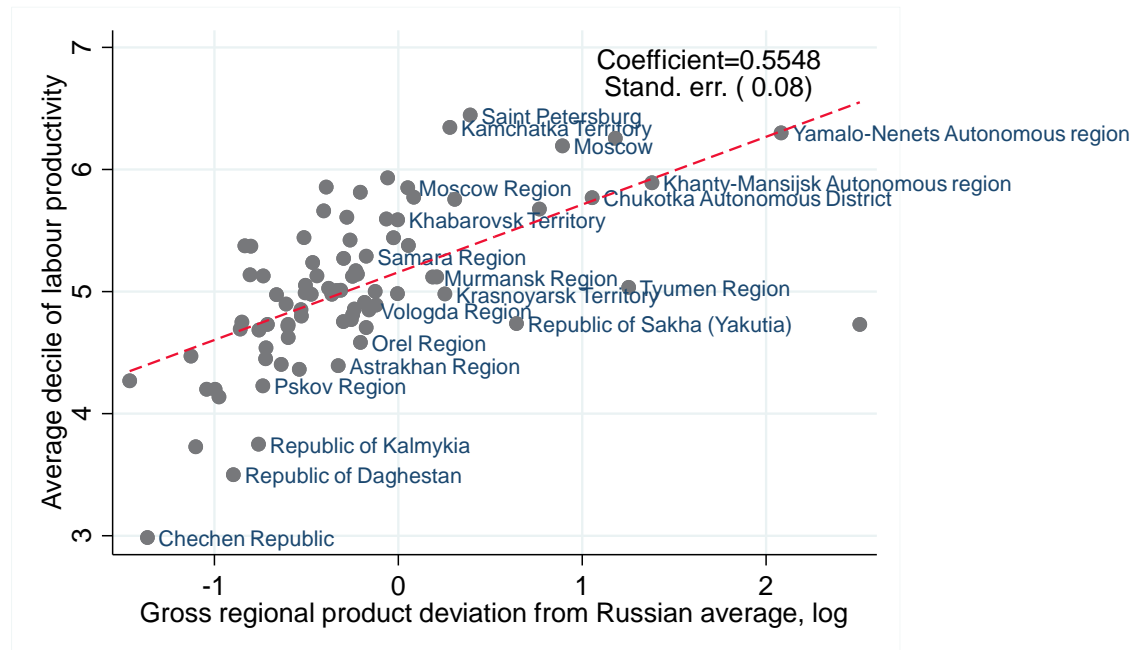
- Leaders are defined according to their efficiency during the whole period
- According the first specification in 139 out of 173 industries establishments diverge from the frontier, in the rest of the industries the convergence rate is insignificant





Possible explanation is regional dispersion

- Regional performance is highly dispersed in Russia.
- We find positive correlation between average productivity decile in region and GRP per capita in region.
- May be the reason for large productivity is that leaders are located in prosperous regions, while followers are located in economically less developed regions.





Conclusions

- According to series of studies productivity is highly heterogeneous even within narrowly defined industries.
- Almost in all studies concerning productivity growth and productivity level β -convergence is found. It means that laggards grow faster than leaders. However the gap between these groups remains wide.
- In Russia we confirm these results and show that the catching up process is mostly driven by young firms starting their life. As firms age the catching up impulse dies out soon.
- As β – and σ –convergence are sensitive to group of leaders/laggards definition, we verify our results using stochastic frontier model. According to this model leaders are defined based on the establishment's performance during the whole period. The results confirm the conclusion that in most industries establishments diverge from the frontier.



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