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Sources of long run economic growth in Russia before and after the global financial crisis

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Abstract

Although productivity decline in the global economy was observed before 2008, the global financial crisis of 2008 stimulated study of its source. In this context, recent literature mentions inefficient investments in machinery, human capital, and organizational processes. This can include skill mismatch and the lack of technology diffusion from advanced to emerging industries and firms. To what extent is this global view helpful in understanding recent productivity decline in the Russian economy? The present study reports that at least some of these sources can be observed in Russia as well. Using conventional industry growth accounting, it compares pre- and post-crisis sources of growth for the Russian economy. Specifically, it presents aggregate labor productivity growth as the sum of capital intensity and total factor productivity (TFP) growth in industries, and the contribution of labor reallocation between industries. It shows that the stagnation of 2008–2014 is more the result of the TFP decline and the deterioration of the allocation of labor than the lack of capital input. Moreover, the TFP decline started in Russia a few years before the crisis, as it did in major global economies, such as the United States, OECD countries, China, and Brazil. At the same time, relatively stable capital intensity made the Russian pattern to some degree similar to resource abundant Australia and Canada. Furthermore, the contribution of information and communications technology capital to labor productivity growth in Russia declined after 2008, which could have also hampered technology diffusion. Finally, the structure of the flow of capital services in Russia changed after 2008. Before the crisis, the contribution of machinery and equipment dominated, while after the crisis, construction provided the lion's share of capital input.

JEL classification: O47, O57.
Keywords: Russia, industry growth accounting, global financial crisis, World KLEMS.

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1. Introduction

Although the productivity slowdown of the world economy was observed and documented before 2008, the global financial crisis fueled the debate on its source and economic nature (McGowan et al., 2015). Ark et al. (2015) indicate that the causes of the global slowdown were inefficient investments in machinery, human capital, and organizational processes. This also included skill mismatch and the lack of technology diffusion from advanced to emerging firms and industries. To what extent is this global view helpful in understanding the productivity slowdown in Russia?

The present study considers a post-transition and resource abundant Russia and compares its pre- and post-crisis productivity patterns. The standard toolkit of Solow (1957) and Jorgenson et al. (1987, 2005), industry growth accounting decomposition, which represents output growth rates as the sum of contributions of *proximate* sources of growth — labor, capital, and total factor productivity (TFP) — can be used to answer the question above. The latter characterizes the ability of the economy to diminish real costs of production. Much of the current literature on growth accounting of the Russian economy at the macro level pays particular attention to TFP as the main source of growth. Using various sources of data on labor and capital,[1] paying special attention to such measurement aspects as capacity utilization (Entov and Lugovoy, 2013), terms of trade (Kaitila, 2016), or taking into account its natural capital (Brandt et al., 2016), TFP is identified as the main driver of Russian growth. Recent studies in this strand of the literature on Russia also report on the productivity slowdown after 2008 (Timmer and Voskoboynikov, 2016; World Bank, 2017), which can reflect the impact of both global and country-specific factors.

Thus far, however, there has been little discussion of changes in these proximate sources of long run growth for the Russian economy after the global crisis of 2008 from a comparative perspective. This study aims to address this gap with the new dataset from the Russia KLEMS, released in March 2017 (Russia KLEMS, 2017).

The present study reports that at least some of the origins of the global slowdown can be observed in Russia, comparing the pre- and post-crisis sources of growth of the Russian economy. Specifically, these sources are aggregate labor productivity growth as the sum of capital intensity and TFP growth in industries, and the contribution of labor reallocation between industries. It shows that the stagnation of 2009–2014 is more the outcome of a decline in TFP and the deterioration of the allocation of labor than a lack of capital input. Moreover, analysis shows that the TFP decline started in Russia a few years before the crisis, as it did in major global economies such as the United States, OECD countries, China, and Brazil. At the same time, relatively stable capital intensity makes the Russian patterns to some degree similar to resource abundant Australia and Canada, which raised investments in their mining sectors in response to the capital-intensive boom in China and India (McGowan et al., 2015). Additionally, the contribution of ICT capital to labor productivity growth in Russia declined after 2008, which hampered technology diffusion. Finally, the structure of capital services in Russia

[1] See literature review in Timmer and Voskoboynikov (2016).

changed after 2008. Before the crisis, the contribution of machinery and equipment dominated, while after the crisis construction provided the lion's share of capital input.

This paper has the following structure. The second section provides a short description of the dataset and the industry-level growth accounting approach. The third section summarizes the main results, starting from the aggregate view of sources of growth of the global economy in the long run (subsection 3.1), proceeds with the impact of labor reallocation in comparison with intra-industry sources of labor productivity growth since 1995 (3.2), and then develops the sector structure of capital intensity and TFP (3.3). The fourth section summarizes and concludes.

2. Data and approach

There are two main sources of data for the present study. The first is the Conference Board Total Economy Database™ (TED).[2] The TED is a comprehensive database with annual data covering gross domestic product (GDP), population, employment, hours, labor quality, capital services, labor productivity, and TFP for 123 countries in the world, including Russia, at the total economy level. For most countries, the TED productivity series starts from 1950. For Russia, the data are available from 1961 for GDP per worker and from 1992 for GDP per hour worked. The TED provides data for the representation of labor productivity growth as $\Delta \ln z$, where labor productivity is defined as the ratio of real value added and hours worked ($z = Z/H$), the sum of contributions of capital intensity (the flow of capital services per hour worked, $k = K/H$), labor composition effect (LQ), and TFP growth rate ($\Delta \ln A$) (Vries and Erumban, 2016):

$$\Delta \ln z = \bar{s}_K \Delta \ln k + \bar{s}_L \Delta \ln LQ + \Delta \ln A, \quad (1)$$

where $\bar{s}$ represents the yearly averaged shares of capital (K) and labor (L) compensation in value added.

The TED is based on national accounts from the official sources, such as the OECD and the UN, and in some cases on alternative estimations in academic publications. For example, in the case of China, two sets of the series are present: the official and the alternative one. This reflects the debates in the literature on the reliability of the official statistics for China.[3] In the case of Russia, the TED uses an official real GDP series, starting from 1990. For the years before 1990, the real GDP series employs data from Kuboniwa and Ponomarenko (2000) and Ponomarenko (2002).

For the comparison of GDP levels across countries, the purchasing power parity (PPP) is used in the TED. Unless otherwise stated, I use the GDP series in constant 1990 US dollars, converted at Geary Khamis PPPs, from the TED release of June 2015.

The second source is the Russia KLEMS dataset (Russia KLEMS, 2017). It includes the dynamic series of value added, hours worked, labor, and capital

[2] The dataset is available at https://www.conference-board.org/data/economydatabase/index.cfm?id=27762. Detailed methodology description is provided by Vries and Erumban (2016).

[3] Unless otherwise stated, the alternative set for China is used in this study.

shares, as well as capital services for 34 industries in the industrial classification NACE 1, starting from 1995. The dataset is nearly consistent with the official Russian National Accounts at the aggregate level for the whole period, and at the level of industries starting from 2005. It is also consistent with similar datasets for other countries within the World KLEMS framework, which makes possible cross-country comparisons at the industry level. A more detailed description of the dataset and its construction can be found in Voskoboynikov (2012).

The TED and Russia KLEMS are partially consistent. They use the same Solow-Jorgenson growth accounting framework. Moreover, as of 2016, the TED uses the Russia KLEMS as one of the sources of its Russian segment (Vries and Erumban, 2016). At the same time, regarding employment and hours worked in Russia, the TED uses the data on organizations only, which leads to an upward bias in labor productivity levels and an underestimation of labor contributions. The Russia KLEMS data uses employment series, which cover the whole economy within the System of National Accounts production boundary.

$$\begin{aligned}\Delta\ln z &= \textstyle\sum_j \bar{v}_{Z,j}^{GDP} \cdot \Delta\ln z_j + (\sum_j \bar{v}_{Z,j}^{GDP} \cdot \Delta\ln H_j - \Delta\ln H) = \\ &= \textstyle\sum_j \bar{v}_{Z,j}^{GDP} \cdot \Delta\ln z_j + R = \\ &= \textstyle\sum_j \bar{v}_{Z,j}^{GDP} \cdot \bar{v}_{K,j}^{Z} \Delta\ln k_j + \sum_j \bar{v}_{Z,j}^{GDP} \cdot \Delta\ln A_j + R, \end{aligned} \quad (2)$$

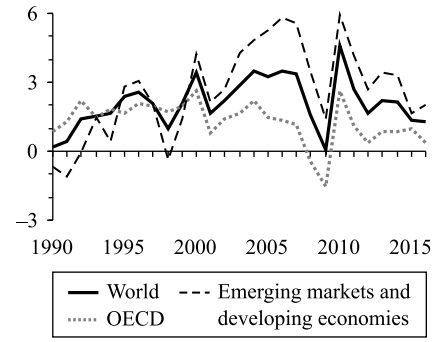
where $\bar{v}_{Z,j}^{GDP}$ is the yearly average share of industry j in total value added and $\bar{v}_{K,j}^{Z} \Delta\ln k_j$ is the yearly average capital share in value added of industry j. The reallocation term R captures changes in labor productivity growth caused by the difference of the share of an industry in value added and hours worked. It is positive if industries with the above average share of value added show positive growth of employment shares.

3. Results and discussion

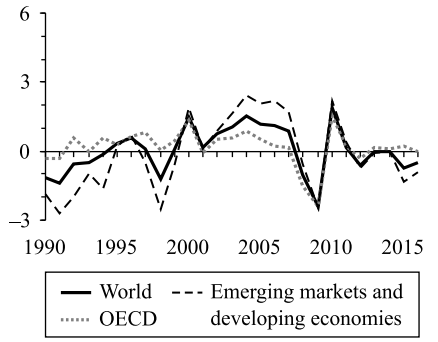
3.1. Long run growth of the Russian economy from a comparative perspective

Labor productivity in the global economy accelerated from the early 1990s until the eve of the global financial crisis (Fig. 1a), being fueled by intensive development of emerging economies and partially offset by OECD countries. However, productivity trends in the post-crisis period changed. Labor productivity in emerging economies continued to grow at a moderate pace, around 2–3%, while in OECD countries, it dropped below 1% per year. Comparing the dynamics of labor productivity (Fig. 1a) and TFP (Fig. 1b), it is possible to see the role of capital intensity in the post-crisis labor productivity slowdown, which was strong in emerging economies and negligible in the OECD zone. In sum, the global economy after 2008 demonstrates low TFP growth. In other words, the impact of efficiency improvements, which include management and organization of production processes, research and development (R&D), and innovations, was lower than in previous decades (McGowan et al., 2015).

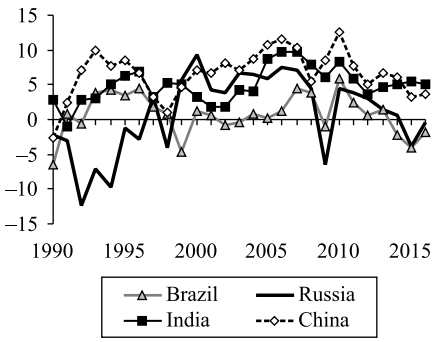
Figs. 1c and 1d spotlight productivity growth patterns, presenting the largest emerging economies, including Russia. The fact that labor productivity slowdown in emerging economies was not as intense as in the OECD area can be



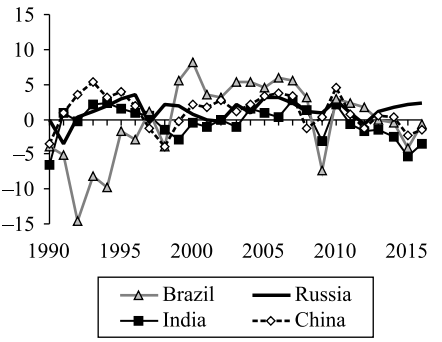
(a) Labour productivity growth rates in the world, the OECD region and emerging markets and developing economies



(b) TFP growth rates in the world, the OECD region and emerging markets and developing economies



(c) Labour productivity growth rates in BRIC economies



(d) TFP growth rates in BRIC economies

Fig. 1. Global productivity growth since 1990 (annual growth rates).

Note: Labour productivity growth is measured as GDP per person employed. TFP growth measures GDP growth over the weighted average of total hours worked, taking into account labour skills, and also machinery, structures and ICT capital. World refers to 122 countries, which are present in the Database. Emerging market end developing countries include China, India, the other developing Asia economies, Latin America, Middle East, North Africa, Sub-Saharan Africa, Russia, Central Asia and Southern East Europe.
Source: The Conference Board Total Economy Database™ (Adjusted version), May 2017.

confirmed in the patterns of all members of the BRIC club, except India. Indeed, China demonstrates relatively stable labor productivity growth after 2008 (Fig. 1c) and the decline in TFP (Fig. 1d).[4] To a lesser degree, this is applicable to Brazil and Russia. The case of Russia is also presented in Fig. 2 in terms of growth rates of labor productivity and its components, TFP and capital intensity. Fig. 2 shows that relatively stable labor productivity growth rates in 2003–2008 masked the decline of TFP against the acceleration of capital intensity. Moreover, the impact of the global crisis of 2008 was more serious for TFP than for labor productivity because capital intensity growth remained stable and varied around 5%. Finally, as follows from the figure, this pattern differs from the experience of the transformational recession and early recovery of 1995–2002, which were characterized by negative growth rates of capital intensity.

Accordingly, there are three important points for the Russian economy that can be derived from these preliminary observations. First, the slowdown of labor

[4] See more about TFP decline in China in Wu (2016).

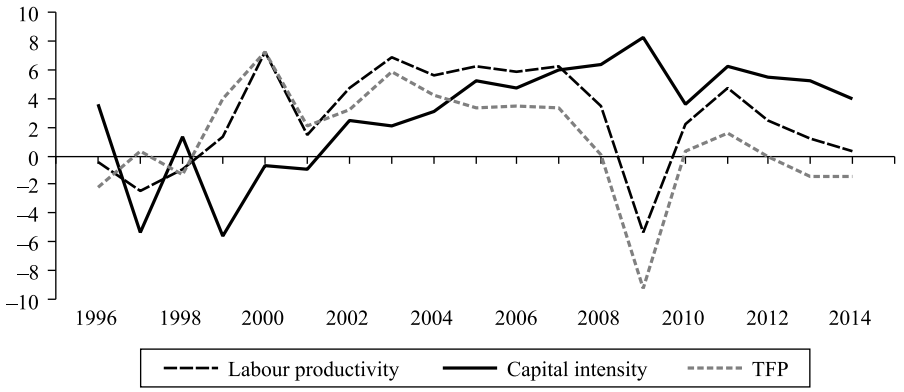


Fig. 2. Growth of labour productivity, capital deepening and TFP in the market sector of the Russian economy in 1995–2014 (annual growth rates).

Note: Labour productivity growth is measured as GDP per hour worked. Capital intensity is the flow of capital services per hour worked. Total factor productivity growth measures GDP growth over the weighted average of total hours worked, machinery, structures, ICT, software, transport equipment and other assets.
Source: Russia KLEMS, 2017.

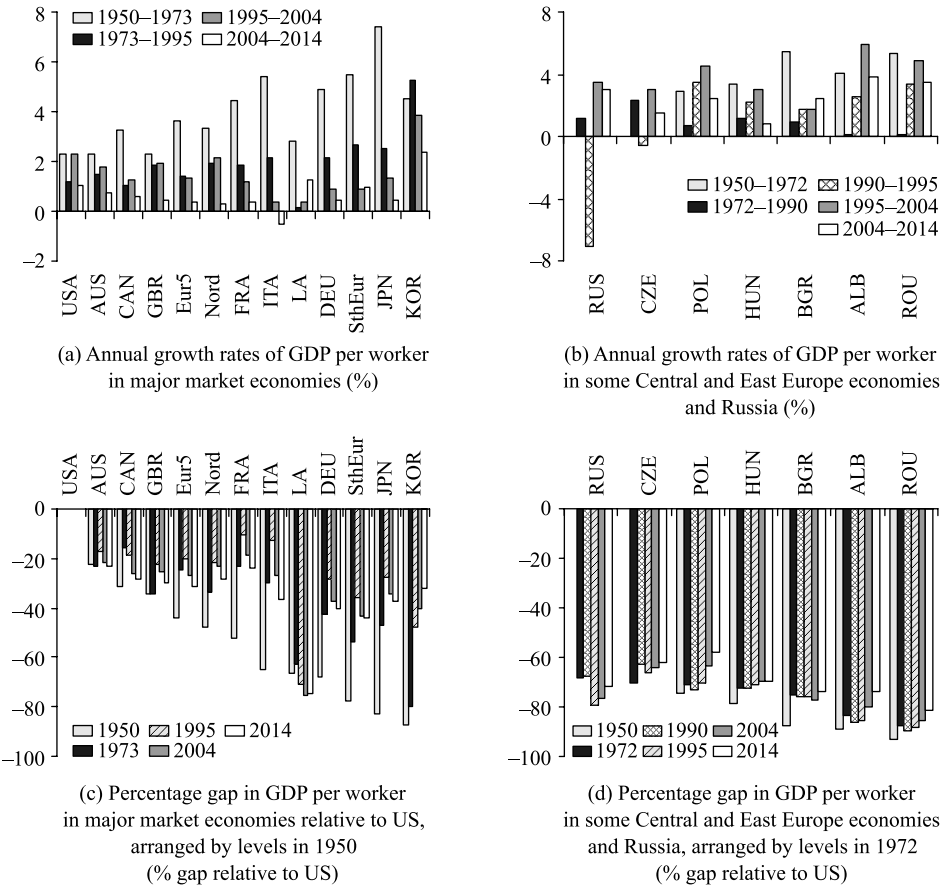
productivity growth was driven mostly by the decline in TFP. Second, the decline in TFP was observed not only in Russia but in most of the leading economies of the world. Finally, this TFP decline started before 2008 both in Russia and in many major economies, and its roots can be found not only in specific features of the Russian economy but also in long run trends of global development. At the same time, the crisis of 2008 could contribute to this stagnation and accelerate the TFP decline.

In what follows, I consider all three issues, starting with the long run global productivity pattern of major economies in terms of the convergence theory (Acemoglu et al., 2006).

The long run comparative perspective of labor productivity trends since 1950 is presented in Fig. 3.[5] This long time span is split into four sub-periods in line with structural breaks of the United States productivity pattern (see, for example, Fernald, 2015). Fig. 3a represents annual labor productivity growth rates of leading *market* economies and economic regions, while Fig. 3c shows productivity levels of these countries and regions relative to the United States and ranked by their initial (1950) productivity gaps. Figs. 3a and 3c provide evidence that most of the regions match the conditional convergence pattern in 1950-1995. Indeed, economies with an initial labor productivity level farther behind the United States grew faster. This can be explained by the recovery process after the Second World War and the technology catch up in old Europe (Crafts and Toniolo, 2010). There are also exceptions, such as Latin America, which confirm that convergence is not always granted. This observation is also applicable to countries in the socialist camp.

Economies of Central and Eastern Europe (CEE) were also involved in the process of recovery after the Second World War. For example, the convergence pattern can be seen in Poland, Hungary, Albania, and Romania in 1950–1974

[5] Analyzing the conditional convergence of major market economies and regions, I follow McGowan et al. (2015).



(a) Annual growth rates of GDP per worker in major market economies (%)

(b) Annual growth rates of GDP per worker in some Central and East Europe economies and Russia (%)

(c) Percentage gap in GDP per worker in major market economies relative to US, arranged by levels in 1950 (% gap relative to US)

(d) Percentage gap in GDP per worker in some Central and East Europe economies and Russia, arranged by levels in 1972 (% gap relative to US)

Fig. 3. Labour productivity performance in the long run.

Notes: The following countries and regions are presented in the figure: United States (USA); Australia (AUS); Canada (CAN); the United Kingdom (GBR); Austria, Belgium, Switzerland, Luxembourg, the Netherlands (Eur5), Denmark, Finland, Iceland, Norway, Sweden (Nord); France (FRA); Italy (ITA); 17 countries of Latin America (LA), including Argentina, Brazil, Chili, Mexico, Peru, Uruguay and Venezuela; Germany (DEU); Greece, Spain, Portugal (SthEur); Japan (JPN), South Korea (KOR); Russia (RUS); the Czech Republic (CZE); Poland (POL); Hungary (HUM); Bulgaria (BGR); Albania (ALB) and Romania (ROU). GDP is measured in 1990 US$, converted at Geary Khamis PPPs.

Source: The Conference Board Total Economy Database™, May 2015.

(Figs. 3b and 3d). However, as Crafts and Toniolo (2010) point out, convergence in the socialist camp before the early 1970s was less sound, and even worse in the last decades before the collapse of the socialist system in the early 1990s. Both the CEE economies and the Soviet Union, being, on average, further behind the United States level in comparison to old Europe, failed to catch up before 1990. The central cause of this was the lack of incentive to adapt new technologies and use them to make production more efficient. Moreover, because of the transformational recession, some of these economies (e.g., Russia and the Czech Republic in Fig. 3d) extended the gap in 1995 relative to 1990. In sum, on the eve of transition, the technological backwardness of the CEE economies and Russia remained one of the serious obstacles to sustainable development. Thus, the years after the transition included both a transformational recession and catch up with the West (Havlik et al., 2012).

McGowan et al. (2015) noticed that the process of convergence in the global economy halted after 1995 for two main reasons. First, as economies approach the technology frontier, the importance of the ability to adapt innovations increases. Second, the soundest innovations in the period 1995–2004 were ICT. The nature of ICT releases "winner takes all" processes, which help the leaders in the technology competition stretch their leads. In turn, the patterns of post-transition economies (Fig. 3d) reflect not only the global impact of ICT but also the post-transition recovery and catch up due to the elimination of multiple imbalances and distortions of the planned economy period.

However, by 2004, the benefits of global diffusion of ICT, as well as the post-transition recovery potential in CEE countries and in Russia, began to wane. This then can be used for the interpretation of the slowdown of labor productivity and TFP growth in different regions of the world, including Russia, represented in Figs. 1–3. This raises the issue of the abilities of different regions of the world in general, and Russia, in particular, to adapt new technologies and allocate resources efficiently at the present time, which is characterized by a broad-based decline in the contribution of the labor composition, the slowdown of capital intensity (excluding the natural resource abundant countries such as Australia, Canada, and also China and India), and the contraction of the TFP (excluding Korea, Japan, and India). Equally important, the global financial crisis of 2008 can have longer run productivity consequences such as a fall in tangible investments, and an impact on investments in knowledge-based and human capital and on labor reallocation (McGowan et al., 2015).

In this context, there are three potential explanations of the post-crisis stagnation in Russia. The first one is the outcome of these factors of the global productivity slowdown. Second, it might be caused by the structural transformation of the Russian economy from the sectors of material production, overinvested in before the transition, to market services. Using the Baumol terminology, this means that a structural change can shift activities from progressive manufacturing to stagnant services (Baumol et al., 1985). Finally, the slowdown can be rooted in the fact that the inflow of oil and gas revenues ran out after the fall of oil prices in the late 2000s. Further analysis of the proximate sources of growth can help us understand, which of the three explanations is based on the evidence.

3.2. Aggregate growth, structural change, and labor reallocation in Russia since 1995

The economic structures of command economies are unbalanced in favor of manufacturing and agriculture. This is why the extension of market services and the shrinking of manufacturing are a few basic stylized facts common to all economies in transition (Campos and Coricelli, 2002). Russia is no exception. Table 1 reports changes in shares of value added in major sectors of the Russian economy. As can be seen from the table, the share of agriculture and manufacturing shrank from 30% in 1995 to 19% in 2014, which could reflect comparative disadvantages of Russian manufacturing in comparison to its main trading partners, reported by Garanina (2009). At the same time, finance and business services, including retail, construction, telecom, and hotels, expanded from 24% to 31%. In contrast with many other post-transition economies, Russia is a resources

Table 1
Aggregate GDP growth and structural change in 1995–2014.

	Share of value added (%)		Growth rates (%)	Contributions (pp)
	1995	2014	1995–2014	1995–2014
Total	100.0	100.0	3.47	3.47
Market economy	86.1	80.9	3.60	3.00
Agriculture	7.6	4.2	1.39	0.08
Extended gas and oil	20.1	24.2	3.59	0.80
Manufacturing	22.4	14.9	2.15	0.40
Retail, construction, telecom, hotels and restaurants (RCT)	19.2	18.6	4.07	0.77
Finance & business services	5.1	12.0	8.41	0.72
Transport	11.7	6.9	2.55	0.24
Nonmarket services	13.9	19.1	2.79	0.46

Notes: Extended gas and oil includes mining, fuel and wholesale trade; RCT incorporates retail, hotels and restaurants, transport, post and telecom, financial and business services. See Appendix Table A1 for the comprehensive list of industries and sectors.
Source: Author's calculations based on Russia KLEMS (2017).

exporting country. Growth of global oil prices after 1999 led to the remarkable expansion of its mining and mining-related industries, combined in Table 1 in sector "Extended gas and oil,"[6] from 20% in 1995 to almost a quarter in 2014. The increasing role of the extended mining and services industries predetermines the leading contribution of these sectors in aggregate growth.

Table 1 provides the summary statistics for sector growth rates and contributions. Finance and business services demonstrate the best performance, with a yearly average growth rate of 8.4%. However, its contribution is more modest and equals 0.7 percentage points (pp), giving place to oil and gas, and RCT sectors, as the average share of the finance industry is only 8.6% ($0.7 = 8.41 \cdot ½ \cdot [5.1\% + 12.0\%]$). These three sectors provide the lion's share of real value added growth, while the role of traditional industries of material production is relatively modest. Agriculture and manufacturing contribute only 0.5 pp of 3.5% aggregate growth, or about one-sixth.

The periods chosen for the comparative analysis are important because short-term changes of input utilization can bias TFP estimations (Hulten, 1986). Realizing this, I opted for sub-period years, which are neither the troughs nor the peaks of the cycle. The first year in question is 1995, which belongs to the period of the transformational recession. In turn, 2002 is one of the first recovery years after the financial crisis of 1998. Finally, 2007 is a year on the eve of the global financial crisis, which can be considered as the final point of the recovery period. In all cases, these years do not belong to local minimum points of

[6] The true size of mining in the Russian economy and its contribution to economic growth have been widely discussed in the literature (see, e.g., Gurvich (2004)). An extended oil and gas sector includes organizations, which are involved in the process of extraction, transportation, and wholesale trade of oil and gas. Some of them have establishments in different industries such as mining, wholesale trade, and fuel and pipeline transport. Because of strong vertical integration and transfer pricing, its share in total value added exceeds mining. Following Timmer and Voskoboynikov (2016), the present study assumes that the extended mining sector includes mining, wholesale trade, and fuel. At the same time, I recognize the limitations of this split. On the one hand, many firms in wholesale trade are not related to energy exports. On the other hand, some pipeline transportation organizations fall within transport in sector "market services."

Table 2
Growth accounting decomposition of the market sector of the Russian economy in 1995–2014 (contributions, pp).

	1995–2002	2002–2007	2007–2014	1995–2014
Real value added	2.66	8.03	1.58	3.60
Hours worked	–0.34	0.96	–0.12	0.08
Labour productivity total	3.00	7.07	1.70	3.51
Labour reallocation	1.36	0.80	0.35	0.73
Intra-industry labour productivity	1.64	6.27	1.35	2.78
Capital intensity	–0.35	2.10	2.76	1.52
ICT	0.21	0.19	0.09	0.12
Machinery and equipment	0.10	1.19	0.92	0.59
Constructions	–0.43	0.50	1.43	0.68
Other assets	–0.23	0.22	0.32	0.13
Total factor productivity	1.99	4.17	–1.41	1.26

Note: The composition of the market sector is presented in Appendix Table A1.
Source: Author's calculations based on Russia KLEMS (2017).

capital capacity utilization for Russian manufacturing (Bessonov, 2004; Salnikov et al., 2017).

Table 2 presents major sources of economic growth of the market sector of the economy in these three periods. What stands out in the table is the remarkable difference in the structure of these sources. While in the early transition (1995–2002), growth was intensive with TFP providing two-thirds of labor productivity growth, in the stagnation period (2007–2014), the TFP declined and grew extensively. Another remarkable difference is the role of capital services. In the early transition, the shortage of capital can be seen at the aggregate level in the form of negative growth of capital intensity. At the same time, both in recovery (2002–2007) and in the post-crisis stagnation (2007–2014), capital intensity was the key growth driver. Moreover, machinery and equipment provided the highest contribution in the recovery period, while construction dominated in the years of stagnation. Interestingly, the contribution of the ICT capital became smaller.[7] This may reflect the global tendency starting in the mid-2000s where ICT no longer drove labor productivity growth. Moreover, McGowan et al. (2015) point out that the slowdown of ICT capital as a component of so-called knowledge-based capital can influence TFP negatively by diminishing technology diffusion. Finally, labor reallocation, being one of the most important growth factors in early transition, slowed and disappeared in the years of stagnation, which can illustrate both the end of transition and the worsening of labor mobility in the years after the global crisis.[8]

I suggest two different explanations for this. The contribution of structural change to labor productivity growth, which is also referred to as a structural bonus, is higher in economies with higher initial variation in labor productivity levels across industries. In developed economies, this variation is usually small and the structural bonus is also marginal, while in developing economies it can be substantial. From

[7] It is important to note here that estimations of ICT capital are rough because it is sensitive to quality change in investment deflators, which have not been adapted in the official statistics yet and not taken into account in Russia KLEMS data.

[8] I overlook labor reallocation within industries and between firms. At the same time, considering CEE economies, Kuusk et al. (2017) demonstrated that labor reallocation within industries is dominant in comparison to the inter-industry reallocation.

this perspective, being industrialized, the CEE economies and Russia did not have much room for the structural bonus. It follows from the fact that in 1995, the variation coefficients of labor productivity levels in industries were significantly lower in CEE countries and in Russia than in market economies with similar levels of development (Timmer and Voskoboynikov, 2016). The second explanation comes from the observation that structural change in post-transition countries shifts the structure of these economies to services. Thus, long run productivity growth in services can be lower than in, say, manufacturing (Baumol et al., 1985). That is why the expansion of services can lead to a slowdown of the aggregate labor productivity *growth* (the Baumol effect). However, both in Russia and in the post-transition economies of Central and Eastern Europe, the Baumol effect, being negative, is offset by labor reallocation to industries with higher productivity levels (the Denison effect; Voskoboynikov, 2018).

Taken together, the results presented here suggest that the influence of structural change on aggregate labor productivity growth is more sophisticated than it might be expected from simple decomposition (2). Indeed, the relatively small contribution of reallocation can be the net effect of two different phenomena, the Denison effect and the Baumol effect, which work in different directions and compensate for each other. Furthermore, these opposite contributions of the two types of labor reallocation are common in all post-transition economies. Finally, the expansion of informality also weakens growth enhancing structural change (Voskoboynikov, 2017).

However, the main conclusion of the aggregate shift share analysis remains unchanged. Namely, intra-industry sources of productivity growth are stronger than the reallocation effects. In what follows, I consider these sources in detail, paying special attention to proximate sources of labor productivity growth in industries and the sector contribution of capital services and TFP to the aggregate.

3.3. Labor productivity slowdown in industries after 2008: lack of capital or efficiency loss?

The sources of intra-industry labor productivity growth include accumulation of human and physical capital, intangible assets, and TFP. The latter is usually interpreted as the outcome of technological change but could be also explained by temporary disequilibrium caused by the delayed reaction to technological changes in previous periods, terms of trade, low mobility of labor and capital, as well as various competitive barriers (Reinsdorf, 2015).

The growth accounting decomposition of the market sector of the economy sheds light on differences in proximate sources of growth before and after 2008. As can be seen from Table 2, the fundamental change explaining the decline is the role of TFP. Indeed, in 2002–2007 TFP contributed 4.2 pp of a total 7.1 pp of aggregate labor productivity growth, while in the following years its contribution was negative and dropped by 5.6 pp from 4.2% per year to –1.4%. In other words, a sharp decline in the TFP growth rate can explain fully the decline in the aggregate labor productivity growth. Nevertheless, it is worth mentioning other factors. The slowdown of labor productivity was not as sharp as real value added, as the employment trend also changed negatively by –1.1 pp. Surprisingly, capital intensity accelerated by 0.7 pp in the years of stagnation. This makes the Russian

pattern to some degree similar to resource abundant Australia and Canada. McGowan et al. (2015) point out that these two economies increased their investments in the mining sector, responding to the capital intensive boom in China and India. In turn, the positive contribution of capital intensity offset the negative influence of labor reallocation. Finally, relatively stable capital intensity masks substantial changes in structure (see, e.g., Berezinskaya, 2017). While before 2008, machinery provided the lion's share of growth, after 2008, its contribution fell by 0.3 pp, giving place to construction. In sum, the extensive, capital intensity-driven component of labor productivity growth became dominant after the crisis.

The detailed industry level decomposition, represented in Appendix Fig. A2, add more detail to the picture. Before 2008, labor productivity in most industries grew because of TFP. Remarkable exceptions were two industries in the extended oil and gas sector, mining and fuel, and in post and telecom, utilities and transportation services. In contrast, after 2008, only a few industries remained intensive: agriculture, machinery, rubber and plastics, transport equipment, textiles, and water transport.

An analysis of sector components and the contribution of different types of assets might be helpful in understanding the origins of this labor productivity decline. Fig. 4 shows that the TFP decrease happened mostly because of the oil and gas sector efficiency loss. Taking into account industry-level patterns of productivity growth (Appendix Fig. A2), this could happen because of a TFP decline in just wholesale trade. At the same time, almost all other sectors were also in a negative zone. The only exception was agriculture, which demonstrated high TFP growth rates both before and after 2008.[9] Unfortunately, the value added share of agriculture was just above 4% (Table 1) and its contribution to aggregate TFP growth was also negligible. In sum, it seems that the sources of TFP growth (catch up in financial and business services, converging in manufacturing) did not play a remarkable role in 2007–2014.

More attention is also expected in dealing with capital intensity. Transmission of oil and gas export revenues to the supply side sources of growth should be

Fig. 4. Sectoral structure of aggregate TFP growth.

Source: Author's calculations based on Russia KLEMS (2017).

[9] The substantial increase of productivity in agriculture seems to be common for former Soviet Republics after transition (Swinnen and Vranken, 2010).

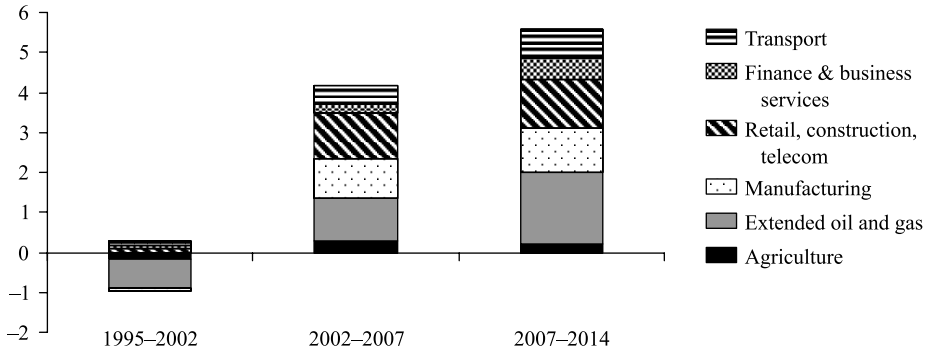


Fig. 5. Sectoral structure of aggregate capital intensity growth of the market economy sector (pp).

Source: Author's calculations based on Russia KLEMS (2017).

identified not only because of a substantial capital contribution at the aggregate level but also in the sector composition of the aggregate capital input. This is confirmed by data reported in Fig. 5. As can be seen, the extended oil and gas sector demonstrates the second largest yearly average contribution among sectors of the market economy in 2002–2007. It contributes almost one-quarter of the market economy capital intensity growth rate. At the same time, market services enjoyed the highest capital inflow. This is also not surprising. Large investments were made in retail, which was underdeveloped early in the transition. McKinsey Global Institute (1999, 2009) reports that as of 1999, only 1% of retail came from modern supermarkets, while 10 years later this share increased to 35%. Huge investments were made in telecommunications both because of its technological backwardness in the planned economy period and the IT revolution. Last, but not least, financial and business services expanded in these years.

Finally, Fig. 6 illustrates changes in the contribution of different types of assets to labor productivity growth. In 1995–2002, capital intensity was negative despite the substantial labor outflow. In contrast, in the years of the post-crisis recovery, capital intensity grew mostly because of contributions of oil and gas, market services (RCT), and manufacturing. However, if the RCT sector and oil

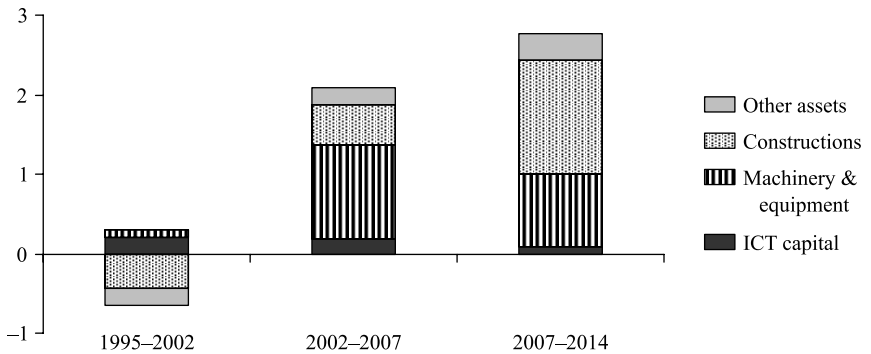


Fig. 6. Contributions of types of assets to aggregate capital intensity growth of the market economy sector (pp).

Source: Author's calculations based on Russia KLEMS (2017).

and gas grew mostly because of the inflow of investments, capital intensity in manufacturing and agriculture grew also because of continuing labor outflow. Finally, in the period of stagnation, capital intensity continued growing with the role of oil and gas increasing.

The structure of asset contributions to aggregate capital intensity, presented in Fig. 6, also reflects, to a certain extent, the role of capital in industry. Machinery, the backbone of manufacturing, dominated before 2008, while construction, more relevant for oil and gas, played a remarkable role in the years of stagnation. This could reflect the fact that the slowdown of investment inflow after 2008 hit the contribution of machinery with short-term service lives more than long-term constructions and infrastructure. As a result, the acceleration of capital intensity in 2009 (see Fig. 2), could take place due to new construction projects, launched before the crisis and put into operation after 2008, and also the decline in hours worked in the crisis.

4. Conclusion

In a globalized world, there are global factors that accelerate and decelerate the long-run productivity of national economies. After the Second World War, such factors included the post-war recovery and technology catch up to the United States level. Starting in the 1990s, ICT picked up the slack. At present, the key to sustainable productivity growth is efficient reallocation of resources and an institutional environment that can stimulate technology diffusion among firms, as summarized by McGowan et al. (2015).

The present study has established that from the supply side perspective, the recent stagnation in 2009–2014 in the Russian economy is more the outcome of the TFP decline and the deterioration of labor allocation than the lack of capital input. At the same time, capital intensity continues to grow, which makes the Russian pattern to some degree similar to resource abundant Australia and Canada. The contribution of ICT capital to labor productivity growth in Russia declined after 2008, which could have also interfered with technology diffusion.

In sum, this study suggests the usefulness of considering the post-crisis stagnation of the Russian economy from a comparative perspective. This can, thereby, shed new light on the causes of the productivity stagnation as, at least some, are global in nature.

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Appendix A

Table A1
List of industries and sectors.

#	Code*	Industry, short	Industry, full	Sector	Aggregated sector
1	AtB	Agriculture	Agriculture, hunting, forestry and fishing	Agriculture	Market economy
2	23	Fuel	Coke, refined petroleum products and nuclear fuel	Extended gas and oil	Market economy
3	C	Mining	Mining and quarrying	Extended gas and oil	Market economy
4	51	Wholesale	Wholesale trade and commission trade, except of motor vehicles and motorcycles	Extended gas and oil	Market economy
5	15t16	Food	Food products, beverages and tobacco	Manufacturing	Market economy
6	17t18	Textile	Textiles, textile products	Manufacturing	Market economy

(continued on next page)

Table A1 *(continued)*

#	Code*	Industry, short	Industry, full	Sector	Aggregated sector
7	19	Leather	Leather and footwear	Manufacturing	Market economy
8	20	Wood	Wood and products of wood and cork	Manufacturing	Market economy
9	21t22	Pulp & paper	Pulp, paper, paper products, printing and publishing	Manufacturing	Market economy
10	24	Chemicals	Chemicals and chemical products	Manufacturing	Market economy
11	25	Rubber & plastics	Rubber and plastics products	Manufacturing	Market economy
12	26	Non-metal minerals	Other non-metallic mineral products	Manufacturing	Market economy
13	27t28	Basic metals	Basic metals and fabricated metal products	Manufacturing	Market economy
14	29	Machinery	Machinery, nec	Manufacturing	Market economy
15	30t33	Electrics & optics	Electrical and optical equipment	Manufacturing	Market economy
16	34t35	Transport equipment	Transport equipment	Manufacturing	Market economy
17	36t37	Recycling	Manufacturing, nec; recycling	Manufacturing	Market economy
18	E	Distribution	Electricity, gas and water supply	Manufacturing	Market economy
19	F	Construction	Construction	Retail, construction, telecom	Market economy
20	50	Sale — vehicles	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	Retail, construction, telecom	Market economy
21	52	Retail	Retail trade, except of motor vehicles and motorcycles; repair of household goods	Retail, construction, telecom	Market economy
22	H	Hotels & restaurants	Hotels and restaurants	Retail, construction, telecom	Market economy
23	64	Telecom	Post and telecommunications	Retail, construction, telecom	Market economy
24	O	Social services	Other community, social and personal services	Retail, construction, telecom	Market economy
25	J	Finance	Financial intermediation	Finance & business services	Market economy
26	71t74	Business services	Renting of machinery and equipment and other business activities	Finance & business services	Market economy
27	60	Inland transport	Inland transport	Transport	Market economy
28	61	Water transport	Water transport	Transport	Market economy
29	62	Air transport	Air transport	Transport	Market economy
30	63	Other transport services	Supporting and auxiliary transport activities; activities of travel agencies	Transport	Market economy
31	70	Real estate	Real estate activities	Non-market services	Non-market economy
32	L	Public administration	Public admin and defence; compulsory social security	Non-market services	Non-market economy
33	M	Education	Education	Non-market services	Non-market economy
34	N	Health	Health and social work	Non-market services	Non-market economy

* Codes refer to the industrial classification, adapted in EU KLEMS project (Timmer et al., 2007, pp. 11–12). It is consistent with NACE 1.0.

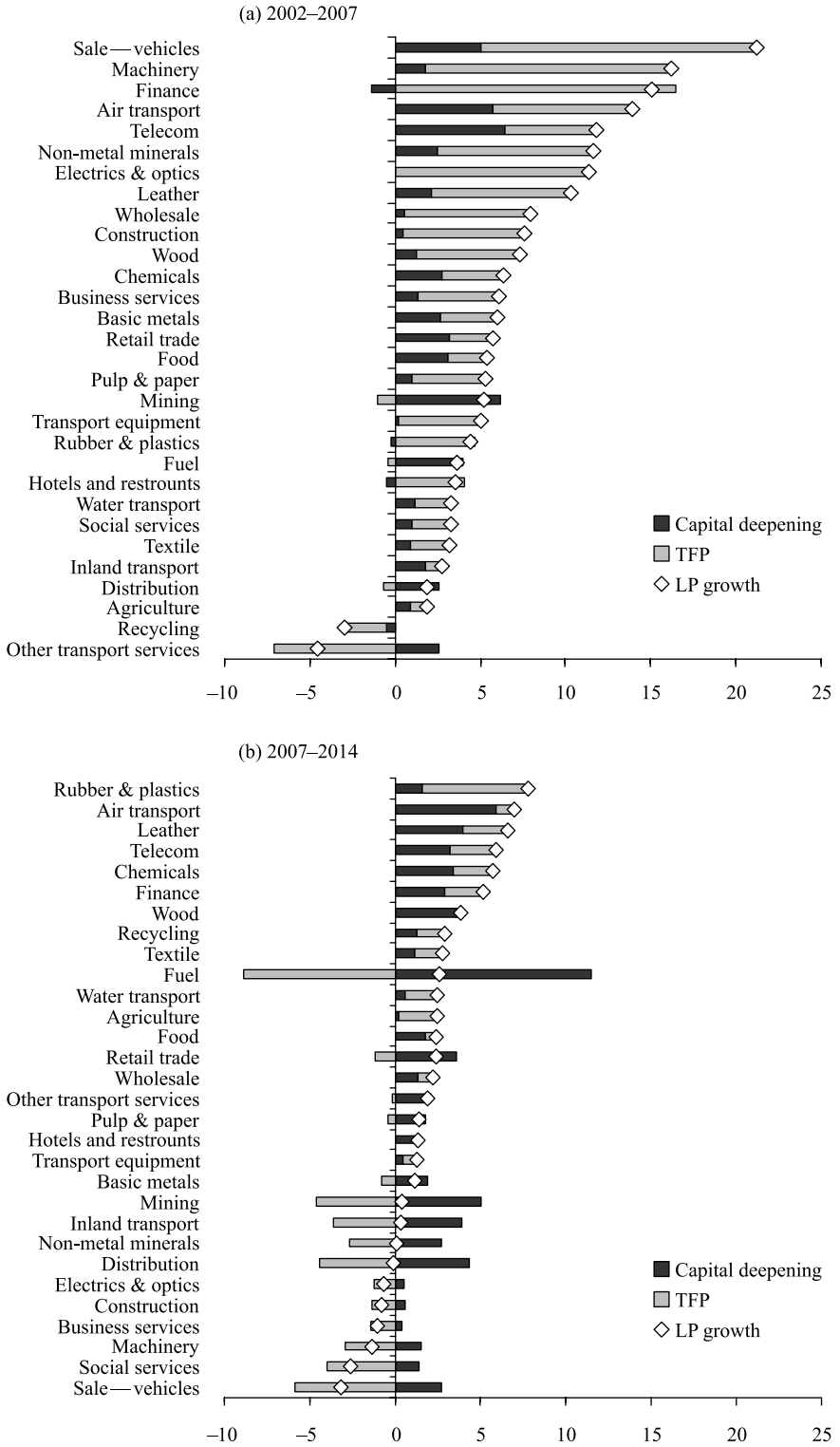

Fig. A2. Labour productivity growth decomposition in industries of the Russian economy, 2002–2007 (annual growth rates).

Note: Arranged with labour productivity growth rates.
Source: Author's calculations based on Russia KLEMS (2017).