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STRUCTURAL CHANGE, EXPANDING INFORMALITY AND LABOUR PRODUCTIVITY GROWTH IN RUSSIA

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Recent decades have been years of intensive growth, structural change and expanding informality for many developing and emerging economies. However, in exploring the relationship between structural change and productivity growth, most empirical studies ignored informality. This paper explores how structural change in the Russian economy 1995–2012 affects aggregate labour productivity growth, taking into account the informal sector. Using a newly developed dataset for 34 industries and applying three alternative approaches aggregate labour productivity growth is decomposed into intra-industry and inter-industry contributions. All three approaches show that the *overall* contribution of structural change is growth enhancing, significant, and dumped in time. In turn, labour reallocation between the formal and informal sectors is growth reducing because of the extension of informal activities with low productivity levels. At the same time, *sectoral* labour reallocation effects are found to be highly sensitive to the methods.

Key words: labour productivity, structural change, informal economy, Russia

JEL: O11, O17, C82, N14

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1. Introduction

Last two decades were years of intensive growth and structural change in emerging and developing economies in many regions of the world (Diao, McMillan, and Rodrik 2017). Many of these economies are also characterized by a sizable informal sector accounting for a substantial share of employment and value added (Hassan and Schneider 2016). In this context, Vries et al. (2012, 219) noticed that if formal and informal activities within industries are not split, the estimation of the impact of structural change on growth may be biased.

In recent years, research has shown an increased interest in the link between informality and productivity. Restuccia (2013, 93) has assumed that informality is the response of less productive entrepreneurs to tightening regulations. In turn, informality itself creates economy-wide distortions, which are harmful to productivity. For example, McKinsey (2006) has pinpointed informality as one of the main causes of the productivity gap between Brazil and the U.S.[2] Marcouiller et al. (1997) identified informality as the cause of low productivity growth in construction, manufacturing and retailing in Latin America. Using the example of Mexico Leal Ordóñez (2014) specified three types of distortions, induced by the informal sector, which are the misallocation of resources towards small and stagnant plants, distortions in occupational choices and distortions in capital use in informal establishments. Such distortions made productivity lower in Mexican manufacturing, retail, wholesale and services (Busso, Maria, and Levy 2012).

However, there is a notable paucity of empirical research focusing specifically on the issue of what would change our understanding of the impact of structural change on productivity growth, if labour outflow to the informal sector of the economy is taken into account explicitly. A notable exception is the paper of Vries et al. (2012), which has shown that expanding informality in India made the reallocation effect growth reducing, while the shrinking informal sector in Brazil made the contribution of labour reallocation more sound. Vries et al. (2012) applied a conventional method of the shift-share analysis for the decomposition of aggregate labour productivity growth into inter-industry and intra-industry components. The seminal works of Fabricant (1942) and Denison (1962) pioneered this method. However, there are some weaknesses of it. In particular, De Avillez (2012) points out to the possible counterintuitive interpretation of the contributions of industries to structural change, whereas Dumagan (2013) highlights the problem of fixed weights in this approach, and its dependence on aggregation formulae.

The case of post-transition Russia is remarkable in this context. Kapelyushnikov et al. (2012) considered informality as one of the outcomes of the shock therapy of early 1990s after the transition from plan to market, which illustrates the concept of "second best institutions" of Rodrik (2008). The adaptation of new labour market legislation, based on "first-best" practices of

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[2] See also (Üngör 2017).

developed economies, in combination with weak state enforcement forced firms and workers to look for alternative forms of adaptation including informality. All this created the pre-conditions for the expansion of the informal economy, which continues. Although the informal sector smoothed negative consequences of the shock therapy in Russia, absorbing excessive labour, its consequences for productivity growth, as Kapelyushnikov et al. (2012) point out, could be harmful for two reasons.[3] First, employment contracts were poorly enforced, so the employees did not have much incentive to invest in their human capital. Second, the persistence of `obsolete' jobs hindered the appearance of the `modern' ones.

The present paper has three key aims. First, it estimates not only the total contribution, as de Vries et al. (2012) did, but also the sectoral contributions of labour reallocation to labour productivity growth for the Russian economy in 1995-2012. Second, it considers for the first time the impact of expanding informality on labour productivity growth in Russia. For this I develop a new industry-level data set, which includes variables for output and labour input for the period spanning from 1995 to 2012, using industry-level series of the Russia KLEMS data base (Timmer and Voskoboynikov 2016) and splitting them into formal and informal segments.[4] Finally, along with the traditional approach two other methods of the shift share analysis area applied, better tailored for the strong volatility of domestic relative prices (Tang and Wang 2004; Sharpe 2010).

This study is one of the first attempts to assess the impact of structural change on the growth of the Russian economy.[5] I decompose aggregate labour productivity growth into intra-industry and inter-industry contributions. All three approaches provide consistent evidence of the link between structural change and productivity. The *overall* contribution of structural change was growth enhancing, significant, and dumped in time. An explicit estimate of labour reallocation between formal and informal sectors of the economy, novel for Russia, leads to the reduction of the overall contribution effect because of the extension of informal segments of industries with low productivity levels. At the same time, *sectoral* labour input reallocation effects, also discussed in the literature[6], are found to be highly sensitive to the assumptions of the methods and to the presence of the informal split.

The paper has the following structure. Section 2 presents alternative approaches to the shift-share analysis that are used in later sections. Section 3 describes the process of data construction and data sources. Section 4 overviews major industry-level productivity and

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[3] In this context the paper of Kapelyushnikov et al. (2012) also mentions informal relations within firms and assumes that such relations helped inefficient firms to survive. However, the present study neglects the effect of informality within firms, focusing on producers with no status of legal entities.

[4] See Appendix A on the usage of terms formal/informal sectors and segments through the text.

[5] Vries et al. (2012) apply the conventional shift-share analysis to the Russian economy in 1995-2009, using one of the previous releases of the Russia KLEMS dataset in 1995-2009 with no informal split.

[6] See, e.g., (Diao, McMillan, and Rodrik 2017)

employment trends and points out productivity gaps between the formal and informal segments of the economy, essential for the following analysis. Section 5 discusses the outcomes of decomposing labour productivity growth rates into intra- and inter-industry effects. Section 6 concludes.

2. Approach to the structural decomposition

The reallocation of workers across industries contributes to aggregate labour productivity growth. There is a large volume of published studies[7] describing this phenomenon, originating from the pioneering study of Fabricant (1942), which decomposes the increment of aggregate labour productivity growth into intra-industry and inter-industry components. The former is caused by the accumulation of human and physical capital, intangible assets and technological progress[8], while the latter depends on structural changes in the economy. With the assumption of additivity of output in constant prices

(1) $\quad \bar{\bar{Y}}^t = \sum_n^N \bar{\bar{Y}}_n^t,$[9]

where $\bar{\bar{Y}}^t$ is the aggregate output in year t, $\bar{\bar{Y}}_n^t$ is the output of industry n, and N is the number of industries, the change in the aggregate labour productivity $\Delta \bar{\bar{X}}$ ($X \equiv Y/L$) can be written as follows

(2) $\quad \Delta \bar{\bar{X}} = \sum \left(s_{L,n}^0 \Delta \bar{\bar{X}}_n \right) + \sum \left(\Delta s_{L,n} \bar{\bar{X}}_n^1 \right) = \sum \left(s_{L,n}^0 \Delta \bar{\bar{X}}_n \right) + R.$

The last term in the second expression captures the reallocation effect $R \equiv \sum \left(\Delta s_{L,n} \bar{\bar{X}}_n^1 \right)$. Weights $s_{L,n}^t$ are shares of industry n in total labour.[10]

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[7] See, e.g., the review in (G. de Vries, Timmer, and Vries 2015).

[8] The contribution of multifactor productivity growth, which is usually interpreted as the outcome of technological change, could be also explained by temporary disequilibrium, caused by a delayed reaction on technological changes in previous periods, terms of trade, low mobility of labour and capital, as well as various competitive barriers (Reinsdorf 2015).

[9] For brevity sake, below we skip summation indices. Variables are marked with the double bar if it depends on output in constant prices with fixed weights (the Laspeires index formulae).

[10] One more reason for difficulties in the interpretation of sectoral contributions to structural change as independent, is the following point, raised by Diewert (2014). Say, an increase of labour share of this industry is offset by changes in labour shares of other industries. Indeed, if the number of industries exceeds two, there is no way to determine how the increase of the labour share of a certain industry is offset by decreases in labour shares of the other industries. The same logic is applicable to changes in relative prices. At the same time the total reallocation effect remains correct. So, the sectoral contributions should be considered as labour input reallocation effect, rather than the sectoral contributions to structural change.

Vries et al. (2012, sec. 4) showed that (2) depends on the level of disaggregation. Formally, applying (2) to the case when each industry n consists of M_n sub-industries, the corresponding labour productivity increment can be represented as

$$(3) \qquad \Delta \bar{\bar{X}}_n = \sum_m^{M_n} \left(\left(\frac{L_{n,m}^0}{L_n^0} \right) \Delta \bar{\bar{X}}_{n,m} \right) + R_n,$$

where $\left(\frac{L_{n,m}^0}{L_n^0} \right)$ is the labour share of industry n, and $\Delta \bar{\bar{X}}_{n,m}$ is the labour productivity growth of subindustry m in industry n. In turn, R_n is the effect of labour reallocation between sub-industries of n. Substituting (3) into (2), we have

$$(4) \qquad \Delta \bar{\bar{X}} = \sum_n^N \sum_m^{M_n} \left(s_{L;n,m}^0 \Delta \bar{\bar{X}}_{n,m} \right) + \sum \left(s_{L,n}^0 R_n \right) + R,$$

where $s_{L;n,m}^0 = \left(L_{n,m}/L \right).$

It is useful to represent (2) in terms of growth rates, rather than levels. Dividing both sides of equation (2) by $\bar{\bar{X}}$ and reformulating we come to

$$(5) \qquad \bar{\bar{\gamma}} = \sum \left(s_{\bar{Y},n}^0 \bar{\bar{\gamma}}_n \right) + \sum \left(s_{\bar{Y},n}^0 \sigma_n \right) + \sum \left(s_{\bar{Y},n}^0 \sigma_n \bar{\bar{\gamma}}_n \right).$$

Here $\gamma \equiv \Delta X / X_0$ is the labour productivity growth rate, $s_{\bar{Y},n}^0$ are the shares of the output of industry n in aggregate output, and σ is the growth rate of labour shares. Equation (5) originates from Denison (1962) and, following Dumagan (2013), will be referred TRAD. While the first term represents the contribution of labour productivity growth in industries. The second and the third terms taken together are associated with reallocation, or the `between' effect. Nordhaus (2002) labelled them *Denison* and *Baumol effects*, respectively.

The Denison effect is the contribution of labour reallocation between industries with different productivity levels. It shows why labour productivity acceleration in a certain industry can slow the aggregate productivity growth. Consider two industries in the economy, industry A being more productive than B $\left(\bar{\bar{X}}_A^0 > \bar{\bar{X}}_B^0 \right)$. Then because of, say, technology improvements in industry A its labour productivity level goes up, remaining unchanged in the rest of the economy. Under the

condition of constant demand for product industry A starts releasing workers, who find new jobs in B. As a result, the labour share in A shrinks, and in B grows, being both equal in absolute magnitude, or $\Delta s_{L,B} = -\Delta s_{L,A} > 0$. Then terms of industries A and B in the Denison effect component of (5) are

$$(6) \qquad s_{\bar{Y},A}^0 \sigma_A + s_{\bar{Y},B}^0 \sigma_B = \Delta s_{L,B} \left(s_{\bar{X},B}^0 - s_{\bar{X},A}^0 \right) < 0.$$

In other words, the negative contribution of the employment share in A is more harmful for aggregate growth, than a positive contribution of B, because *initial* productivity of A is higher than B.[11]

The Baumol effect, represented by the last term in (5), reflects the contribution of the labour reallocation between progressive industries with high productivity growth and stagnant ones with low growth (Baumol 1967).

One limitation of TRAD, mentioned in the literature[12], is the counter-intuitive interpretation of reallocation in some cases. Consider industry *n* with a below average productivity level. Intuitively, if it hires more workers from a more productive industry($\sigma_n > 0$), the reallocation effect should be negative. However, as follows from (5), contribution $s_{\bar{Y},n}^0 \sigma_n$ is positive. Another case is when the employment share of an industry with the below average productivity level shrinks ($\sigma_n < 0$), and its labour productivity falls ($\bar{\bar{\gamma}}_n < 0$). As seen from the third term in (5), $s_{\bar{Y},n}^0 \sigma_n \bar{\bar{\gamma}}_n$, the contribution of reallocation will be also positive.

Resolving this is an alternative approach developed in the Centre for the Study of Living Standards (CSLS) and implemented in the series of publications (De Avillez 2012), which accounts for the difference between productivity levels in an industry and in the economy as a whole. Reformulating (5) gives the explicit expression for the CSLS decomposition:

$$(7) \qquad \bar{\bar{\gamma}} = \Sigma \left(s_{\bar{Y},n}^0 \bar{\bar{\gamma}}_n \right) + \Sigma \sigma_n \left(s_{\bar{Y},n}^0 - s_{L,n}^0 \right) + \Sigma \sigma_n \left(s_{\bar{Y},n}^0 \bar{\bar{\gamma}}_n - s_{L,n}^0 \bar{\bar{\gamma}} \right).$$

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[11] As it follows from (6), the Denison effect is independent of labour productivity growth in industries. Its direction is specified by shifts in labour shares and relative productivity levels only. Denison stresses this, mentioning, that the aggregate labour productivity growth can be negative even if productivity growth in all industries is nill.

[12] See, e.g., (De Avillez 2012; Reinsdorf 2015).

Comparing TRAD (5) and CSLS (7), it can be seen that the first terms in both equations are the same. However, the industry-level components of the second term in (7) (Denison effect) become negative if employment expands in an industry with a below average level of labour productivity. In this case $\sigma_n \left(s^0_{\bar{Y},n} - s^0_{L,n} \right) = \Delta s_{L,n} \left(\frac{\bar{\bar{X}}^0_n}{\bar{\bar{X}}^0} - 1 \right) < 0$. By analogy, the Baumol effect for a low productive, shrinking industry is positive.

A major source of uncertainty of TRAD and CSLS is assumption (1) of the additivity of output in constant prices. Since (1) holds if aggregated output is calculated with fixed weights at constant prices of a certain base year, the output series are sensitive to the choice of this year. This dependence of the choice of the base year is the stronger the higher are changes of relative prices of a current year relative to the base one. Such dramatic changes took place both in developed economies and in economies in transition. Relative prices in developed economies varied mostly because of rapid development of ICT technologies (Nordhaus 2002) and transition economies experienced a smoothing of the multiple distortions of the planned economy period (Campos and Coricelli 2002). One more source of intensive variations in relative prices, specific for the Russian economy, is oil prices.

A conventional solution for this mismeasurement problem is the substitution of volume indices at constant prices with chained volume indices, as is recommended by the System of National Accounts.[13] In this case the exact additivity assumption (1) does not hold. One also needs other approaches to the shift-share analysis, consistent with the chained volume indices system, which were suggested by Tang and Wang (2004) and called Generalized Exactly Additive Decomposition (GEAD).[14] The counterpart of (1) in GEAD is additivity of output V in current, rather than constant prices

(8) $V = \sum V_n$.

Then real output Y refers to nominal output, adjusted for the level of current prices relative to the price level of a certain base year $Y \equiv V/P$.

With (8) an aggregated labour productivity level X can be represented as

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[13] (*System of National Accounts* 1993: 1.17, *System of National Accounts* 2008: 15.21), See more about using chain volume output indices in Russian statistics in (Rosstat 2014, section 3).
[14] See also the literature reviews in (Balk 2014; Reinsdorf 2015)

(9) $X \equiv \frac{Y}{L} = \frac{V}{PL} = \frac{\sum V_n}{PL} = \frac{1}{L} \sum \frac{V_n}{P_n} \frac{P_n}{P} = \sum \frac{Y_n}{L_n} \frac{L_n}{L} \frac{P_n}{P} = \sum s_{L,n} p_n X_n,$

where $p_n \equiv (P_n/P)$ is the relative price index of industry n. Specifying $s_n \equiv s_{L,n} p_n$, we represent the aggregated labour productivity level as

(10) $X = \sum s_n X_n,$

and, with small manipulations, aggregated labour productivity growth as

(11) $\gamma = \sum s_{Y,n}^0 \gamma_n + \sum s_{X,n}^0 (s_n^1 - s_n^0) + \sum s_{X,n}^0 (s_n^1 - s_n^0)\gamma_n,$

where $s_{Y,n}^0 = (Y_n^0/Y^0)$ and $s_{X,n}^0 = (X_n^0/X^0)$ are the ratios of productivity level in industry n to the aggregated one. Equation (11) is the GEAD decomposition with the first term being within contributions of industries, the second one is interpreted as the Denison effect, and the third one is the Baumol effect.

Dumagan (2013) showed that compared to TRAD, GEAD has, along with the superiority in terms of the fixed weights problem, two additional advantages. First, the within component in GEAD (the first term in (11)) depends only on industry price deflators, while in TRAD it (the first term in (5)) also rests on the price deflator for the total economy.[15] In other words, the TRAD decomposition is sensitive to the relationship between industry level deflators and the aggregated deflator. Second, in contrast to TRAD, GEAD takes into account changes in the aggregate productivity growth, caused by variations in relative prices. Such changes do not necessary lead to labour reallocation and can be explained, for example, by extra inflow of capital services.

Summing up, the three methods are implemented in the present study. The first one, TRAD, assumes fixed relative prices on industry products. It is widely used in the literature for the analysis of structural changes, so that the literature provides a rich context for comparisons across time and space. In addition, it provides an opportunity for the interpretation of the reallocation effect as the sum of two effects, which are labour reallocation between industries with different productivity

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[15] See equations (4.1) and (4.2) in (Dumagan 2013) for the explicit exposition of this.

levels (the Denison effect) and growth rates (the Baumol effect). The second, CSLS uses the same assumption of fixed product weights, as TRAD. However, it provides a better intuitive interpretation of sectoral contributions to structural change, than TRAD. Weakening the limitation of fixed relative prices leads to the third, GEAD. This approach also explores the split of the reallocation effect into the Denison and Baumol components.

Taking into account the rich literature on structural change and labour productivity growth,[16] the list of these three decompositions is not comprehensive. Moreover, these methods are not perfect.[17] This framework does form a coherent system of methods with a well-developed economic interpretation. The sections that follow show how these methods work for Russia.

3. Data

As discussed above, methods of the shift-share analysis require industry-level time series data on nominal value added, real value added, and labour input. Taking account of informality we are also expected to split these series into formal and informal segments in each industry.

The conventional source for industry-level data is the official System of National Accounts series (SNA). However, the Russian statistics office (Rosstat) provides consistent industry-level series in an international industry classification only from 2003. The only alternative data source with the time series set going back to 1995, is Russia KLEMS (Timmer and Voskoboynikov 2016; "Russia KLEMS" 2017). It includes backcast estimations of output and inputs to 1995, being consistent with the official total economy level SNA series 1995-2002, and the official industry-level SNA series afterwards.

The next step is breaking down the industry-level series into formal and informal segments. A worker is considered informal if (s)he is *not* engaged in an organization which belongs to the corporate sector or, in other words, has no status as a legal entity.[18] The informal segment, therefore, is measured statistically as the production in the institutional sector of households in SNA.

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[16] See. for example, the alternatives in the following studies (G. J. de Vries et al. 2012; Diewert 2014; Roncolato and Kucera 2014; Reinsdorf 2015).

[17] See more about shortages and limitations in (Timmer and Szirmai 2000; G. J. de Vries et al. 2012; Reinsdorf 2015)

[18] Being interested also in labour reallocation between formal and informal segments I disaggregate data for each industry by these segments, correspondingly. There is a long discussion in the literature how to define informality; I rely here on the productive definition which associates informality with properties of firms, not workers. For alternative definitions of informality and their application to the Russian employment are discussed by Lehman and Zaiceva (2013), Gimpelson and Kapelyushnikov (2015) and Lehman (2015).

Industry-level nominal value added is estimated by Rosstat as the sum of value added in the corporate sector and the household sector. The latter is measured by using various indirect estimates in accordance with international guidelines.[19] The share of the informal segment in value added is assumed to be the share of the household sector in the total value added of a particular industry.[20] Unfortunately, this subset of data is available at the one-digit level only. For example, manufacturing includes thirteen industries, among which the informal segment in 2005 varied from 3% of hours worked in Electrical and Optical Equipment (code 30t33, see Appendix B) to 38% in wood and wood products and cork (20). To resolve the issue for an industry at the two-digit level I use shares of a corresponding parent industry from the higher aggregation level. Thus, the informal share of both Electrical and optical equipment (30t33) and Wood (20) are assumed to be equal to that in all manufacturing. The share of hours worked in the informal segment of each industry was calculated with data on hours worked in total and in the corporate sector, which is available starting from 2005.

There are two exceptions in the application of this general approach. First, we set the informal share in mining (C) and financial intermediation (J) to be nil. Official data estimates for the value added in these industries produced by SMEs are under 0.2% and 1%, respectively.

Finally, I need to estimate the real value added series in formal and informal segments. Assuming that price deflators in these two segments within each industry are the same, we deflate nominal value added applying the implicit GDP deflators in each industry. These deflators are calculated implicitly with the real and nominal value added in each industry, given in Russia KLEMS.

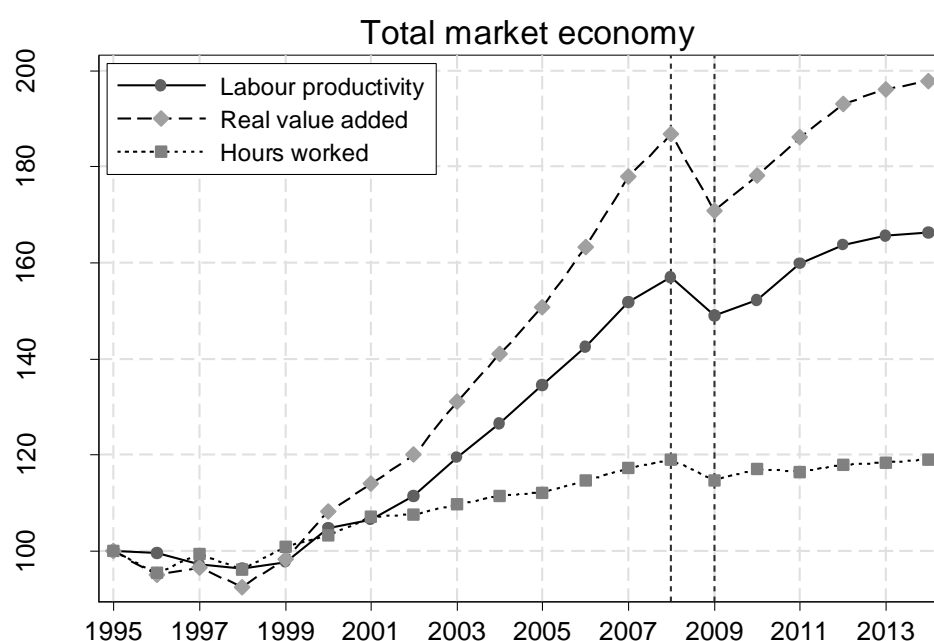## 4. Trends of productivity growth in Russia: shocks and adaptation

One of peculiarities of the Russian growth pattern has been relatively stable employment with highly volatile output. This characterized the transformational recession 1991-1998, the post-transition recovery in 1999-2008 and the following stagnation after the global financial crisis in 2009 onwards (Kapelyushnikov, Kuznetsov, and Kuznetsova 2012). Figure 1 reveals that in 1999-2008 real value added of total market economy doubled, while employment grew by less than 24%. Another example of this is the reaction of the economy to the global crisis of 2009. While output plummeted by 8.9% in 2009 relative to 2008, the fall of employment was just 3.6%. Although all

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[19] Methodology description of output and value added of the economy, including the informal segment, is available by Rosstat(1998). International experience of this is generalized by OECD (2002).

[20] Data is available in official publications of Rosstat. See, for example, Rosstat (2014, tab. 2.3.44), and similar publications for previous years. Starting from 2002, Rosstat publishes also shares of value added, adjusted for unobserved economic operations (Rosstat 2010, tab. 2.3.46-52). I prefer the former since the share of the sector of households concur with the share of unobserved economic operations until 2009. For succeeding years the latter falls much faster than the former, which unveils some unreported changes in methodology. I thank Rostislav Kapelyushnikov, who attracted my attention to this issue.

transition economies passed through stages of the transformational recession and the post-transition recovery, these stages varied in depth and duration[21] and most economies of central and eastern Europe employment trends followed GDP more closely. Market reforms in central and eastern Europe triggered unemployment growth, which reached at least 10% almost immediately, while in Russia the unemployment level passed this level only on the sixth year of reforms, and reached maximum of 13.3% in 1998.

Figure 1. Trends of real value added, hours worked and labour productivity in 1995-2014 in total market economy (1995=100)

Sources: (Timmer and Voskoboynikov 2016; "Russia KLEMS" 2017)

Note: Market economy includes all industries except those, where non-market services dominate, such as Public Administration, Education, Healthcare and Real Estate

The explanation for the Russian anomaly lies in `the Russian way' of adapting the labour market to external shocks, starting from the shock therapy in early transition (Layard and Richter 1995), and includes a wide range of informal arrangements between employers and employees, which help absorb external shocks by proper adjustment of wages and actual hours worked. Another form of this adaptation is the availability of multiple job opportunities in the informal

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[21] See (Campos and Coricelli 2002) for a comprehensive review.

segment (Kapelyushnikov, Kuznetsov, and Kuznetsova 2012). [22] After losing work in registered firms a job could be found in a firm with no legal status.

Such a reallocation does not change the total number of hours worked in the economy significantly, but influences the structure of the economy and increases the share of the informal segment. The corresponding changes in the employment structure in 2000-2013 are represented in Figure 2. The small total increment of jobs by almost 3.5 million for thirteen years, mostly in years of outstanding growth[23], masks huge inflow of 8.8 million jobs to the informal segment, and also significant outflow of 5.3 million jobs from formal organizations. The most significant losses of formal jobs were manufacturing (3.7 mil) and agricultural firms (3.3 mil), while informal jobs gained in construction (1.4 mil), trade (1.3 mil), transport (1.0 mil), and business services (0.5 mil). This is more or less in line with expectations about traditional sectors with a significant labour share of informal workers. What stand out are the remarkable cross-flows of jobs between formal and informal segments within manufacturing and transport. This can indicate that some manufacturing workers preferred staying in profession, but leaving corporate enterprises for small workshops.
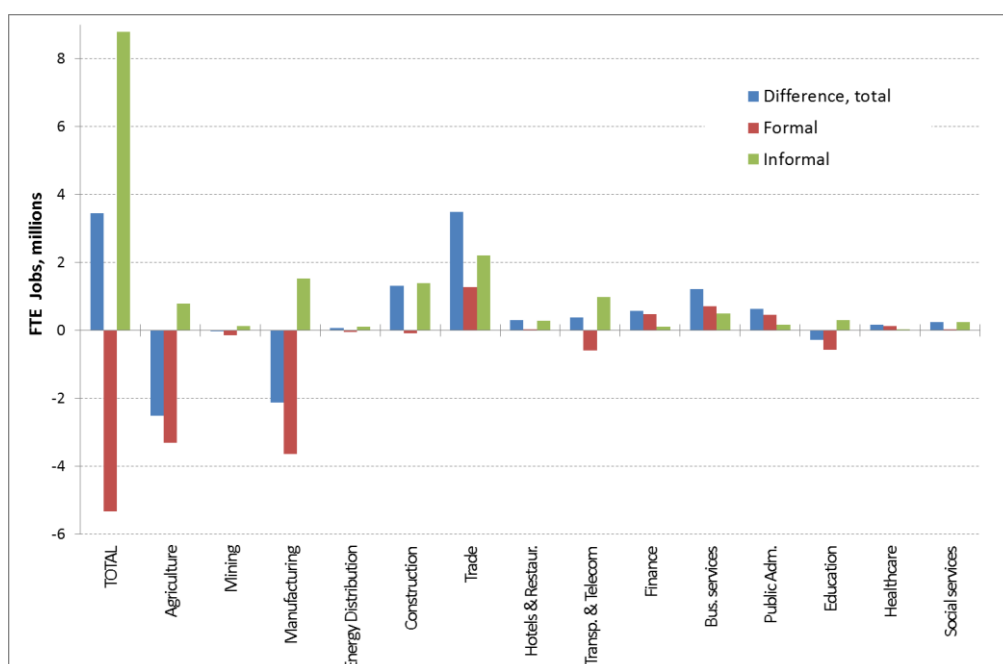
All in all, the impact of the `Russian way' of labour market adaptation to the initial shock therapy of plan-market transition, and to the following shocks of 1998 and 2008, is ambiguous. It provided some level of social stability through the relatively low level of unemployment because of the absorption of excessive labour by the informal segment; however such labour reallocation to low productive informality influences aggregate labour productivity growth. The drastic changes in the structure of employment in Figure 1, can slow aggregate labour productivity growth.

What follows in this section is a brief description of the other proximate factors which contribute to the aggregate labour productivity growth.

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[22] See also the study of Gimpelson and Kapelyushnikov (2013) for the literature review.
[23] Some similarities of the countercyclical expansion of informality in Russia might be found in Mexico – see (Fernández and Meza 2015).

Figure 2. The change of the number of workers in total economy and major sectors in 2000-2013

Source: the Labour Force Survey, Rosstat

Aggregate labour productivity is driven by two types of proximate sources: changes in the performance of industries, fuelled mostly by investments to physical and human capital and innovations, and labour reallocation across industries. The study of Timmer and Voskoboynikov (2016) reveals that the former is driven by capital intensity in low-skill intensive services and Extended Mining, and by technology catching up in Manufacturing, Financial intermediation and business services. Extended Mining includes not only Mining, but also Wholesale trade and Fuel, because the lion's share of oil and gas revenues falls at them (Timmer and Voskoboynikov 2016). Labour reallocation is the focus of the present study. It reflects fluctuations in the industrial structure of the economy. The impact of labour reallocation is more substantial, the more the structure changes and industries differ in productivity.

Considering reallocation effects between thirty industries of market economy, for descriptive purposes I have combined them into six sectors, which are Agriculture, Manufacturing, Extended Mining, Market Services (e.g. Construction, Retail and Telecommunications (CRT)), Transport, and Finance and Business Services[24]. Suggesting these sectors I take into account the following considerations. Agriculture and Manufacturing are sectors, which are conventional within the three-sectoral analysis in development economics. One more reason of our interest in

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[24] The composition of these sectors is represented in Appendix B.

Agriculture in the context of Russia is its high share in comparison to other post-industrialized and post-transition economies of a similar level of development. Extended Mining is considered separately because of its size and the specific role in the Russian economic performance. Taking into account the high share of services in modern developed economies and their heterogeneous performance (Jorgenson and Timmer 2011), I split services into three additional sectors. Transport is specific for its high capital intensity. Workers engaged in Finance and Business Services differ from the rest of market servicers activities with the average level of skills and education (O'Mahony and Ark 2003), which make these industries specific in terms of labour productivity performance. Finally, I exclude Public administration, Education and Healthcare, because of low quality of productivity measures in non-market services in the National Accounts (Timmer et al. 2010).

In recent decades the Russian economy has gone through intensive structural changes. The structure of the economy in 1995, three years after transition, still carried some rudiments of the planned economy and early transition distortions. In terms of hours worked the share of goods (Agriculture and Manufacturing) was almost 60%. Surprisingly, more than two thirds of all labour was agricultural, which is enormous for a post-industrialized economy. This was caused by labour intensive non-market households, which produce agricultural products for their own consumption (Gimpelson and Kapelyushnikov 2015). Being labour intensive and having low productivity in comparison with agricultural firms, these households use around 12% of total hours worked or more than half in Agriculture (Rosstat 2009, tab. 3.5). As might be expected, the share of Extended Mining was small.

In the following years we observe a replacement of goods by services, which was the outcome of different forces acting in one direction. These are the shift of demand from goods to services because of income growth; the overcoming of the planned economy over-industrialization; competition with Asia in manufactured goods; the expansion of Extended Mining in the years of soaring global oil prices, starting from 1999. Table 1 shows the shares of sectoral hours worked and value added in 1995 and 2012. The share of Agriculture in the total hours worked reduced from 28% to 21% and the share of Manufacturing decreased from 19% to 15%. This contrasts sharply with the expansion of CRT from 20% to about 28% of total hours worked. Not less impressive was the structural change in value added. The share of Agriculture almost halved, the share of Manufacturing reduced from 7.6% to about 4%, that of Transportation fell from 11.7% to 6.8%. Mining, Finance and Business Services increased their shares in GDP, while the aggregate share of Retail, Construction and Services changed little.

Table 1. Sectoral shares in 1995 and 2012 (%)

Sectors	Value added		Hours worked	
	1995	2012	1995	2012
Total economy	100.0	100.0	100.0	100.0
Market economy	86.1	81.7	80.9	79.6
Agriculture	7.6	3.9	27.9	20.9
Manufacturing	22.4	14.9	18.8	15.1
Extended Mining	20.1	25.0	3.5	4.5
Construction, Retail and Telecom	19.2	20.1	19.7	27.5
Transport	11.7	6.8	5.7	5.9
Finance and Business Services	5.1	10.9	5.2	5.7
Non-market economy	13.9	18.3	19.1	20.4

Source: (Timmer and Voskoboynikov 2016; "Russia KLEMS" 2017)

A comparison of the shares of value added and hours worked in Table 1 also provides some insight about the variations in labour productivity levels and growth across sectors. For example, Agriculture seems the least productive, because its share of hours worked in 1995 is almost four times as much as its share of value added. It is not surprising that the share of value added of capital intensive Extended Mining is more than five times higher than the share of hours worked. We expect the remarkable growth of labour productivity in Financial and Business Services, because by 2012 its share of value added raised by 5.8 p.p., while the share of hours worked by only 0.5 p.p. It is also worth mentioning the fall of labour productivity in CRT with its constant share of value added and the expanding labour share by 10.3 p.p.

Taking into account the substantial changes in jobs in the formal and informal segments of the economy, represented in Figure 2, this can be the additional source of variations in productivity. Indeed, Table 2 shows that the share in hours worked by informal workers in 2005 was almost 44% and continued expanding. The share of informality varies across sectors from a modest 10% (2012) in Financial and Business Services to 80% in agriculture. Equally important, the gap in labour productivity levels between the formal and the informal segments of the economy is substantial and becomes deeper. While the labour productivity level of total informal economy was 17% of the formal one in 2005 and fall to 14% by 2012, the picture across sectors is heterogeneous. Informal manufacturing is very unproductive and degrades from 11% in 2005 to 5% in 2012. At the other extreme, in Financial and Business Services informal workers seem to be much more productive than their formal colleagues. This is the area where high quality freelancers over perform traditional corporate forms of activity.

Table 2. Shares of hours worked of the informal segment and relative labour productivity levels

	Labour shares of informal segments (% of hours worked)		LP levels of informal segments relative to formal ones	
	2005	2012	2005	2012
Total market economy	43.8	44.8	0.17	0.14
Agriculture	79.7	82.7	0.31	0.27
Manufacturing	12.1	15.4	0.11	0.05
Extended Mining	38.2	35.4	0.19	0.15
Construction, Retail and Telecommunications	44.8	44.8	0.22	0.16
Transport	21.4	27.2	0.14	0.19
Finance and Business Services	8.1	9.7	1.74	1.29

Source: authors' calculations. See details in main text.

Note: Relatively high shares of informal segment in extended mining are caused by high informality in some organizations of wholesale trade. However, it is unclear if these organizations provide some specific energy-export oriented services or other wholesale trade activities. Numbers may not sum exactly due to rounding.

The results reported in this section show that structural change can be a substantial source of variation in aggregate labour productivity. This follows from the fact that the shifts in the structure of the economy in recent decades were substantial and variations in productivity across industries were high. In addition, I provide evidence that labour reallocation between formal and informal sectors of the economy can contribute to productivity variations. However, these preliminary results do not answer the question of what the relative impacts of all these reallocation effects to aggregate productivity growth are. Such estimations need a more accurate shift share analysis technique, which will be implemented in the following section.

5. The contribution of labour reallocation and informality

This section assesses the impact of structural change and labour reallocation on aggregate labour productivity growth in two cases. The first one, conventional in the literature, deals with industries with no informal split. Applying the three alternative methods of the shift-share analysis, discussed in section 2, I tease out the effects where they provide consistent results. Next, addressing the issue that this `no-split' approach wrongly treats the impact on aggregate

productivity from job flows between formal and informal segments within industries as the outcome of the intra-industry sources, I take into account the informal split explicitly.[25] Comparing results of the two cases, I discuss the bias of the `no-split' approach and the impact of informality expansion on labour productivity growth.

Table 3. Alternative decompositions of labour productivity growth

Contributions to yearly average growth rates (p.p.)

	TRAD, CSLS		GEAD	
	1995-2005	2005-2012	1995-2005	2005-2012
Total market economy	5.04	4.00	4.98	3.71
Total intra-industry	4.21	3.36	3.81	3.36
Agriculture	0.28	0.14	0.32	0.14
Manufacturing	0.93	0.43	1.09	0.43
Extended Mining	1.10	0.98	0.55	0.98
Construction, Retail and Telecommunications	0.52	1.06	0.61	1.06
Transport	0.33	0.16	0.32	0.16
Finance and Business Services	1.05	0.60	0.93	0.60
Reallocation	0.83	0.64	1.17	0.36

Notes: In this decomposition informal split is *not* taken into account. TRAD, CSLS: constant prices of 2005 are used. Numbers may not sum exactly due to rounding.

Source: authors' calculations. See main text.

Table 3 presents the decomposition of aggregate labour productivity growth into intra-industry contributions and the impact of labour reallocation for 30 industries of the market economy in 1995-2012, which are grouped in six aggregated sectors. The table also reports the results obtained by the alternative methods.[26] Over the period all approaches are consistent in revealing the main trends of this decomposition. First, aggregate productivity growth decelerates in

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[25] A similar approach was used by Vries et al. (2012) for Brazil and India

[26] Comparing equations (5) and (7) one can be noticed that sectoral contributions and the total reallocation effect in TRAD and CSLS are the same.

2005-2012 in comparison with the previous decade. Next, the main drivers of aggregate productivity growth in the first decade were Extended Mining, Manufacturing, and Finance and Business Services, while in the following years Manufacturing and Finance and Business Services gave way to the consumption-oriented sector of CRT. Finally, the contribution of labour reallocation declines. For example, the estimations of TRAD/CSLS demonstrate the fall of the reallocation component by almost 0.2 p.p. or from 0.83 p.p. in 1995-2005 to 0.64 p.p. in 2005-2012. The fall of reallocation explains from one fifth of the total [27] for TRAD/CSLS to almost two thirds for GEAD. A possible explanation for this decline is the slow elimination of the disproportions of the planned economy in the late stages of the transition from plan to market. Summing up, the role of labour reallocation in total growth is minor in comparison with intra-industry sources. From this perspective, Russia seems similar to the Latin America region, rather than East Asia or Africa (see Diao et al (2017)).

The overall reallocation component deserves more attention not only because its contribution remains significant for the Russian economy, but also because of the contribution of labour input reallocation to structural change in different patterns of structural transformation, discussed by Diao et al (2017) and calculated with the TRAD approach.

Section 2 elaborates the differences in initial assumptions of the three methods of structural decomposition, which are shown as different approaches to the calculation of the reallocation term. That is why it is little wonder that sectoral contributions to structural change, represented in Tables 4 and 5, are mostly sensitive to the method used. For example, the negative contribution of Agriculture, provided by TRAD both in 1995-2005 (- 0.18 p.p., table 4) and in 2005-2012 (-0.08 p.p., table 5) becomes positive with CSLS (0.41 p.p. and 0.26 p.p. respectively). This could be expected, because CSLS is a modification of TRAD, which provides the positive contribution to structural change for sectoral labour outflow from a low productive industry as Agriculture. In turn, the GEAD-based contribution of Extended Mining in 1995-2005 is at least three times as much as TRAD and CSLS, which can be explained by drastic changes of the relative prices in 2005 in comparison with 1995 against the rapid growth of oil prices. Interestingly, the variation of GEAD-based structural change contributions are higher in comparison with TRAD in 1995-2005 (Table 4), rather than in the following years (Table 5), which can also be interpreted as the outcome of the drastic change of oil prices. These findings clearly indicate that sectoral contributions to structural change are sensitive to the way the shift-share analysis is implemented.

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[27] Aggregate productivity growth dropped by 1.04 p.p. while reallocation – by 0.19 p.p., or almost 19% of 1.04.

Table 4. Sectoral labour reallocation effects in 1995-2005

Contributions to yearly average growth rates (p.p.)

	TRAD	CSLS	GEAD
Reallocation, total market economy	0,83	0,83	1,17
Agriculture	-0,18	0,41	-0,33
Manufacturing	-0,16	0,12	-0,59
Extended Mining	0,57	0,44	1,81
Construction, Retail and Telecommunications	0,62	-0,16	0,43
Transport	-0,02	-0,02	-0,33
Finance and Business Services	0,00	0,03	0,18

Notes: In this decomposition informal split is *not* taken into account. TRAD, CSLS: constant prices of 2005 are used. TRAD, CSLS, GEAD – references to methods. Numbers may not sum exactly due to rounding.

Source: authors' calculations. See main text.

Along with the variety of methods, one more source of uncertainty in this type of the analysis is the option to take into account informality. Indeed, the substantial share of informal labour is a reality in most developing economies. It has been widely discussed in the context of its influence on overall productivity growth. At the same time, it is usually[28] skipped in the quantitative decompositions of aggregate labour productivity growth.

Taking into account substantial heterogeneity of productivity levels, reported in Table 2, the introduction of the informal split increases heterogeneity in labour productivity levels and, therefore it is expected to affect components of productivity growth. As follows from equations (3) and (4), the fraction of aggregate labour productivity growth, which was initially attributed to the within effect, now becomes the part of the between effect. This shift reflects implications of flows across formal-informal divide.

Data from Tables 4 and 5 empower the quantitative evaluation of this fraction. Indeed, as follows from Table 3, the total yearly average labour productivity growth rates in 2005-2012 are 4.00%, of which 3.49p.p. is contributed by the total intra-industry contributions, and 0.64 p.p. by the reallocation effect between industries and -0.13 p.p. by the overall reallocation between the formal and informal segments within industries. In other words, if the informal split is not taken into account, the overall within effect is underestimated by -0.13 p.p., equals 3.36 p.p. and reported

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[28] The remarkable exception is the study of de Vries at al (2012), in which the impact informality on the reallocation effect is considered for Brazil and India.

in Table 3. This negative impact reflects the expansion of the low-productive informal segment. Table 2 reports that its share grew in 2005-2012 by 1 p.p., while its labour productivity level was below one fifth of the formal one.

Table 5. Sectoral reallocation effects in 2005-2012

Contributions to yearly average growth rates (p.p.)

	TRAD		CSLS		GEAD	
	Informal split:		Informal split:		Informal split:	
	No	Yes	No	Yes	No	Yes
Reallocation, total market economy	0,64	0,51	0,64	0,51	0,36	0,22
Agriculture	-0,08	-0,13	0,26	0,20	-0,11	-0,16
Manufacturing	-0,17	-0,31	0,04	-0,09	-0,09	-0,22
Extended Mining	0,04	0,17	0,03	0,16	0,05	0,17
Construction, Retail and Telecommunications	0,28	0,26	-0,07	-0,09	0,26	0,25
Transport	0,04	-0,04	0,01	-0,08	0,06	-0,02
Finance and Business Services	0,53	0,56	0,38	0,40	0,18	0,20

Notes: TRAD, CSLS: constant prices of 2005 are used. Numbers may not sum exactly due to rounding.
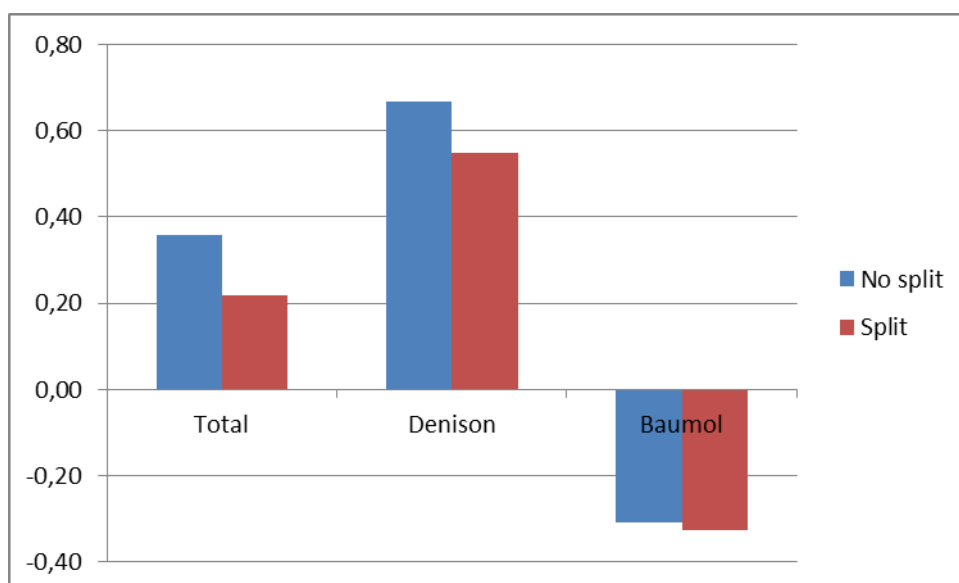
Source: authors' calculations. See main text.

Consequently, the effect of labour reallocation between the formal and informal segments within a sector (the difference between the second and the first columns of Table 5) equals the sectoral contributions of this reallocation between formal and informal segments. The table shows that this reallocation is negative for all sectors with two exceptions. In Finance and Business Services the informal segment is more productive, which follows from Table 2, so there is little surprise that the expansion of its informal segment by 1.6 p.p. leads to a positive contribution. Such a shift could reflect the fact, for example, that a qualified lawyer has left a firm and become self-employed.[29] Another exception is Extended Mining. As follows from Table 2, this is the only sector where the informal sector contracted by 2.8 p.p. This effect is also evident as the gross flow of jobs in Figure 2. The most substantial intra-sectoral reallocation of jobs between formal and informal segments in Manufacturing, Agriculture and Construction corresponds to the largest values of the effect (in absolute values).

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[29] We see this group of highly qualified self-employed at micro level (Gimpelson and Kapelyushnikov 2015).

Figure 3. The contribution of labour reallocation on aggregate labour productivity growth of the Russian economy in 2005-2012

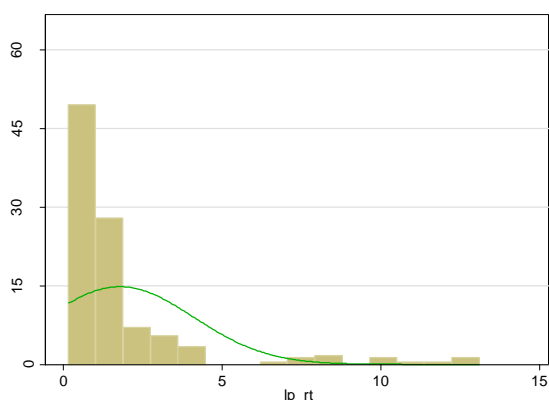Contributions to yearly average growth rates (p.p.)
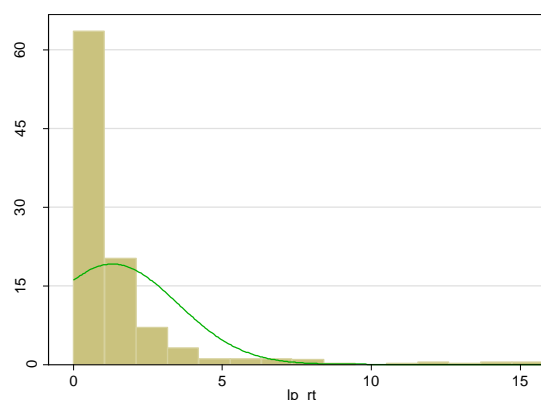

Source: author's calculations, see main text

Note: GEAD approach for the shift-share analysis (Tang and Wang 2004)

Figure 4. Distributions of labour productivity levels across industries in 2005-2012

A. Total industries with no informal split.
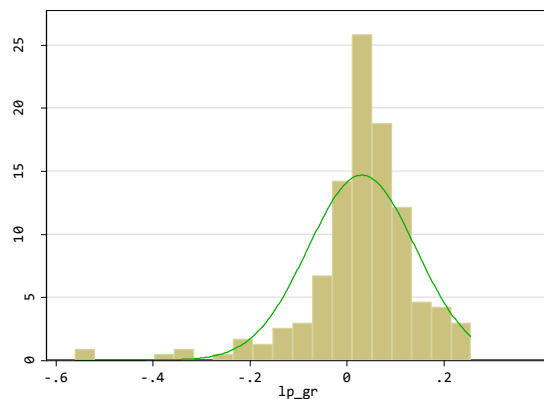
B. Industries with the informal split

Note. Labour productivity level in an industry refers to the nominal value added per hour worked, normalized to the aggregate labour productivity level of a corresponding year. Descriptive statistics of the distributions is available in Appendix C.
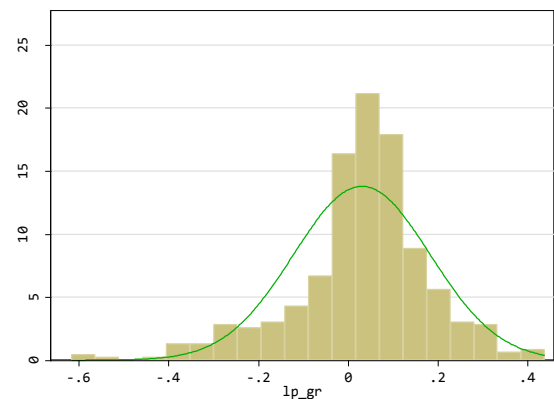
Sources: authors' calculations. See main text.

Figure 5. Distributions of labour productivity growth rates across industries in 2005-2012

A. Total industries with no informal split.　　B. Industries with the informal split

Note. Labour productivity growth rate in an industry relative to the previous year is defined as the difference in growth rates of the real value added of this industry and its hours worked. Descriptive statistics of the distributions is available in Appendix C.

Sources: authors' calculations. See main text.

As it stands, expanding informality reduces growth enhancing structural change because of labour reallocation to less productive informal segments of industries. One can make one step further and answer the question of the nature of this aggregate productivity slowdown—if it is driven by the expansion of industries with lower productivity levels as defined in section 2 (the Dennison effect), or, alternatively, growth rates (the Baumol effect). The results of the corresponding decomposition for GEAD are given in Figure 3. Of the total decrease -0.14 p.p. the Denison effect contribution is -0.12 p.p., while the Baumol effect is only 0.02 p.p. In other words, reallocation of labour between industries with different productivity levels has a larger effect on aggregate growth than with different growth rates.

Why is that? The Denison effect captures shifts of labour between industries with different levels of labour productivity, while the Baumol effect deals with growth rates. Comparing Figures 2 and 3, the informal split impacts the distribution of levels stronger than of growth rates. Since the distribution of levels became more asymmetrical, biased in the direction of the left tail, one can conclude that the probability of a reallocation to a position with a lower level of productivity in comparison with the previous one is much higher than to a more productive one. On the contrary, with the informal split the distribution of growth rates becomes more symmetrical. We expect that the extension of informality led to employment growth in industries with below average productivity levels.

The same effect can be represented in the form of distributions of industries by labour productivity levels (Figure 4) and growth rates (Figure 2). Taking into account the informal split shifts, the distribution of productivity levels is to the left, which can be noticed by comparison of these Figures. In comparison with the no split case the skewness of the distribution with the informal split raises by one quarter. With that, the increasing number of low productivity industries shifts the average productivity down from 1.8 to 1.3 of the total economy level (see Appendix C). The growing spike appears also in the form of increasing kurtosis. All this indicates that the probability of finding a new job for a worker with the lower *level* of productivity than the previous one is higher if the informal split is taken into consideration.

The informal split can also impact the distribution of productivity growth rates. Figures 3A and 3B show that it does, but the influence is different. In contrast to the distribution of levels, the asymmetry of growth rate distribution decreases. The corresponding skewness (Appendix C) becomes closer to nil, changing from -1.7 to -0.8, which indicates that the tails on both sides balance out. Interestingly, the informal split has no impact on the mean growth rates, which remain 3.1 per cent per year. At the same time, higher standard deviation (15.3 instead of 11.1) is caused by increasing infrequent extreme deviations, as follows from the decreasing value of kurtosis. In other words, the number of industries with extreme productivity growth, both positive and negative, increases. All in all, there is no evidence that taking into account the informal split leads to the increasing role of industries with growing or falling productivity.

Though the estimates produced by alternative decomposition methodologies differ, they paint a largely similar picture. The core is that the reallocation in the Russian economy in 1995-2012 was not growth neutral. Its contribution into the aggregate labour productivity growth was positive. This finding matches evidence from other studies which suggest a consistent upgrade in job quality in 2000-2012 (Gimpelson and Kapelyushnikov 2014). However, a more precise account of the informality composition and associated trends discounts the positive contribution of labour reallocation. Reallocation remained progressive but the trend towards the expansion of informality worked in the opposite direction. Workers who moved from the formal sector into the informal one got jobs in industries where the productivity levels were lower than in industries they exited. A worker leaving large industrial plant could become a cab driver or a sales person (formal or informal), or could earn their living transforming their garage or basement into a small workshop. The latter option allows them to stay in the same industry but working informally. In any case, in this new job one hour of work produces much less value added than in the previous one.

6. Conclusion

The present study was designed to examine the link between structural change and the aggregate labour productivity growth of the Russian economy to obtain the quantitative evaluation of the impact of the expanding informal segment in Russia on productivity in the context of structural dualism, thoroughly discussed by Diao, McMillan and Rodrik (2017) for the analysis of the recent performance of developing and emerging economies. For this I have applied a set of alternative analytical tools to decompose the aggregate labour productivity growth into the between and within components.

Three main findings are that in 1995-2012 labour reallocation in Russia was significant, growth enhancing and dumping. Considering 2005-2012 the study also evidences that expanding labour reallocation to the informal segment of the economy acted in the opposite direction and slowed down aggregate labour productivity growth. Further decomposition of the reallocation contribution unveiled that this deceleration can be caused by the expanding employment share of informal activities with low labour productivity levels.

Overall, this study strengthens the idea of the dual role of the informal sector. While the informal sector is a safety valve which amplifies social consequences of external shocks and makes employment stable, the expanding informality leads to a slowdown of labour productivity and, from this perspective, is harmful for growth. The study also raises important questions about the methods used for the shift-share analysis. Indeed, although the main findings have been confirmed with the three methods used, sectoral labour reallocation effects were sensitive to the approach. Finally the study highlights the role of relevant institutions, which is discussed by Rodrik (2008). Formal adaptation of the best practices of developed economies by Russia in first years of the transition from plan to market in conjunction with weak state enforcement reduced the structural bonus because of expanding informality and abated long run growth.

In conclusion, a number of important limitations of this study need to be mentioned. The consideration of the problem at the level of industries overlooks the contribution of labour reallocation between firms within an industry, which can be significant.[30] I am also limited with the definition of informality by the one adapted in the Russian system of national accounts. At the same time, the share of informality depends on the definition, as seen in the data of household surveys.[31] Using this definition, adapted by the Russian official statistics, it is also difficult to split the impact of the informal economy and household production. However, the macro perspective, used in the present study, is the only one which considers the whole economy, rather than the corporate sector for firm-level surveys, and is consistent with the total economy measure of economic growth.

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[30] See, e.g., (Brown and Earle 2008).
[31] (Lehmann and Zaiceva 2013; Gimpelson and Kapelyushnikov 2015)

Acknowledgements

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Appendices

Appendix A. Usage of terms `sector' and `segment'

The following terminology is used through the text. The economy consists of *industries*. Groups of industries can be combined into *aggregated sectors*, such as total market economy, or *sectors* such as manufacturing. The full list of industries and aggregated sectors is given in Appendix B.

Next, if the *informal split* is taken into account, each industry is divided into two *segments*, formal and informal. Formal segments of all industries form the formal sector of the economy, whereas the informal segments are combined into the informal one. It is also possible to discuss informal segments of an aggregated sector, assuming the set of informal segments of industries, which belong to the aggregated sector. For example, the informal segment of manufacturing consists of informal segments of industries within manufacturing. It is worth mentioning that term `*sectoral contribution*' assumes the contribution of sectors or aggregated sectors only in the no-split case.

Finally, it is worth mentioning that the informal sector addresses the set of the informal segments of industries of the total market economy, because informal activities of the non-market economy are not in the scope of the paper.

Appendix B. The list of industries and the composition of aggregated sectors

#	Code	Industry	Sector	Aggregated Sector
1	AtB	Agriculture, Hunting, Forestry and Fishing	Agriculture	Market economy
2	23	Fuel	Extended gas and oil	Market economy
3	C	Mining and quarrying	Extended gas and oil	Market economy
4	51	Wholesale trade	Extended gas and oil	Market economy
5	15t16	Food, Beverages and Tobacco	Manufacturing	Market economy
6	17t18	Textiles and Textile Products	Manufacturing	Market economy
7	19	Leather, Leather and Footwear	Manufacturing	Market economy
8	20	Wood and Products of Wood and Cork	Manufacturing	Market economy
9	21t22	Pulp, Paper, Paper , Printing and Publishing	Manufacturing	Market economy
10	24	Chemicals	Manufacturing	Market economy
11	25	Rubber and Plastics	Manufacturing	Market economy
12	26	Other Non-Metallic Mineral	Manufacturing	Market economy
13	27t28	Basic Metals and Fabricated Metal	Manufacturing	Market economy
14	29	Other Machinery	Manufacturing	Market economy
15	30t33	Electrical and Optical Equipment	Manufacturing	Market economy
16	34t35	Transport Equipment	Manufacturing	Market economy
17	36t37	Manufacturing, nec.; Recycling	Manufacturing	Market economy
18	E	Electricity, Gas and Water supply	Manufacturing	Market economy
19	F	Construction	Retail, Construction, Telecom	Market economy
20	50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	Retail, Construction, Telecom	Market economy
21	52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	Retail, Construction, Telecom	Market economy
22	H	Hotels and Restaurants	Retail, Construction, Telecom	Market economy
23	64	Post and Telecommunications	Retail, Construction, Telecom	Market economy
24	O	Other Community, Social and Personal Services	Retail, Construction, Telecom	Market economy
25	J	Financial intermediation	Fin. & Business Services	Market economy
26	71t74	Renting of Machinery and Equipment and Other Business Activities	Fin. & Business Services	Market economy
27	60	Inland transport	Transport	Market economy
28	61	Water Transport	Transport	Market economy
29	62	Air Transport	Transport	Market economy
30	63	Other Transport Services	Transport	Market economy
31	70	Real est. Act.	Non-market	Non-market economy

			services	
32	L	Public Admin And Defence; Compulsory Social Security	Non-market services	Non-market economy
33	M	Education	Non-market services	Non-market economy
34	N	Health And Social Work	Non-market services	Non-market economy

Appendix C. Distributions of labour productivity levels and growth rates by industries

Table C1. Measures of labour productivity level distribution in industries in 2005-2012

	NO Split	Informal Split
Mean	1.79	1.32
Standard deviation	2.33	2.20
Skewness	3.05	3.82
Kurtosis	12.46	20.20

Note. Labour productivity in industries refers to nominal value added over hours worked. Industry productivity levels are normalized to the level of total economy of a corresponding year.

Table C2. Measures of labour productivity growth rates distribution in industries in 2005-2012

	NO Split	Informal Split
Mean	0.0320	0.0319
Standard deviation	0.1113	0.1520
Skewness	-1.7148	-0.7810
Kurtosis	9.4647	4.9661

Note. Labour productivity growth rates are measured in yearly average growth rates

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