the review of income and wealth

Review of Income and Wealth
Series 66, Number 2, June 2020
DOI: 10.1111/roiw.12417

STRUCTURAL CHANGE, EXPANDING INFORMALITY AND LABOR PRODUCTIVITY GROWTH IN RUSSIA

by Ilya B. Voskoboynikov*

National Research University Higher School of Economics

Strong growth, intensive structural change, and expanding informality have characterized many developing and emerging economies in recent decades. Yet most empirical investigations into the relationship between structural change and productivity growth overlook informality. This paper includes the informal sector in an analysis of the effects of structural changes in the Russian economy on aggregate labor productivity growth. Using a newly developed dataset for 34 industries covering the period 1995–2012 and applying three alternative approaches, aggregate labor 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 decreasing over time. Labor reallocation from the formal sector to the informal sector tends to reduce growth through the extension of informal activities with low productivity levels. Sectoral labor reallocation effects are found to be highly sensitive to the methods applied.

JEL Codes: O11, O17, C82

Keywords: informal economy, labor productivity, Russia, structural change

1. Introduction

The past two decades have witnessed intensive growth and structural change[1] in emerging and developing economies (Diao *et al.*, 2017). Many such economies are characterized by sizable informal sectors, which account for a substantial share of employment and value-added production (Hassan and Schneider, 2016).

de Vries *et al.* (2012, p. 219) observe that when formal and informal activities within industries are not distinguished, the estimation of the impact of structural

Note: I acknowledge support from the Higher School of Economics (HSE) Basic Research Program, and thank Vladimir Bessonov, Rostislav Kapelyushnikov, Boris Kuznetsov, Laura Solanko and the two anonymous referees for their valuable comments and suggestions. I owe a special thanks to Vladimir Gimpelson, who helped me in early stages of this project. I thank Greg Moore for excellent proofreading, which improved the draft substantially. Various versions of this paper have been presented in the research seminar of the department of economics at HSE (May 20, 2015), the research seminar at the Bank of Finland's Institute for Economies in Transition (October 13, 2015), the 34th General IARIW Conference in Dresden (August 25, 2016) and at a conference in honor of Elinor Ostrom "Informality and Development" at the Indiana University, Bloomington (October 23, 2016). The participants and discussants in these events provided many valuable comments. The usual disclaimer on errors and omissions applies.

*Correspondence to: Ilya B. Voskoboynikov, National Research University Higher School of Economics, 20 Myasnitskaya Ulitsa, Moscow, 101000, Russia (ivoskoboynikov@hse.ru)

[1]Structural change is defined as changes in labor input shares by industry.

change on growth may be biased. Researchers have also begun to explore the link between informality and productivity. Restuccia (2013, p. 93), for example, asserts that informality is the response of less productive entrepreneurs to tightened regulations.

Informality itself can create economy-wide distortions that are harmful to productivity. McKinsey (2006), for instance, singles out informality as a major reason for the productivity gap between Brazil and the US.[2] Marcouiller *et al.* (1997) identifies informality as the cause of low productivity growth in construction, manufacturing, and retailing in Latin America. Using Mexico as his subject, Leal-Ordóñez (2014) specifies three types of distortions induced by the informal sector: the misallocation of resources to small, stagnant plants; distortions in occupational choices; and distortions in capital use in informal establishments. Such distortions were earlier found to lower Mexican productivity in manufacturing, retail, wholesale, and services (Busso *et al.*, 2012).

Even with new research, few empirical studies have deepened our understanding of the impact of structural change on productivity growth when labor outflow to the informal sector is explicitly included. The exception is de Vries *et al.* (2012), which shows that expanding informality generated a growth-reducing reallocation effect in India, while a shrinking informal sector in Brazil produced a growth-enhancing labor reallocation. de Vries *et al.* (2012) apply a conventional shift-share analysis to a decomposition of aggregate labor productivity growth into inter-industry and intra-industry components. Their approach is in line with the pioneering works of Fabricant (1942) and Denison (1962), but still suffers from basic shortcomings. In particular, De Avillez (2012) points to the possible counter-intuitive interpretation of the contributions of labor reallocation in industries to aggregate labor productivity growth. 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) consider informality as a significant outcome of the shock therapy approaches applied in the early 1990s to speed up the transition from a planned economy to a market economy. Not only does this historical episode illustrate well the concept of "second-best institutions" suggested by Rodrik (2008), it also highlights the struggle to adapt to labor market legislation based on the best practices of developed economies. Informality emerges as an obvious solution in a weak institutional environment with poor state enforcement which forces firms and workers to adapt. Thus, Russia's transition created the pre-conditions for the expansion of its informal economy.

This shift of labor into the informal sector has continued for a quarter of a century, even during the boom years of the Russian economy (1999–2008). Although the informal sector smoothed the negative consequences of the shock therapy in Russia, absorbing excessive labor, the consequences for productivity

[2]See also Üngör (2017).

growth, as Kapelyushnikov *et al.* (2012) point out, were harmful in two respects.[3] First, employment contracts were poorly enforced, so employees had little incentive to invest in improving their specific skills (i.e. increase specific human capital). Second, the persistence of obsolete jobs hindered the emergence of jobs relevant to changed economic circumstances.

The present paper has two key points. First, it considers the impact of expanding informality on labor productivity growth in Russia. For this, I develop a new industry-level dataset that includes variables for output and labor input for the period 1995–2012. It draws upon industry-level series from the Russia KLEMS database (Timmer and Voskoboynikov, 2016) and splits them into formal and informal segments.[4] Second, in additional to the traditional approach, I apply two newer methods to the shift-share analysis. These newer methods are better tailored for the strong volatility of domestic relative prices than the traditional approach (Tang and Wang, 2004; Sharpe, 2010).

This study aims to assess the impact of structural change on growth of the Russian economy.[5] I decompose aggregate labor productivity growth into intra-industry and inter-industry contributions. All three approaches (traditional plus the two new methods) provide consistent evidence of a link between structural change and productivity. *Overall*, structural change in Russia has been growth-enhancing, significant, and attenuating over time. An explicit estimation of labor reallocation between the formal and informal sectors of the economy, something new in the case of Russia, leads to a reduction in the overall contribution effect due to an expansion of the informal segments of industries with low productivity levels. At the same time, *sectoral* labor input reallocation effects, which are 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.

Following the official definition of the Russian statistics office (Rosstat), a worker is considered informal if they are not employed by a corporation or some other legally recognized entity.[7] Because our focus is on labor reallocation between formal and informal segments, I also disaggregate data for each industry by informal and formal segments. While there has been a long discussion in the literature on how to define informality, I rely here on a simple definition that associates informality with properties of the firm or enterprise, rather than the worker.[8]

[3]In this context, Kapelyushnikov *et al.* (2012) also mentions informal relations within firms and assumes that such relations help inefficient firms to survive. Here, I do not deal with the effect of informality *within* firms, focusing on producers formally associated with some legal entity such as a registered company (formal segment) and all other organizational forms of production (informal segment).

[4]See Appendix A (in the Online Supporting Information) on the usage of terms formal/informal sectors and segments through the text.

[5]Vries *et al.* (2012) apply a conventional shift-share analysis to the Russian economy in 1995–2009. They use an earlier release of the Russia KLEMS dataset (1995–2009) with no informal split.

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

[7]Formally, Rosstat classifies a worker as informal, if he or she is a non-incorporated entrepreneur or an employee of such an entrepreneur, if he or she is engaged in a farm enterprise or works in his or her own household and produces goods and services for own consumption (Kapelyushnikov, 2012, p. 21). This definition is not entirely satisfactory, but it is the only one that is consistent with Russian national accounts.

[8]Alternative definitions of informality and their application to the Russian employment are discussed by Lehman and Zaiceva (2015), Gimpelson and Kapelyushnikov (2015) and Lehman (2015).

Finally, the limitations of the study should be mentioned. The consideration of the informality problem at the industry level ignores the contribution of labor reallocation between firms within an industry, which can be significant.[9] I am also limited to the definition of informality used in the Russian system of national accounts, which, while not entirely satisfactory, is at least consistent. Of course, the share of informality depends on its definition as we see in the household survey data.[10] However, from a macro perspective, it is the only definition that considers the economy as a whole, rather than the corporate sector for firm-level surveys. Moreover, it is consistent with the total economy measure of economic growth.

The paper has the following structure. Section 2 presents alternative approaches to the shift-share analysis, which are used in the subsequent sections. Section 3 describes the process of data construction and sources. Section 4 overviews major industry-level productivity and employment trends and points out productivity gaps between the formal and informal segments of the economy which are essential for the analysis. Section 5 discusses the outcomes of decomposing labor productivity growth rates into *intra*- and *inter*-industry effects. Section 6 concludes.

2. Approach to Structural Decomposition

The reallocation of workers across industries contributes to aggregate labor productivity growth. Many studies have described this phenomenon[11] but the strand originates from Fabricant (1942), who decomposes the increment of aggregate labor 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.[12] The latter depends on structural changes in the economy. Assuming the additivity of output in constant prices[13]

$$\bar{\bar{Y}}^{t} = \sum_{n}^{N} \bar{\bar{Y}}^{t}_{n}, \tag{1}$$

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

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

[9]See e.g. Brown and Earle (2008).
[10]Surveys of Lehmann and Zaiceva (2015) and Gimpelson and Kapelyushnikov (2015).
[11]See the review in (de Vries *et al*., 2015).
[12]The contribution of multifactor productivity growth, which is usually interpreted as the outcome of technological change, may also be explained in terms of a temporary disequilibrium that is caused by a delayed reaction to technological changes in previous periods, terms of trade, low mobility of labour and capital, as well as various competitive barriers (Reinsdorf, 2015).
[13]For brevity's sake, we skip summation indices. A variable is marked with a double bar if it depends on output in constant prices with fixed weights (Laspeyres index formula).

The last term in the second expression captures the reallocation effect $R \equiv \sum \left(\Delta s_{L,n} \overline{\overline{X}}_n^1 \right)$. In turn, weights $s_{L,n}^t$ are the shares of labor in industry n in the total labor input.[14]

de Vries *et al.* (2012, sec. 4) show 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 labor productivity increment can be represented as

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

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

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

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

It is useful to represent decomposition (2) in terms of growth rates, rather than levels. Dividing both sides of equation (2) by $\overline{\overline{X}}$ and making simple algebra manipulations, we get

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

Here $\gamma \equiv \Delta X / X_0$ represents labor productivity growth rates, $s_{\overline{\overline{Y}},n}$ are the shares of the output of industry n in the aggregate output and σ is the growth rates of labor shares. Equation (5) originates from Denison (1962) and, following Dumagan (2013), we refer to it as TRAD. The first term represents the contribution of labor productivity growth in industries. In turn, the second and the third terms taken together are associated with reallocation, or the "between" effect. Nordhaus (2002) labels these the "Denison" and "Baumol" effects.

The *Denison effect* is the contribution of labor reallocation between industries with different productivity levels. It explains why labor productivity acceleration in a certain industry can be harmful for the economy by slowing aggregate productivity growth. To illustrate, consider two industries in the economy, with

[14]Diewert (2014) notes that the interpretation of sectoral contributions to structural change may be difficult. Say, an increase of labor share of one industry is offset by changes in labor shares of other industries. If the number of industries involved is greater than two, there is no way to determine how the increase of the labor share of a certain industry is offset by decreases in labor shares of the other industries. The same logic applies to changes in relative prices. The *total reallocation effect*, of course, remains correct. Thus, sectoral contributions should be considered as the labour input reallocation effect rather than sectoral contributions to structural change.

industry A more productive than B $\left(\bar{\bar{X}}^0_A > \bar{\bar{X}}^0_B\right)$. Because of, say, technological improvements in industry A its labor productivity level goes up, while the rest of the economy remains unchanged. Under the condition of constant demand for their product, industry A starts releasing workers, who find new jobs in industry B. As a result, the labor share shrinks in industry A $\left(\Delta s_{L,A} < 0\right)$ and expands in industry B $\left(\Delta s_{L,B} > 0\right)$, being both equal in absolute magnitude, or $\Delta s_{L,B} = -\Delta s_{L,A}$. At this point, the terms of industries A and B in the Denison effect component of (5) are

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

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 the *initial* productivity of A is higher than B. It also follows from (6) that the Denison effect is independent of labor productivity growth in industries. Its direction is specified by shifts in labor shares and relative productivity levels only. Denison (1962) even mentions that the aggregate labor productivity growth can be negative even if productivity growth in all industries is nil.

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

The literature mentions a counterintuitive interpretation of reallocation in certain cases of TRAD.[15] For example, consider industry n with a below-average productivity level. Intuitively, if n hires more workers from more productive industries $\left(\sigma_n > 0\right)$, the reallocation effect should be negative. However, as follows from (5), the contribution $s^0_{\bar{\bar{Y}},n}\,\sigma_n$ is positive. Similarly, when the employment share of an industry with below-average productivity shrinks $\left(\sigma_n < 0\right)$, its labor productivity falls $\left(\bar{\bar{\gamma}}_n < 0\right)$. As seen from the third term in (5), $s^0_{\bar{\bar{Y}},n}\,\sigma_n\,\bar{\bar{\gamma}}_n$, the contribution of reallocation is also positive.

To resolve this, an alternative approach was developed at the Centre for the Study of Living Standards (CSLS) and implemented in a series of publications (De Avillez, 2012) that account for the difference between productivity levels in an industry and the economy as a whole. With some algebra, we get the explicit expression for the CSLS decomposition:

$$\bar{\bar{\gamma}} = \sum\left(s^0_{\bar{\bar{Y}},n}\,\bar{\bar{\gamma}}_n\right) + \sum\sigma_n\left(s^0_{\bar{\bar{Y}},n} - s^0_{L,n}\right) + \sum\sigma_n\left(s^0_{\bar{\bar{Y}},n}\,\bar{\bar{\gamma}}_n - s^0_{L,n}\,\bar{\bar{\gamma}}\right). \tag{7}$$

Compared with each other, we see that the first term is the same in both the TRAD and CSLS equations, (5) and (7), respectively. However, the industry-level components of the second term in (7), the Denison effect, become negative if employment increases in an industry with the below-average level of labor

[15]See e.g. De Avillez (2012) and Reinsdorf (2015).

productivity. In this case, $\sigma_n\left(s^0_{\bar{\bar{Y}},n}-s^0_{L,n}\right)=\Delta s_{L,n}\left(\frac{\bar{\bar{X}}^0_n}{\bar{\bar{X}}^0}-1\right)<0$. By analogy, the Baumol effect for a low-productivity, shrinking industry is positive.

A major source of uncertainty of TRAD and CSLS is the assumption in (1) of the additivity of output at constant prices. Since (1) holds if aggregated output is calculated with fixed weights at constant prices for a certain base year, the output series are sensitive to the choice of year. This measurement uncertainty increases with larger changes in the relative prices of the current year relative to the base year. Such dramatic changes are not limited to transition economies. Indeed, large changes in prices in developed economies have typically come from the rapid development of information and communications technologies (Nordhaus, 2002), while transition economies experienced a smoothing of multiple distortions of the planned economy period (Campos and Coricelli, 2002). Global oil prices are a source of large variations in relative prices specific to the Russian economy.

As recommended by the System National Accounts, the conventional solution for this mismeasurement problem is the substitution of volume indices at constant prices with chained volume indices.[16] In such a case, the exact additivity assumption (1) no longer holds and requires some other approach to the shift-share analysis which is consistent with the chained volume indices system. The suggestion of Tang and Wang (2004) is the Generalized Exactly Additive Decomposition (GEAD).[17] The counterpart of (1) in GEAD is the additivity of output V in current, rather than constant, prices, so

$$V=\sum V_n. \tag{8}$$

Here, real output V 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 labor productivity level X can be represented as

$$X\equiv\frac{Y}{L}=\frac{V}{PL}=\frac{\sum V_n}{PL}=\frac{1}{L}\sum\frac{V_n}{P_n}\frac{P_n}{P}=\sum\frac{Y_n}{L_n}\frac{L_n}{L}\frac{P_n}{P}=\sum s_{L,n}p_nX_n, \tag{9}$$

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

$$X=\sum s_nX_n, \tag{10}$$

and, with small manipulations, aggregated labor productivity growth as

$$\gamma=\sum s^0_{Y,n}\gamma_n+\sum s^0_{X,n}\left(s^1_n-s^0_n\right)+\sum s^0_{X,n}\left(s^1_n-s^0_n\right)\gamma_n, \tag{11}$$

[16](System of National Accounts, 1993: 1.17, System of National Accounts 2008: 15.21). For more on chain volume output indices in Russian statistics, see Rosstat (2014, section 3).

[17]See also the literature reviews in Balk (2014) and Reinsdorf (2015).

[Correction added on 3 November 2021 after first online publication: The year for Balk on footnote 17 has been corrected in this version.]

where $s^0_{Y,n} = \left(Y^0_n / Y^0\right)$ and $s^0_{X,n} = \left(X^0_n / X^0\right)$ is the ratio of productivity level in industry n to the aggregated one. Equation (11) is the GEAD decomposition with the first term being within the contributions of industries, the second one is interpreted as the Denison effect, and the third one as the Baumol effect.

Dumagan (2013) shows that, along with the superiority in terms of the fixed weights problem, GEAD has two additional advantages over TRAD. First, the "within" component in GEAD, i.e. the first term in (11), depends only on industry price deflators. In TRAD, i.e. the first term in (5), it also rests on the price deflator for the total economy.[18] In other words, the TRAD decomposition is sensitive to the relationship between industry-level deflators and the aggregated deflator. Second, unlike TRAD, GEAD recognizes changes in aggregate productivity growth caused by variations in relative prices. Such changes do not necessary lead to labor reallocation and can be explained, for example, by extra inflow of capital services.

All three methods are implemented in the present study. The TRAD method assumes fixed relative prices for industry products. It is widely used in the literature for the analysis of structural changes and 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, i.e. labor reallocation between industries with different productivity levels (Denison effect) and growth rates (Baumol effect). The second method, CSLS, uses the same assumption of fixed product weights as TRAD, but provides a better intuitive interpretation than TRAD for sectoral contributions to structural change. Finally, weakening the limitation of fixed relative prices leads to GEAD. This approach allows us to explore splits of the reallocation effect into the Denison and Baumol components.

There is a peculiarity in the interpretation of sectoral contributions to the inter-industry component of (11). As noted in footnote 14, Diewert (2014) raises the difficulty of interpretation if we treat a term like $\sum s^0_{X,n}\left(s^1_n - s^0_n\right)$ in (11) as independent. The increase of labor share of the industry is offset by changes in labor shares of other industries. If the number of industries is greater than two, however, there is no way to determine how the increase of the labor share of a certain industry is offset by decreases in the labor shares of the other industries. The total reallocation effect remains correct. Thus, each member of sum $\sum s^0_{X,n}\left(s^1_n - s^0_n\right)$ should be considered as the sectoral effect of change in the sectoral labor share, rather than the sectoral contribution to structural change.

Considering the rich literature on structural change and labor productivity growth,[19] the list of these three decompositions is hardly comprehensive or perfect.[20] The framework discussed amounts to a coherent system of methods with a well-developed economic interpretation. The following sections show how these methods work in case of Russia.

[18]See Equations (4.1) and (4.2) in (Dumagan, 2013) for an explicit exposition.
[19]See, for example, the alternatives in the following studies (G. J. de Vries *et al.,* 2012; Diewert, 2014; Reinsdorf, 2015).
[20]See more about shortages and limitations in studies of Timmer and Szirmai (2000), G. J. de Vries *et al.* (2012) and Reinsdorf (2015).

3. Data

Shift-share analysis methods require industry-level time series data on nominal value added, real value added, and labor input. To account for informality, we need to split these series into formal and informal segments for each industry.

The best data source is the official National Accounts series. However, for Russia, Rosstat provides consistent industry-level series only from 2003. The only alternative data source with a time series back to 1995 is Russia KLEMS (Timmer and Voskoboynikov, 2016; Russia KLEMS 2017). This dataset includes backcast estimations of output and inputs to 1995 that are consistent with the total economy level official SNA series 1995–2002 and the official industry-level SNA series thereafter.

The next step is to break down the industry-level series into formal and informal segments. As mentioned in the introduction, a worker is considered informal if they are *not* working for a corporation or other recognized legal entity. The informal segment, therefore, is measured statistically as the production in the institutional sector of households in SNA.

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 through various indirect estimates in accordance with international guidelines.[21] 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.[22] Unfortunately, this subset of data is available at the one-digit level only. For example, manufacturing includes13 industries, among which the informal segment in 2005 varied from 3 percent of hours worked in "Electrical and optical equipment" (code 30t33 in Appendix B, in the Online Supporting Information) to 38% in "Wood and products of wood and cork" (20). To resolve the issue for an industry at the two-digit level, we use the share of a corresponding parent industry from the higher aggregation level.

The share of hours worked in the informal segment of each industry is calculated with data on hours worked in total and in the corporate sector (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 zero.

[21]The methodology description for assessing output and value added of the economy, including the informal segment, is available from Rosstat (1998). OECD (2002) provides a general international overview of practices. In general, the approach of Rosstat to the estimation of output of the informal segment within the SNA framework is based on matching data of various statistical surveys and administrative records. For example, in trade, the informal activity is evaluated as the difference between the value of sales turnover, reported by large, medium, and small firms, and households' goods and services expenditures. In manufacturing, estimations are based on administrative records of random inspections of tax authorities. In comparison with special sample surveys, which are designed for informal sector enterprises, (see, e.g. Kaushal *et al.,* 2011 for India) the approach of Rosstat is sensitive to the quality of administrative records and trade statistics of imported goods.

[22]Rosstat publishes this data. See, for example, (Rosstat, 2014, Table 2.3.44), as well as similar publications for previous years. Since 2002, Rosstat has also released shares of value added adjusted for unobserved economic operations (e.g. Rosstat, 2010, Table 2.3.46-52). The former datasets have the advantage that the share of the sector of households agrees with the share of unobserved economic operations up to 2009. In the succeeding years, the latter falls much faster than the former, which suggest some unreported changes in methodology. I thank Rostislav Kapelyushnikov for enlightening me on this issue.

Official data estimates for value added in these industries produced by SMEs are less than 0.2 percent and 1 percent, respectively.

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

4. Trends of Productivity Growth in Russia: Shocks and Adaptation

A peculiarity of the Russian growth pattern in recent decades has been relatively stable employment amidst highly volatile output. This characterized the transformational recession in 1991–1998, the post-transition recovery in 1999–2008, and the stagnation that followed the global financial crisis in 2009 (Kapelyushnikov *et al.*, 2012). Figure 1 shows that the real value added of the total market economy doubled 1999–2008, yet employment grew by less than 24 percent. Another example of this is the reaction of the economy to the global crisis of 2008. While output plummeted by 8.9 percent in 2009 relative to 2008, the fall of employment was just 3.6% percent Although all transition economies passed through the stages of the transformational recession and a subsequent post-transition recovery, albeit with varying depth and duration,[23] the employment trends of most economies of Central and Eastern Europe followed GDP growth rather closely. Market reforms in CEEs triggered unemployment rates that rose up above 10 percent almost immediately. In contrast, the Russian unemployment level only reached 10 percent in the sixth year of reforms and peaked at 13.3 percent in 1998.

This phenomenon highlights a distinctly Russian approach to labor market adjustment to external shocks. It is apparent from the shock therapy episodes in early transition (Layard and Richter, 1995), which saw the emergence of a wide range of informal arrangements between employers and employees to help absorb the impacts of external shocks. In additions to appropriate adjustments in wages and hours worked, Russians could turn to job opportunities in the informal segment (Kapelyushnikov *et al.*, 2012).[24]

Such reallocations do not significantly alter total hours worked in the economy, but it does influence the structure of the economy and increases the share of the informal segment.

The corresponding changes in the employment structure 2000–2013 are presented in Figure 2. The small net change in jobs of nearly 3.5 million over thirteen years (mostly in years of high growth)[25] masks the huge inflow of 8.8 million jobs to the informal segment and the significant outflow of 5.3 million jobs from formal

[23]Drastic fall in productivity during the transformational recession and the following recovery was common for all economies in transition. Theoretical explanations are mostly connected with drastic changes in the institutional environment of former socialist economies (Campos and Coricelli, 2002; Ickes, 2018).

[24]Gimpelson and Kapelyushnikov (2013) also provide an excellent literature review.

[25]Some similarities of the countercyclical expansion of informality in Russia may be found in Mexico. See Fernández and Meza (2015).

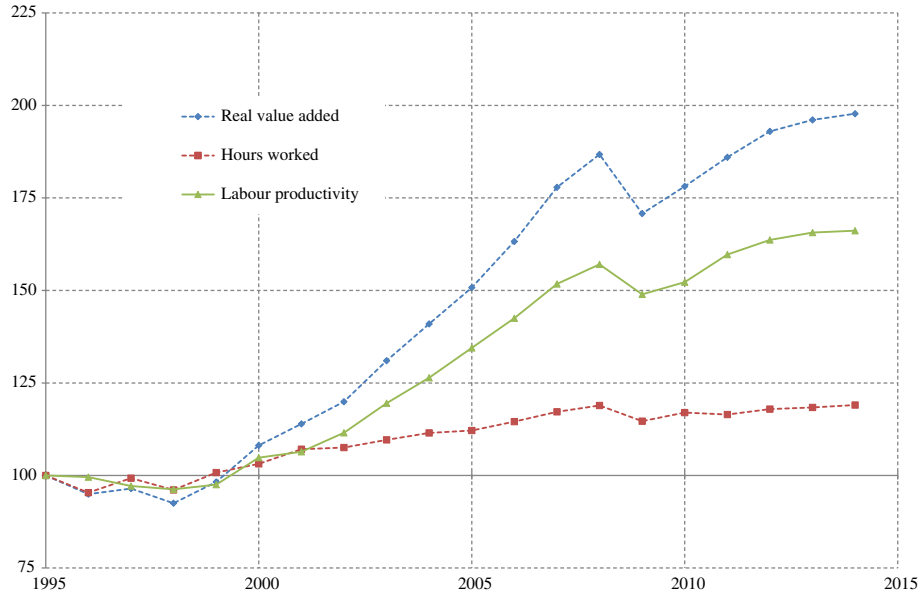

Figure 1. Trends of Real Value Added, Hours Worked and Labor Productivity in Total Market Economy, 1995–2014 (1995 = 100).

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

Note: Market economy includes all industries where non-market services do not dominate. I follow the industry growth accounting literature (e.g. Timmer *et al.*, 2010), in which public administration, education, healthcare and real estate are considered non-market services and excluded from market economy. [Colour figure can be viewed at wileyonlinelibrary.com]

organizations. The most significant losses of formal jobs were in manufacturing (3.7 million) and agricultural firms (3.3 million), while new informal jobs were created gained in trade (2.2 million), construction (1.4 million), transport (1.0 million), agriculture (0.8 million), and business services (0.5 million). This is more or less in line with expectations about the traditional sectors with significant labor shares of informal workers.

What stands out is the remarkable cross-flow of jobs between formal and informal segments within manufacturing and transport. This seems to indicate that some manufacturing workers preferred staying in the profession but were willing to leave large corporate enterprises for small workshops.

Overall the impact of the Russian approach to labor market adjustment to the initial shock therapy of plan–market transition, as well as the shocks of 1998 and 2008, is ambiguous. On the one hand, this approach provides a level of social stability through the relatively low level of unemployment due to the absorption of the formal segment's shed labor by the informal segment. On the other hand, such labor reallocation to low productive informality influences aggregate labor productivity growth, resulting in drastic changes in the structure of employment.

The other proximate factors that contribute to aggregate labor productivity growth come from two sources: changes in the performance of industries, which were fuelled mostly by investments in physical and human capital, and in innovation. Timmer and Voskoboynikov (2016) note that the first source of labor

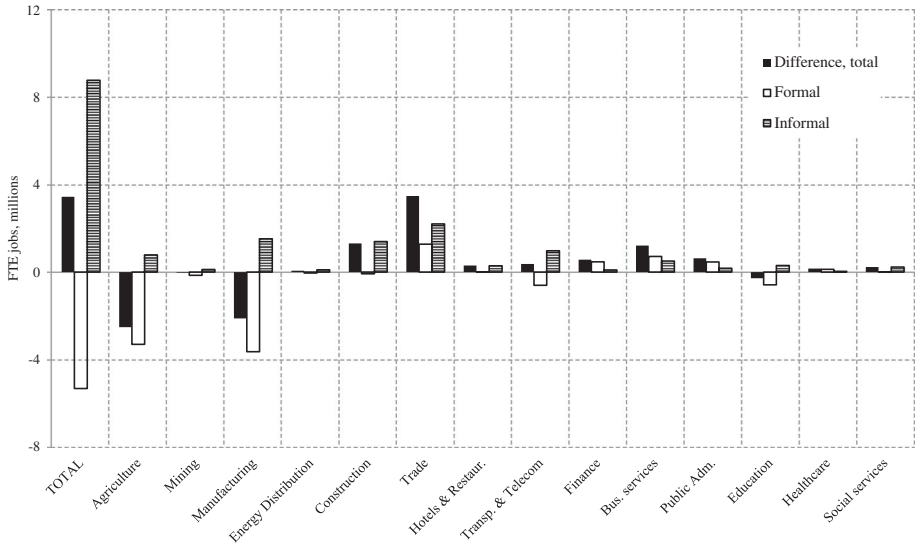

Figure 2. Change in Number of Workers in Total Economy and Major Sectors, 2000–2013.
Sources: Author's calculations based on the Rosstat data.

productivity growth is driven by capital intensity in low-skill-intensive services and the extended gas and oil sector, and by technology catching-up in manufacturing, financial intermediation and business services. Labor reallocation, the focus of this study, reflects fluctuations in the industrial structure of the economy. The impact of labor reallocation increases with greater structural changes and differences in productivity across industries.

Before tackling the reallocation effects among 30 industries of Russia's market economy, I combine them into six sectors: agriculture; manufacturing; extended gas and oil; the construction, retail and telecommunications sector (CRT); transport; and finance and business services.[26] These broader sector descriptions present their own challenges. Agriculture and manufacturing are conventional sectors within the three-sectoral analysis in development economics, but the role of agriculture in Russia is still fairly large. Specifically, farm work occupies a larger share of the labor force than in other post-industrialized and post-transition economies at similar levels of development. Extended gas and oil is considered separately because of its size and the specific role in the Russian economy. It includes mining, wholesale trade and fuel (Timmer and Voskoboynikov, 2016).

Services employ a large share of workers in developed economies and their roles are quite diverse (Jorgenson and Timmer, 2011). For this reason, I split services into three sectors. Transport is notable for its high capital intensity. Workers engaged in finance and business services are different from the rest of market services activities as they have fairly high of average level of skills and education (O'Mahony and van Ark, 2003). This makes these industries distinct in terms of labor productivity performance.

[26]The composition of these sectors is represented in Appendix B (in the Online Supporting Information).

I exclude public administration, education and healthcare altogether due to the poor quality of productivity measures in non-market services in National Accounts (Timmer *et al.*, 2010, p. 26).

The Russian economy has experienced intensive structural changes over the past two decades. The structure of the economy in 1995, three years after transition, still incorporated elements of the planned economy and early transition distortions. Almost 60 percent of hours worked went to producing goods (agriculture and manufacturing). Surprisingly, over quarter of the labor force fall at agriculture in the early days of transition. This proportion, enormous for a post-industrial economy, mainly reflects labor-intensive non-market households producing agricultural products for their own consumption (Gimpelson and Kapelyushnikov, 2015). These household arrangements, labor intensive and low productivity relative to agricultural firms, accounting for around 12 peecent of total hours worked and more than half of hours worked in agriculture (Rosstat, 2009, tab. 3.5). As might be expected, the share of extended gas and oil was small.

In the following years, we observe services gradually crowding out goods as the focus of labor activity. The shift in demand from goods to services reflected rising incomes, an overcoming of the over-industrialization of the planned economy, competition with Asia in manufactured goods, and, starting in 1999, an expansion of extended gas and oil during a period of soaring global oil prices. Table 1 shows the shares of sectoral hours worked and value added in 1995 and 2012. The share of agriculture in total hours worked falls from 28 percent to 21 percent, while the share of manufacturing decreases from 19 percent to 15 percent. These figures contrast sharply with the expansion of CRT from 20 percent to about 28 percent of total hours worked.

No less impressive is the structural change in value added. The share of agriculture almost halves, the share of manufacturing decreases from 7.6 percent to about 4 percent. Transportation sinks from 11.7 percent to 6.8 percent. At the same time, mining,[27] finance, and business services increase their relative shares of GDP. The aggregate shares of retail, construction and services are largely unchanged.

The comparison of shares of value added and hours worked in Table 1 provides an insight into variations in labor productivity levels and growth across sectors. For example, agriculture seems the least productive. Its share of hours worked in 1995 is nearly four times as its value-added share. It is not surprising that the share of value added of capital intensive extended gas and oil is more than five times higher than hours worked. Given that Russia is moving to a market economy, we expect to see high growth of labor productivity in financial and business services. By 2012, its share of value added was up 5.8 percentage points, while the share of hours worked only rose by half of a percentage point.[28] It is also worth

[27]Mining, fuel, and wholesale trade are clubbed together because performance measures of each of these industries on the basis of SNA data are misleading due to non-market pricing of transactions between establishments of the vertically integrated holdings, such as Gazprom (see, e.g. Kuboniwa *et al.,* 2005). These firms have establishments in various industries and known to use transfer pricing in order to minimize tax payments. Due to a lack of detailed data, we approximate the size of the mining sector by clubbing together the mining and wholesale distribution industries and find that its share has been growing from is around one fifth of total GDP in 1995 to almost a quarter in 2008.

[28]The increase in nominal value added may have been due to relative price changes rather than labor productivity growth rates. At the same time, labor and total factor productivity growth in finance is also reported by Timmer and Voskoboynikov (2016). I thank an anonymous referee, who attracted my attention to the issue that change in relative prices can be an alternative explanation of the data.

TABLE 1
Sectoral Shares in 1995 and 2012

Sectors	Nominal value added		Hours worked		Relative labor productivity level (total economy = 1.00)	
	1995	2012	1995	2012	1995	2012
Total economy	100.0	100.0	100.0	100.0	1.00	1.00
Market economy	86.1	81.7	80.9	79.6	0.94	0.98
Agriculture	7.6	3.9	27.9	20.9	3.67	5.32
Manufacturing	22.4	14.9	18.8	15.1	0.84	1.01
Extended gas and oil	20.1	25.0	3.5	4.5	0.17	0.18
Construction, Retail and Telecom	19.2	20.1	19.7	27.5	1.03	1.37
Transport	11.7	6.8	5.7	5.9	0.49	0.86
Finance and Business Services	5.1	10.9	5.2	5.7	1.02	0.52
Non-market economy	13.9	18.3	19.1	20.4	1.38	1.11

Source: Timmer and Voskoboynikov, 2016; Russia KLEMS, 2017.

mentioning the fall of labor productivity in CRT with its constant share of value added and the expanding labor share by 10.3 percentage points.

The substantial changes in jobs in the formal and informal segments of the economy, as shown in Figure 2, may also be an additional source of variations in productivity. Table 2 reports that the share in hours worked by informal workers in 2005 was almost 44 percent and continued expanding.[29] The share of informality varies across sectors from a modest one-tenth (2012) in financial and business services to a hefty four-fifths in agriculture. Equally important, the substantial gap in labor productivity levels between formal and informal segments of the economy *widens*. While the level of total market economy was 17 percent of the formal one in 2005 and fell to 14 percent by 2012, the picture in sectors is heterogeneous. Informal manufacturing is very unproductive and continued to degrade from 11 percent in 2005 to 5 percent in 2012. At the other extreme, informal workers in financial and business services seem to be much more productive than their formal colleagues. This is the area where high-quality freelancers outperform traditional corporate forms of activity.

[29]Based on official statistics of hours worked, Table 2 shows that informality expansion in 2005–2012 was relatively modest and grew by 1 p.p. in seven years. However, informality had been expanding long before 2005. Figure 2 reports that in 2000–2013 in total the informal segment grew by 8.8 mln. FTE jobs, while the formal one shrank by more than 5.3 mln. FTE jobs. Taking into account that the total amount of FTE jobs was 74 mln in 2000 and 78 mln 2013 (Russia KLEMS, 2017) and assuming the informal share in 2013 the same as in 2013 (44.8 percent, Table 2), the informal share in 2000 was about 35 percent. Accordingly, it expanded by almost 10 p.p. in 13 years.

TABLE 2
Shares of Hours Worked for Informal Segment and Relative Labor Productivity Levels

	Labor 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 gas and oil	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

Notes: Relatively high shares of informal segment in extended gas and oil 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 the source of substantial variations in aggregate labor 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, we provide evidence that labor reallocation between the formal and informal sectors of the economy can contribute to productivity variations. These preliminary results do not answer the big question: What are the relative impacts of all these reallocation effects on aggregate productivity growth? Such estimations demand the more accurate shift-share analysis techniques implemented in the following section.

5. The Contribution of Labor Reallocation and Informality

In this section, I assess the impact of structural change and labor reallocation on aggregate labor productivity growth in two cases. The first, in line with conventional literature, deals with industries without splitting them into informal and formal segments. Applying the three alternative methods of the shift-share analysis discussed in Section 2, I tease out the effects where consistent results are available. I then address the drawback of the "no-split" approach, which wrongly assesses the impact of job flows between the formal and informal segments within industries on aggregate productivity as part of the intra-industry contribution, taking the informal split explicitly into account. Comparing the results, I discuss the bias of the no-split approach and the impact of the expansion of informality on labor productivity growth.

Table 3 presents the decomposition of aggregate labor productivity growth into intra-industry contributions and the impact of labor reallocation for 30 industries of the market economy in 1995–2012 after they have been grouped into six aggregated sectors. The table also reports the results obtained by alternative

methods.[30] Over the period, all approaches are consistent in revealing main trends of this decomposition. First, aggregate productivity growth decelerated 2005–2012 from the previous decade. Next, the main drivers of aggregate productivity growth in the first decade were extended gas and oil, manufacturing, and finance and business services, while in the following years manufacturing and business services gave way to the consumption-oriented sector, i.e. construction, retail, and telecom. Finally, the contribution of labor reallocation declines. For example, the TRAD/CSLS estimations show the reallocation component fell by almost one-fifth of a percentage point (from 0.83 p.p. 1995–2005 to 0.64 p.p. 2005–2012). The fall of reallocation explains one fifth of the total decline for TRAD/CSLS.[31] It declined by almost two-thirds for GEAD. A possible explanation for this decline is the slow evaporation of the planned economy distortions in late stages of the transition. Summing up, compared with intra-industry sources, the role of labor reallocation in total growth seems modest. From this perspective, Russia seems similar to the Latin America region, rather than East Asia or Africa (Diao *et al.*, 2017).

In any case, the overall reallocation component deserves more attention, because its contribution is crucial in understanding the Russian economy and because of the role of labor input reallocation contributions to structural change in different patterns of structural transformation as discussed in 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. These are shown as different approaches to the calculation of the reallocation term. It is hardly surprising that the 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 1995–2005 (−0.18 p.p., Table 4) and 2005–2012 (−0.08 p.p., Table 5) becomes positive with CSLS (0.41 p.p. and 0.26 p.p., respectively). This is expected as CSLS is a modification of TRAD, which provides a positive contribution to structural change for a sectoral labor outflow from a low-productivity industry such as agriculture. In turn, the GEAD-based contribution of extended gas and oil 1995–2005 is at least three times higher than for TRAD and CSLS. This is explained by the drastic changes of relative prices in 2005 in comparison with 1995 against soaring oil prices. Interestingly, the variation of the GEAD-based structural change contributions are higher in comparison with TRAD 1995–2005 (Table 4) than in the following years (Table 5). This can also be interpreted as an effect of soaring oil prices. These findings clearly indicate that sectoral contributions to the reallocation term are sensitive to the way the shift-share analysis is implemented.

In addition to the variety of methods, one more source of uncertainty in this type of analysis is the option of taking informality into account. After all, the reality is that a substantial share of labor is found in the informal segment in most developing economies. While widely discussed in the context of its influence to

[30]Note that sectoral contributions and the total reallocation effect in TRAD and CSLS are the same for equations (5) and (7).

[31]Aggregate productivity growth dropped by 1.04 p.p. and reallocation by 0.19 p.p. (almost 19% of 1.04).

TABLE 3
ALTERNATIVE DECOMPOSITIONS OF LABOR PRODUCTIVITY GROWTH

	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 gas and oil	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, the informal split is *not* considered. TRAD, CSLS: constant prices of 2005 are used. GEAD decomposition is based on chained volume measures. Numbers may not sum exactly due to rounding.

TABLE 4
SECTORAL LABOR REALLOCATION EFFECTS, 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 gas and oil	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, the informal split is *not* considered. Sectoral labor reallocation effects are contributions to the aggregate reallocation component. TRAD, CSLS: constant prices of 2005 are used. GEAD decomposition is based on chained volume measures. TRAD, CSLS, GEAD: references to methods. Due to rounding, numbers may not sum exactly.

overall productivity growth, this fairly significant aspect of labor activity is largely overlooked in quantitative decompositions of aggregate labor productivity growth.

Given the substantial variation of productivity levels reported in Table 2, the introduction of the informal split increases heterogeneity in labor productivity levels across sectors and should affect the components of productivity growth. As follows from equations (3) and (4), the fraction $\sum \left(s^0_{L,n} R_n \right)$ of the aggregate labor productivity growth, which in (2) was attributed to the intra-industry effect, now becomes part of the inter-industry effect. This fraction reflects the implications of flows across the formal-informal divide and can be calculated as the difference between the reallocation components of the "split" (4) and "no-split" (2)

TABLE 5
Sectoral Reallocation Effects, 2005–2012

	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 gas and oil	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: Sectoral labor reallocation effects are contributions to the aggregate reallocation component. TRAD, CSLS: constant prices of 2005 are used. GEAD decomposition is based on chained volume measures. Numbers may not sum exactly due to rounding.

Source: Authors' calculations.

decompositions. As follows from Tables 3 and 5, the corresponding reallocation components equal 0.51 and 0.64 p.p., or −0.13 p.p. Thus, if the informal split is ignored, the overall "within" effect is underestimated by -0.13 p.p., and amounts to 3.36 p.p. (as reported in Table 3). This negative fraction reflects the expansion of the low-productivity informal segment. Revisiting Table 2, we see that its share grew by 1 p.p. 2005–2012, while its labor productivity level was less than 20% of the formal segment.

Consequently, the effect of the labor 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 the formal and informal segments. Table 5 shows that this reallocation is negative for all sectors with two exceptions. For finance and business services, the informal segment is more productive. Looking at Table 2, it is hardly surprising that the expansion of its informal segment by 1.6 p.p. leads to the positive contribution. The shift likely reflects professionals outsourcing themselves. For example, a talented lawyer could abandon his or her firm to engage in a solo or freelance practice.[32] Another exception is extended gas and oil. Referring again to Table 2, we see this is the only sector where the informal sector contracts 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 the formal and informal segments in manufacturing, agriculture, and construction corresponds to the largest values of the effect (in absolute values).

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

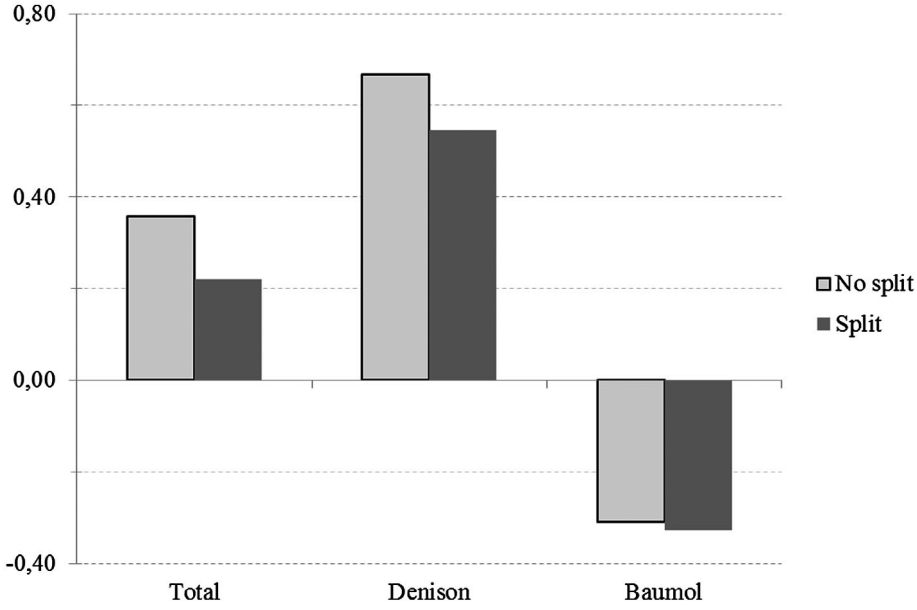

Figure 3. Contribution of Labor Reallocation on Aggregate Labor Productivity Growth of the Russian Economy, 2005–2012.
Source: Author's calculations. See also Appendix C (in the Online Supporting Information).
Note: GEAD approach for the shift-share analysis follows Tang and Wang (2004). GEAD decomposition is based on chained volume measures. Results for TRAD/CSLS are reported in Appendix C (in the Online Supporting Information).

As an overarching observation, we can say that expanding informality reduces growth-enhancing structural change through labor reallocation to the less-productive informal segments of most industries. But can we refine this further and determine whether the nature of this aggregate productivity slowdown is driven by the expansion of industries with lower productivity levels (Denison effect) or growth rates (Baumol effect)?

The results of the corresponding decomposition for GEAD (11) are given in Figure 3. They show the contribution of the reallocation effect and its components to aggregate labor productivity growth 2005–2012 in both the "no split" (light) and "split" (dark) assessments. The total reallocation effect contributes a net of 0.36 p.p. (Table 5), with the Denison effect providing 0.67 p.p. and the Baumol effect reducing by 0.31 p.p. The corresponding decomposition of the "split" case is 0.22 p.p. = (0.55 p.p. – 0.33 p.p.).[33] Accordingly, the total decrease of the split case in comparison with the no-split case is 0.14 p.p. (0.22 p.p. – 0.36 p.p.). The Denison effect shows a fall of 0.12 p.p., while the Baumol effect only goes down by 0.02 p.p. In other words, *the reallocation of labor between industries with different productivity levels has a larger effect on aggregate growth than the differences in growth rates*.

[33]See also Appendix C (in the Online Supporting Information).

The explanation seems to be that the Denison effect captures shifts of labor between industries with different levels of labor productivity, while the Baumol effect deals with growth rates. The informal split impacts the distribution of levels stronger than the distribution of growth rates. Since the distribution of levels is more asymmetrical (i.e. biased in the direction of the left tail), the probability of a reallocation to a position with a lower productivity level in comparison with the previous one is much higher than reallocation to a higher productivity level. In contrast, the distribution of growth rates with the informal split becomes more symmetrical. Thus, we can expect that the trend to informality leads to employment growth in industries with below-average productivity levels.

The same effect can be represented in the form of distributions of industries by labor productivity levels (Figure 4) and growth rates (Figure 5). Regarding the informal split shifts, the distribution of productivity levels to the left can be seen in comparison with these figures. For the no-split case, the skew of the distribution with the informal split rises by a quarter. The increasing number of low-productivity industries shifts the average productivity down from 1.8 to 1.3 for the overall economy (see Appendix D1, in the Online Supporting Information). Increasing kurtosis appears as a growing spike. Again, the probability of a worker finding a job with a lower level of productivity than their previous job is higher when the informal split is taken into consideration.

Informal split can also impact the distribution of productivity growth rates. Figures 5A and 5B, in contrast with the distribution of levels, show that *the asymmetry of growth-rate distribution decreases*. The corresponding skew (Appendix D2, in the Online Supporting Information) approaches zero, going from -1.7 to -0.8. This 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 percent per year. Higher standard deviation (15.2 c.f. 11.1) is caused by the increasingly rare extreme deviations (as follows from a decreasing kurtosis value). In other words, the number of industries with extreme productivity growth, both positive and negative,

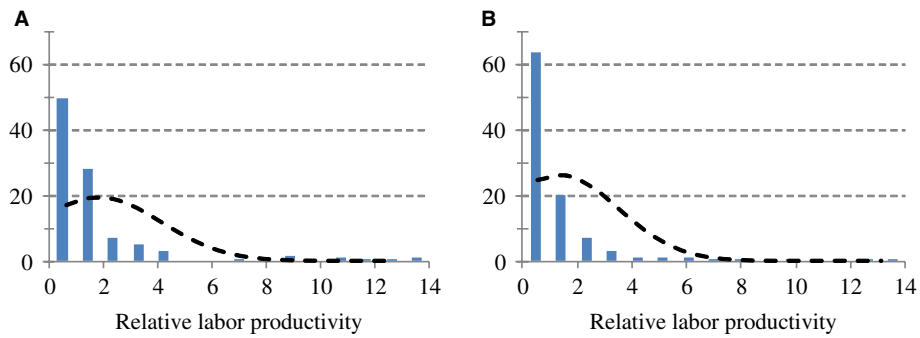

Figure 4. Distributions of Labor Productivity Levels Across Industries, 2005–2012.
Sources: Authors' calculations.
Notes: Labor productivity level in an industry refers to the nominal value added per hour worked, normalized to the aggregate labor productivity level of a corresponding year (horizontal axis). Percentage of the sample (vertical axis). The sample includes productivity levels of all industries in each year. Descriptive statistics of the distributions are available in Appendix D (in the Online Supporting Information). [Colour figure can be viewed at wileyonlinelibrary.com]

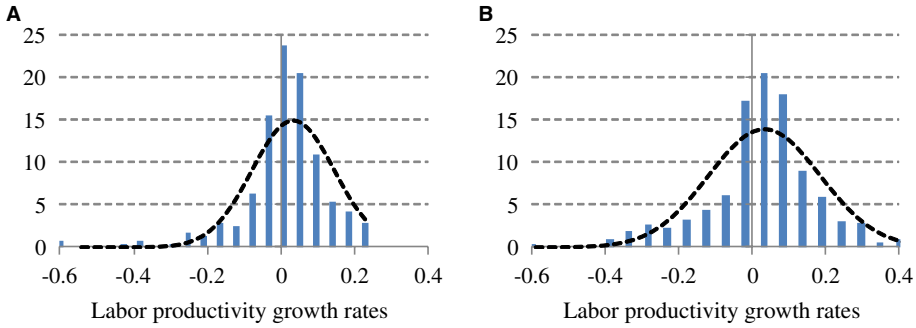

Figure 5. Distributions of Labor Productivity Growth Rates Across Industries, 2005–2012.
Sources: authors' calculations. See main text.
Notes: Labor productivity growth rate in an industry relative to the previous year is defined as the difference in growth rates of the real value added of this industry and its hours worked (horizontal axis). The sample includes labor productivity growth rates for all industries in each year. Descriptive statistics of the distributions are available in Appendix D (in the Online Supporting Information). [Colour figure can be viewed at wileyonlinelibrary.com]

increases. All in all, there is no evidence that including the informal split within an industry boosts the role of industries with growing or falling productivity.

Although the estimates produced by alternative decomposition methodologies differ, they paint essentially the same picture. The core is that the labor reallocation in the Russian economy 1995–2012 was not growth neutral. Its contribution to aggregate labor productivity growth was positive. This finding matches the evidence of other studies suggesting a consistent improvement in job quality 2000–2012 (Gimpelson and Kapelyushnikov, 2014). On the other hand, a more precise account of the informality composition and associated trends discounts the positive contribution of labor reallocation. Reallocation remained progressive, but the trend toward the expansion of informality worked in the opposite direction. Workers who moved from the formal sector into the informal sector tended to take jobs in industries where the productivity levels were lower than in the industries they had left. A worker leaving a large industrial plant might become a cab driver or salesperson (formal or informal), or might earn a living transforming their home garage or basement into a workshop. The latter option would allow them to remain in the same industry while working informally. In any case, one hour of work at the new informal workplace is likely to produce much less value added than in the previous job in a formal workplace.

6. Conclusions

The present study examines the link between structural change and aggregate labor productivity growth of the Russian economy to obtain a quantitative evaluation of the impact of the country's expanding informal segment on productivity. Using a diverse set of analytical tools to decompose the aggregate labor productivity growth into the inter-industry and intra-industry components, three main findings emerge.

First, labor reallocation in Russia was significant, growth-enhancing and attenuating throughout the 1995–2012 period. Narrowing the focus to 2005–2012, we see that the increasing labor reallocation to the informal segment of the economy *slowed* aggregate labor productivity growth. Further decomposition of the reallocation contribution revealed that this deceleration seems to have been caused by the expanding employment share of informal activities with low labor productivity.

Second, this study strengthens the idea of the informal sector's dual role. On the one hand, the informal sector acts as a safety valve, absorbing the social consequences of external shocks and holding employment stable. On the other hand, expanding informality is a drag on labor productivity, which is harmful to growth. The study also raises important questions about methods used for the shift-share analysis. Indeed, although the main findings have been confirmed with all three methods used, sectoral labor reallocation effects were sensitive to the approach used.

Finally, in line with Rodrik (2008), the study highlights the role of institutions. Russia's formal adoption of best practices from developed economies in the early years of transition, which caused a rapid shift from a planned to market economy, was thwarted to some extent by the lack of state enforcement. The structural bonus was diluted by expanding informality, diminishing long-run growth. This failure highlights the drawbacks of the shock therapy approach compared to the more gradual reform strategies pursued by China and Vietnam, and suggests that the optimal speed of reform may not be the fastest.[34] Such transition economies provide fertile opportunities for the further study of informality on aggregate productivity growth and labor reallocation.

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[34]A summary of the debate can be found in Wyplosz (2014, 228-230).

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