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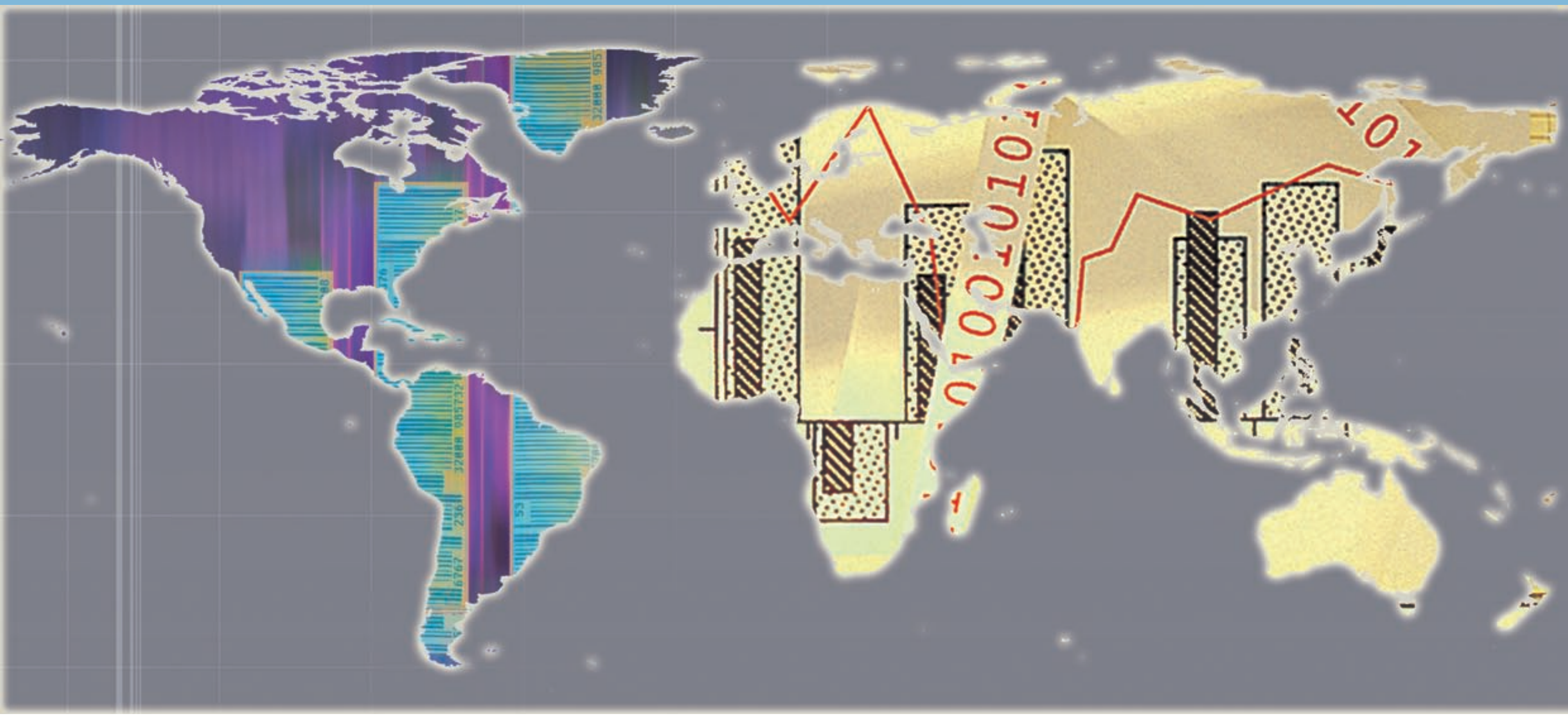

Structural Change and Productivity Growth: A Review with Implications for Developing Countries

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Structural Change and Productivity Growth: A Review with Implications for Developing Countries

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Contents

Abstract

The purpose of this paper is to obtain a measure of how important *inter*sectoral reallocation, or structural change, of firms is for aggregate productivity performance. Evidence for such effects is sought by reviewing empirical literature. In addition, the methodological evolution for such measurement is discussed. The a priori belief was that the reallocation component is a relatively important contributor in developing countries and less so in industrialized ones, leading to differing policy implications. It turns out, however, that those expectations found little support in the data. In fact, relatively poor countries benefit at least as much as do advanced economies from firms' own innovation efforts; also in those countries does the structural change effect contribute little to overall performance. The policy implications of this finding are far-reaching and point to the need to develop capabilities for innovative activities. However, such capabilities may be different in developing countries in that strengthening of base functions such as schooling and health may be more important than, say, the development of national innovation systems, which are more appropriate for advanced economies. While *inter*sectoral reallocations may not play a prominent role, there are reasons to believe that *intra*sectoral reallocations are. If correct, the decomposition efforts and methods would need to be refined further. The paper concludes by pointing to how this could be done as well as where to look for such information.

Keywords: D24; L60; O11; O12; O14; O47

1. Introduction

The literature on the *sources* of aggregate productivity growth is vast and important. With sustained economic growth being the pillar on which societies' welfare is built, it is only to be expected that productivity takes the centrepiece of attention for policy makers. In trying to understand how to increase productivity growth, it is not only important to identify *where* such growth has its roots, but equally important to learn about the determinants of productivity change. This paper is about the where-question.

There are essentially two ways to think of sources of growth. The first one that comes to mind takes departure from a production frontier type of analysis, which is often coupled with decomposition of a productivity growth index into its technological progress and technical-efficiency change sources. The other one is growth-accounting types of applications, on which this paper focuses. Although growth accounting is often the basis of source-of-growth analysis with decompositions into factor accumulation and total-factor productivity (TFP) growth, economic growth can also be decomposed into its sectoral components. These, in turn, can be decomposed into the contribution of the sector itself and changes to the overall sectoral composition, that is, structural change.

This latter literature has fairly recently evolved from the simple two component analysis just mentioned into one that also accounts for firm dynamics, that is, entry and exit of firms. In other words, the task is to try to understand the relative importance of these components, as they have strong bearings on policy making. For example, should governments allocate funds to facilitate resource shifts or should the lion's share of funds be directed towards innovative activities. With unlimited amounts of funds, this would not be an issue at all, alas the stark reality is that of scarce resources.

Firms and resources moving from low-productivity to high-productivity sectors contribute to aggregate productivity performance by changing the distribution of activities in favour of the latter or, couched differently, structural change is a source of productivity growth. Whereas relative sectoral productivity levels change and cause structural change, what is important here is the role such that change means for aggregate performance. This aggregate does not have to be at the total economy level, but might as well as occur at total manufacturing level or some other aggregate within, say, manufacturing.

To fix thoughts further: Overall productivity change can occur because firms become more technologically advanced and increase their productivity performance, which is the so-called "within" effect. Thus, actually no structural change is required to increase aggregate productivity performance. Likewise, a sector's productivity performance can increase because the sectoral composition or population of firms has changed. For example, a positive effect occurs when firms reduce their activities in sectors with low technological sophistication and move resources and become more active in sectors with higher sophistication. As this involves higher technology levels, overall productivity increases. This is called the "between" effect, or reallocation effect or structural change effects. Furthermore, poor performers may have been forced to exit, leaving a more favourable within-sector distribution, which will be called the firm-dynamics effect.

Most empirical studies attempt to quantity these different effects to learn about the sources of productivity change. By nature, the studies are data intensive for one need a fair amount of observations across space and time, since reallocation only occurs slowly and, therefore, are difficult to detect. The implication is that empirical studies tend to cover countries or industries rich in data, that is, members of the Organization of Economic Cooperation for Development (OECD) and a handful of Latin American and Asian countries.

The literature based on sector data goes back some time, but it is with the advent of firm-level information that the empirical work has started evolving into an industry with increasingly valuable insights. The purpose of this paper is to discuss the methods commonly used for such quantification and describe how those methods have evolved over time, as more detailed firm-level information have become available. This has allowed for more intricate analysis and catered to detailed insights into the dynamism of development. Section 2 is devoted to methods. The paper proceeds in Section 3 with a review of the empirical literature to tease out the relevant implications for policy making in developing countries. Because of country-idiosyncrasies it is not straightforward to generalize from these results to, say, low-income countries. Notwithstanding these difficulties, an attempt will be made to describe the implications for the (reallocation) sources of productivity change in developing countries. To this end, the difference between the OECD and developing countries, if any, may provide a basis for such description. In Section 4, some limitations of the methods and results presented are discussed and a suggestion as to why the conclusions may be biased is offered. A solution is proposed as well. Section 5 concludes the paper.

2. Theory and measurement of reallocation

The starting point of decomposing productivity change into its sources is the measurement of such change itself. There are two principal measures of productivity, Total Factor Productivity (TFP) and Labour Productivity (LP). Although TFP in most cases is preferable to LP as a measure of productivity—for example, TFP involves less of policy confusion than does LP—in this case it is immaterial which of the measures is used. In the empirical literature, both are commonly applied. What is crucial, however, is the notion that sectoral differences in productivity levels provides incentives for resources such as labour to move between sectors because higher productivity implies higher salaries. This is, of course, the essence of Lewis-type of development models (Lewis, 1954). Whether these incentives arise out of factor accumulation or technological progress is less important. However, having said that it should be borne in mind that decomposition based on TFP primarily focus on the technology channel—TFP being the common proxy for technology—while LP decomposition leaves the issue of factor accumulation or technological progress open.

The early decomposition attempts pertinent to structural change consisted of finding sectoral sources of productivity growth to overall productivity gains—within-sector productivity growth—and gains stemming from reallocation of resources from low to high performing sectors—between-sector productivity change. While delivering important insights, such crude decompositions also hid crucial information pertaining to firm dynamics in the two components. With firm-level data becoming increasingly available such dynamics could be explicitly accounted for, increasing the value of each components information content. Now, think of firms performing within sectors or reallocating between sectors as well as firm entering and exiting.

First, growth of aggregate manufacturing productivity, however measured, is composed of the growth of productivities of individual plants, in logs:

$$\Delta P_{it} = \sum_{j \in C} s_{jt-1} \Delta p_{jt} \,, \tag{1}$$

Where P_{it} is an index of manufacturing productivity at time t, s_{jt-1} is the *output* share of plant j in manufacturing sector i in the base period $t-1$, p_{jt} is plant-level productivity, C denotes continuing plants and Δ indicates growth. This means that at this moment no account of sectoral reallocation or firm dynamics has been made; it is only firms', and thus, the aggregate manufacturing sector's own performance at focus.

The output share is in italics because it is an open issue amongst analysis whether output or employment should be the used at the weight. Furthermore, the weight could be for the base period, like in equation (1), or an average of the base and end period, in this case the average of period t and $t-1$. Output shares concern reallocation of output, while input shares relates to reallocation of inputs, such as labour. Another debate concerns whether output should be measured in value added or gross output terms. Whichever method is chosen, equation (1) is, therefore, a measure of the within-effect. To this effect, reallocation of plants, or structural change, needs to be added, leading up to the Baily, Hulten and Campbell (BHC, 1992) decomposition, which is the seminal contribution in this literature:

$$\Delta P_{it} = \sum_{j\in C} s_{jt-1}\Delta p_{jt} + \sum_{j\in C}(p_{jt-1} - p_{it-1})\Delta s_{jt} \,. \tag{2}$$

The first term is, of course, equation (1) above. The addition is the second component, which measures changing output (or labour) shares weighted by the deviation of base period plant productivity, or relative efficiency of the firm, from the base period manufacturing productivity index. Hence, this is a pure reallocation term capturing the contribution coming from resources shifting between sectors.

To the BHC decomposition, Haltiwanger (1997) added a covariance, or cross, term, which accounts for simultaneous change in firm output share and firm productivity:

$$\Delta P_{it} = \sum_{j\in C} s_{jt-1}\Delta p_{jt} + \sum_{j\in C}(p_{jt-1} - p_{it-1})\Delta s_{jt} + \sum_{j\in C}\Delta s_{jt}\Delta p_{jt} \,. \tag{3}$$

One may argue that equation (3) is flawed because manufacturing productivity is significantly affected by exit and entry of plants and yet no components appear in the equation to directly capture such effects. As a consequence, the three components could be capturing the intended effects *as well as* the impact of net entry, leading to over- or under-estimation of the within and between effects. Therefore, the decomposition nowadays most widely employed is the one proposed by Foster, Haltiwanger and Krizan (FHK, 2001):

$$\begin{aligned}\Delta P_{it} = {} & \sum_{j\in C} s_{jt-1}\Delta p_{jt} + \sum_{j\in C}(p_{jt-1} - p_{it-1})\Delta s_{jt} + \sum_{j\in C}\Delta s_{jt}\Delta p_{jt} \\ & + \sum_{j\in N}(p_{jt} - p_{it-1})s_{jt} + \sum_{j\in X}(p_{jt-1} - p_{it-1})s_{jt-1} ,\end{aligned} \tag{4}$$

where the last two components represent the contribution of plant entry (*N*) and plant exit (*X*), respectively. [1] If a continuing plant has higher productivity than the average initial

[1] Interestingly, Petrin and Levinsohn (2006) have criticized this way of decomposing productivity growth, which might lead to further development of measurement methods. To the best of this author's knowledge, their proposed decomposition has not yet been performed on data and, therefore, the reader is referred to their paper for further discussion. Brandt, Van Biesebroeck and Zheng (2009) attempt at

manufacturing productivity, an increase in its share contributes positively to the reallocation component. The same principle applies in the cases of entrants and exiting plants.[2] [3] Generally, the reallocation and net entry components will not be zero, but the question is whether they are large enough to impact on the focus of this paper, i.e., within versus reallocation.

The final equation considered in this paper is due to Syrquin (1986), who deals with reallocation at the sector rather than the plant level. The reason for including this decomposition is that some papers reviewed in next Section are based on it. Note, however, that it is not a development of equation (4), but rather a predecessor of it, which is normally applied at sector level, not at the firm level. Syrquin's methodology is based on the simple identity:

$$\Delta P_t = \sum_i \left[\alpha_{t-1}^i \left(\Delta Y_{it}^i - \Delta Y_{it}^i\right) + \left(\alpha_{t-1}^i - \beta_{t-1}^i\right) \Delta X^i\right], \tag{5}$$

where ΔP_t is aggregate productivity growth, however measured, α and β represent period zero output and input shares of sector i, respectively, and ΔY and ΔX denote growth of output and an input index in the same sector. In the case of LP growth, the input index only contains employment, while the case of TFP growth requires that each input component in the input be properly weighted. In either case, aggregate productivity growth sources from the sum of a combination of change of productivity in all sectors and change in each sector's share (i.e., reallocation of inputs). Both terms may take either positive or negative sign, depending on how each component changes over time. For example, if employment's share in a sector increases faster than the output share, the reallocation component will be negative. Likewise,

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an approximation of the Petrin-Levinsohn decomposition based on FHK (2001) and the reader is referred to that paper for the results.

[2] If the data are severely plagued by measurement errors, the Griliches and Regev (1995) method of using averages between base and end years might be preferable. The flip side of their decomposition, however, is that some of the effects will be confounded, i.e., the within and reallocation effects will also capture part of the cross term, which does not appear in the formula.

[3] Brown and Earle (2008) argue that it might be better to compare entrants with the productivity of incumbents in year t and to distinguish the contribution of net entry to aggregate productivity performance due to above/below-average productivity levels. This would be compared to a benchmark in which exiting firms are like incumbents in the year they exit and entering ones are like incumbents in the year of entry. The authors show how this can be accomplished.

if input growth is faster than output growth the productivity component will be negative.[4] As said above, the issue of which weights are correct to use remains debatable.

Finally, before turning to the review of the empirical analyses carried out based on the above equations, it needs to be emphasized that this is still an evolving research field. As such, measurement methods are still being refined, new ideas are taken up, new fields of applications are being added and new components are being accounted for and explained.

3. Review of empirical studies

In this section, empirical results based on equations (3)-(5) applied to developed-, transitional- and developing-country data are reviewed. The relative contributions of the within and reallocation components will be presented in terms of percentage contribution to aggregate productivity. In other words, the presentation is very close to growth accounting in spirit.

The idea is to examine whether the sources of productivity change differ according to the stage of development of countries. For example, since the within-effect reflects firms' own innovation activities that translate into productivity growth—and these are activities that require a well developed national innovation system, human capital base and resources for research and development—for advanced economies one may expect that the within-effect will dominate the between effect. Another reason for why this may be the case is that advanced economies already have undergone structural change from low- to high-productivity sectors. Developing countries, on the other hand, are undergoing structural change. Furthermore, they do not have as much resources to devote to innovation and adoption of relatively advanced technologies, which means that the between effect is a more likely source of productivity growth. In the case of transition economies, it is difficult to know what to expect, but it is likely that this group of countries is an intermediate case of the other two, that is, a mix of within and between effects.

A sectoral perspective based on either direct application to sectoral data or implications for sectors derived from plant-level analysis is adopted. Studies founded on equations (1) and (4) will be regarded to be of rather low sophistication and with less detailed content, while those based on equations (2) and (3) are much more detailed. It should be recalled that, essentially, the main difference is the number of components included, but also that in cases of relatively low sophistication the decompositions could be biased in the sense of confounding the effects of the cross term and net entry, since those are not explicitly accounted for.

[4] Dynamic sectors tend to have positively signed components, especially for reallocation.

Tables 1-3 contain summaries of the results and are classified according to country category (developed, transitional or developing). It should be noted that some of the papers only present their results in the form of graphical illustrations, in which case the numbers have been read off graphically and, therefore, could be somewhat inaccurate in terms of precision.

3.1 Industrialized countries

Starting with industrialized economies (Table 1), which tend to be based on relatively sophisticated methods and output measured as gross output, for the United Kingdom Brown and Earle (2008) show that the within-effect nearly explains half of manufacturing labour productivity performance between 1980 and 1992. An almost equally large proportion sources from new entry of relatively productive plants. It follows that the other components, including structural change, play minor roles. The authors also consider TFP in which case results change drastically, with the within-effect decreasing to about five per cent and new entrants explaining about 42 per cent, followed by the cross term (26 per cent) and reallocation (15 per cent). This could mean that entry and structural change play a much bigger role for technology than for factor intensity (for example, the capital-labour ratio).

In the case of the United States (1977-1987), the within-effect accounts for nearly three-quarters of the total LP growth, while structural change only accounts for about eight per cent. For TFP, the within-effect is considerably larger in the United States than in the United Kingdom and attains 48 per cent. But at 34 per cent, the cross term is large too, as is entry (21 per cent). It, thus, seems clear that the performance variable considered is of significant importance in that decompositions yield rather different results.

Also Bartelsman, Haltiwanger and Scarpetta (2004) have studied labour productivity growth in these two countries. For the United Kingdom but for a different time period (2000-2001) they concur with the former authors that almost half of aggregate productivity is due to within effects and that entry is important as well (35 per cent). However, in the case of the United States, their results differ starkly from those of Brown and Earle. The authors have data for 1992 and 1997 and based on these they find that more than 100 per cent is explained by plants' own accomplishments and thus they corroborate that dominance over structural change. But the really new item is the significant role played by exiting plants, which account for as much as 48 per cent. In the Brown and Earle paper, this source only contributed eight per cent. The most important difference between the two studies is the time period considered and probably different data sources, since both us gross output and similar measurement methods.

Bartelsman, Haltiwanger and Scarpetta (2004) also consider manufacturing labour productivity growth for Finland (2000-2002), France (1990-1995), Netherlands (1992-2001), Portugal (2002-2002) and West Germany (2000-2002). Again, an overwhelmingly large part of productivity growth—78 to 88 per cent—is accounted for by the within-effect. In the best case the between term attains 20 per cent (the Netherlands), while in the worst it even contributes negatively to performance. In Portugal (30 per cent), France (22 per cent) and West Germany (18 per cent), the role of exiting firms also figures prominently.

Giannangeli and Gómez-Salvador (2008) focus on LP and TFP decompositions for Belgium, France, Italy, Spain and (Unified) Germany for the time period of 1993 to 2003 based on a gross-output decomposition. An interesting feature of their work is that they distinguish between employment and output shares, a distinction that makes a quantitative difference. Independent of which productivity variable is being used, the within-effect overwhelms all the other components in all cases; for Italy and output shares, the labour productivity within-effect is negative and must be considered an outlier.

Reallocation shows up in the cases of France (TFP, labour share, 21 per cent) and Belgium (TFP, labour and output shares, 16.3 and 29.1 per cent, respectively), Spain (LP, output shares, -21.1 per cent), but otherwise that component plays a minor role. Italy, again, is an outlier, with reallocation effects that are large and negative when labour shares are used and large and positive when output shares are used. The cross term is consistently negative throughout and even reaches -30 per cent in the case of Germany (LP). Italy is the only country with negative total productivity performance; it is also the only country with a large reallocation effect and large negative within-effect. In terms of prior expectations, its "behaviour" resembles more developing countries than other industrialized economies.

One can safely conclude that industrialized countries, in line with prior expectations, source their productivity growth from within-effects—that is, from own innovation activities—and not from sectoral reallocation, or structural change. An additional conclusion, when the methodology permits, is that firm entry and exit seems to play a role in some countries and lack of accounting for such firm dynamics seems to upward bias the reallocation term more than the within component. It is possible that the role that firm dynamics is allowed to play is a function of market flexibility. In relatively inflexible and regulated markets, it is easier for inefficient firms to stay in the market, while in flexible markets such firms find it difficult to compete and eventually are forced out.

3.2 Countries with economies in transition

Table 2 contains the results for transition economies, whose decompositions are thought to fall between those of industrialized and developing countries. The expectation is that the within contribution will be smaller than it was for industrialized countries and the reallocation effect greater, but a lot of uncertainty as what to actually expect.

Foster, Haltiwanger and Krizan (2001) present two sets of results. The first set includes LP and TFP for Hungary (1990-2005), Lithuania (1995-2005), Romania (1990-2006), Russia (1992-2004) and Ukraine (1992-2006), while the second set only includes LP for Estonia (2000-2001), Latvia (2000-2002) and Slovenia (1997-2001). In the first set, Russia turns out to be an outlier and, like Italy in the case of industrialized countries, will be discussed separately.

For all transition economies, the within-effect dominates, but as expected its contribution is smaller than that for industrialized countries. In this case, it ranges from 26 (Ukraine) to 68 per cent (Slovenia) for LP, while for TFP it ranges from just below zero (Ukraine) to 52 per cent (Romania). At 40 per cent contribution, Latvia has the largest contribution from reallocation, followed by 18 per cent for Slovenia and much smaller for the rest of the countries in this group. Firm dynamics in the form of entry of relatively productive firm, however, plays an important role. In this respect, Hungary tops the ranking with 72 per cent and an even larger contribution in the case of TFP. Also the other countries have sizeable contributions from firm entry. Firm exits, however, does not seem to be very important and only Estonia has a contribution exceeding 20 per cent.

Russia seems to be a special case. First of all, while LP growth was declining, that of TFP was increasing. The difference—TFP growth of 9.26 versus an LP decline of -1.98—does not seem right, as that would imply very large negative factor accumulation. But what is more troublesome are the magnitudes. For LP growth, the within is the largest component but the magnitude is -590 per cent. Another large negative component is firm entry, which means that the firms that entered probably were not better than the incumbents. Reallocation contributed positively and although smaller than the within component in absolute terms, its role is significant. Also very important has been the exit of inefficient firms. In terms of TFP growth, the between component is the largest positive component, followed by both entry and exit;

recall that entry contributed negatively to LP growth. The within component, again, contributes negatively. Russia, thus, seems to still be re-organizing its production both in terms of firm dynamics, factor accumulation and structural reallocation of its resources. Yet, because of the magnitudes and the somewhat contradictory results, one had better be cautious when interpreting these results.

3.3 Developing countries

Results for developing countries are presented in Table 3. The most comparable results are those produced by Foster, Haltiwanger and Krizan (2001) for LP growth in the Republic of Korea (1988-1993) and Taiwan, Province of China (1986, 1991, and 1996) in the case of Asia and Argentina (1995-2001), Chile (1985-1999) and Colombia (1987-1998) for Latin America, since these results include the cross term as well as entry and exit components. The most striking result is the large within component for all these countries, which records between 72 and 125 per cent. This is actually higher than the contributions for industrialized countries, running directly against the expectations. Whereas reallocation did not make much difference in Asia, some 20-25 per cent of productivity growth is explained in Latin America by that component. Exit of inefficient firms has a considerable impact in Chile (65 per cent) and Colombia (40 per cent) and the effect is significant for the two Asian countries as well. Finally, while firm entry contributed positively in Asia, the opposite was the case in Latin America.

Van Biesebroeck (2005) focuses on seven African countries (Cameroon, Cote d'Ivoire, Ghana, Kenya, Tanzania, Zambia and Zimbabwe) between 1990 and 1995. In this case there is a cross term, but no measured contributions from entry or exit. Once again, an overwhelming part of contribution comes from the within-effect, which sometimes attains almost absurd proportions. For example, in Kenya it accounts for more than 400 per cent of aggregate labour productivity growth, while in Zambia the contribution is some 350 per cent. However, compared with other developing countries, African ones display the largest structural change component. Again, Kenya stands out, with a reallocation term contributing nearly 300 per cent, which means a large negative contribution coming from the cross term. Also in Ghana and Zimbabwe has structural change contributed significantly to aggregate productivity performance. Yet, reallocation is clearly dwarfed by firms' own achievements and in Cameroon reallocation even contributes negatively to productivity growth.

The final set of results refers to the least sophisticated method, meaning that the decomposition only concerns within and between effects. Using this method and LP growth, Saccone and Valli (2009) examine sectoral performance in India and China between 1980 and 2004, with two sub-periods (1980-1992 and 1992-2004) analyzed as well. Both GDP and manufacturing, or industry in the case of China, are analyzed.[5] In China, at both aggregation levels, the within-effect overwhelms the structural-change component, implying that China's growth has little to do with reallocation and essentially owes its phenomenal performance to firms' performance. In the case of India, structural change has played a larger role, although that component comes only in half from the within-effect.

Bosworth et al (2008) for the time period 1980 to 2005 investigate Thailand at the most aggregated level. As in the case of China and India, intersectoral reallocation has played a minor role and the within-effect "explains" as much as 85 per cent of aggregate growth. Finally, also at the GDP level, from 1981 to 1997 as well as several sub-periods, Ghani and Suri (1999) focus on Malaysia. Like in all previous cases, the within-effect is much larger than the structural-change component. The latter in the early years actually contributed negatively to aggregate GDP growth and only in the 1990s does it begin to exert a positive influence. However, it never exceeds 20 per cent in terms of contribution and Malaysian firms, thus, contribute by own innovative activities rather than moving between activities across sectors.

3.4. Summary

Summarizing the results across the three country groups, it is clear that the within-effect dominates over structural change. It is only in the case of transition economies that reallocation appears to matter in an economically meaningful way. Another important component is firm dynamics, which increases mean productivity by improving the distribution of firms in favour of relatively productive ones. In industrialized countries, entry of above-mean productivity firms contributes positively to aggregate productivity growth, while among developing and transitional economies there are several occurrences of negative contributions. It is unclear how below-average productivity contributors manage to enter the market. An explanation could be that some sort of intervention is at play, giving such firms advantages over incumbent firms. One other possibility is that the data are not of sufficient quality or

[5] The difference between industry and manufacturing is that the former also includes mining, utilities and construction.

are not organized in such a way as to permit proper measurement of reallocation effects.

4. Limitations, issues and possible solutions

This is a literature that has developed impressively since its inception some 20-30 years ago. The data situation has improved too. The advent of longitudinal plant-level data has allowed for a much richer type of analysis. The early kinds of analysis, with only two components, were probably too crude and to a large extent tended to confound different aspects of structural change and productivity growth with those of firm entry and exit. Today, this is no longer the case, although the literature is still evolving. However, there are still limitations with the decompositions in use and perhaps is it the case the current methods have reached its potential. Staying within the remits of available methodologies, here are a few suggestions as to what can be done.

Firstly, there is a timing issue. If one wants to truly capture structural change, one probably needs longer time series. Structural change is a slow process that takes decades to show up in data, unless very disaggregate sector data are used. Analyses presently undertaken are, indeed, capable of detecting how firms and resources move between sectors, but from one year to another this is only marginal compared with other changes taking place. If the analyst were to compare, say, 1970 with, say, 2000, it is very likely that the between-effect would figure more prominently in these decompositions. Therefore, it is expected that as longer time series become available, the role of structural change will increase.

Secondly, not all structural change occurs between sectors. Although this is the traditional way of viewing such change, there are other ways to organize the data. A conjecture of this paper is that firms might stay within a sector—assuming sectors are measured in fairly aggregate fashion, which is normally the case with ISIC2 or ISIC3—but do not remain stagnant. Assume further that a sector, for example, textiles, can be divided "horizontally" in terms of its technological sophistication, say, low, medium and high technological sophistication. Then at least two points are important here. The first refers to the technology leap of moving from, say, low- to medium-level productivity implied by engaging in a more sophisticated task in the textiles value chain. The second concerns moving from textile production to production of some other, different product. It is not obvious which of the two is within reach or if both are, which provides the highest value added. If firms choose to move within the sector, this will be recorded as a within-effect and not structural change. Research should try to find ways to disentangle true within-effects, that is, innovation, from within-sector structural change. This is the motivation for Isaksson (2010a, b).

Thirdly, is structural change about labour moving between activities, be they within or in other sectors, or is it better to think in terms of output shares? In the standard Lewis-model (Lewis, 1954), it is workers that move from agriculture to manufacturing and the analysis is based on that kind of model, labour shares appear more appropriate. But this is perhaps too limiting, since also capital, such as machines and equipment, can shift in the long-term. If one has access to long time series, output shares may be better to use. An advantage of labour shares may be that it is less subject to measurement errors, but the drawback is that such shares are not only influenced by firms' growth decisions, but also by restructuring and changes in factor intensities (Giannangeli and Gómez-Salvador (2008). Perhaps the best solution is to consider using both shares and see if they deliver similar results.

Another issue to factor in is whether labour productivity or TFP is the one being decomposed. It would seem better to use labour shares when labour productivity is the focus, but unfortunately it does not automatically follow that output shares should be used in the case of TFP. The answer ought to depend on the number of inputs being used in the TFP calculation, and the more inputs, the better it is to use output shares. But what if only labour and capital are accounted for in the production function? And with more inputs, should not the correct share be a composite of some kind? These are not easy questions to fully address here and, again, it is probably better to use both kinds of shares and check how sensitive the results are when changing shares.

Fourthly, should one base the analysis on gross output or value added? Theoretically, it is more correct to use gross output. Value added is equally good only if savings on intermediate inputs are orthogonal to savings in other inputs. However, this is rarely, if ever, the case, implying that analysis should always be based on gross output. But the crux of the matter does not end there. A good reason to confine the analysis to the value added concept is the lack of deflators for gross output, but more desperately, intermediate inputs. Using the same deflator for all outputs and inputs is likely to distort the results more than assuming a value-added production function. A final point worth mentioning is that gross output is often measured as sales, which may not necessarily be preferred to value added. The rule could, then, be to use gross output when good deflators for output and inputs exist; otherwise the value-added production function will have to do. One may also want to add, like in the case of output versus labour shares, that both gross output and value added should be used.

Fifth, and finally, which productivity measure should be used, and does it matter? A decomposition of TFP is basically akin to a sources-of-technology analysis. In the case of labour productivity, however, it is technology *plus* capital intensity that are being decomposed. No wonder the decompositions produce dissimilar results! This is not to say that one is better than the other, but the analyst has to be clear about what is to be measured. To the extent that TFP is a good measure of technology—it is certainly one of the most popular—analyzing the sources of TFP seems to be "purer" in that such analysis does not suffer from any policy confusion as to resource allocation. With labour productivity, one may learn about its sources, but not whether those sources refer to technology, factors or both. Again, if it is possible to use both, unless the analyst is clear that it is technology that is at focus, this may be recommendable.

These are five areas that may be useful to focus future research on. However, of particular usefulness would be to resolve items one and two because the other three items only require that the analyst "controls" for alternatives. The first item, which is length of panels, is something that will resolve itself as time goes by and the research community had better concentrate its resources on decomposing the within-effect into its true innovation and *intra*sectoral components. This will probably give more prominence to the role of structural change at the expense of firms own innovation efforts and success.

5. Conclusions with policy implications for developing countries

The aim of this paper has been to review the literature on the contribution of intersectoral reallocation effects, or structural change, vis-à-vis that of other components that make up productivity growth, notably the within-effect, or own innovation activities. There was an initial belief that the reallocation component may be more pronounced in developing countries than in industrialized ones and that based on such evidence policy implications would differ. Before reviewing the literature, recent methodological advances as to the decomposition of aggregate productivity growth was discussed. It was argued that earlier decomposition attempts may be biased because they tend to only provide a broad brush and confound firm dynamics with the within and between effects, and that recent advances have been significantly promising at addressing previous shortcomings.

The expectation was based on the following: Firms in a sector that innovate, that become more efficient in their use of inputs, and that improve their organizations raise that sector's productivity. Because rich countries make up the world technology frontier, and thus have access to the most recent technologies, and invest much more in research and development than developing countries, one would expect the within-effects to be more pronounced in advanced than developing countries.

The review has shown how wrong this paper's priors have been. Independent of stage of development, the within-effect tends to dominate. However, the main differences occur for firm dynamics, but it is not sure this has much to do with stage of development. A conjecture was that the extent to which markets are regulated and can operate in flexible fashion determined how large a role firm dynamics could play. In fact, relatively poor countries benefit at least as much from firms' own innovative efforts and also in those countries does the reallocation effect contribute little (in a relative sense). This might suggest that policies suitable for industrialized countries are no different from those suitable for developing ones, but is this true? That is, should governments, independent of the economy's stage of development, pursue the same policies in order to achieve, in this case, the best aggregate productivity performance? The answer is, probably not, and this for a number of reasons.

First, countries do not produce the same products. In particular, developing countries devote much more weight to, for example, the role of agriculture, whereas manufacturing figures more prominently in industrialized countries. Furthermore, within manufacturing, developing countries tend to produce in relatively low-productivity sectors. This means that the kinds of capabilities that need to be created differ across countries and, consequently, so do the policies.

Secondly, whereas this paper has analyzed the role of reallocation *between* sectors, it has been silent regarding intra-sectoral reallocation. The argument that Isaksson (2010a, b) is making is that within sectors there are different levels of technologies. Some of those technologies are applied by developing countries, for example, in the production of relatively unsophisticated textile products or assembly of electronics, while industrialized countries apply others, for example, production and design of sophisticated products. The latter presumably require much more human capital and R&D input than the production of less sophisticated products. Again, this would call for different policy measures.

Thirdly and related to the former argument, it might be easier to reallocate within a sector than between sectors. For example, the technology of garments production might be relatively close to that of clothing production in technology terms, while the technologies of garments and, say, machinery production are very different. Firms may, therefore, decide to move within the textiles sector rather than to another sector. But the methods on which this review relies, unless the data are sufficiently disaggregated are unable to detect such reallocation and would, if this argument is applicable, bias the within component. Analysis of intrasectoral reallocation requires very disaggregated data so that within-sector technology levels can be identified. Moreover, the methods providing the basis of the reviewed papers probably need further advancement for them to properly account for within-sector technology levels.

Fourthly, nearly all the studies reviewed here have been based on fairly short time period. Short is, of course, a relative concept, but in terms of intersectoral reallocation, i.e., structural change, a decade or two has to be considered short. It is possible that a study of, say, four decades would do more justice to the reallocation component. Having said that, the two cases of China and India, which both cover 25 years, rather strengthened the within-effect so the length of the time period might not be the answer.

The way forward may be to, based on existing methodologies, focus on more disaggregated information. In particular, one way to gain more understanding of the role of reallocation is to survey individual sectors over time, divide the plants into different "horizontal" categories, such as technological sophistication, and perform a similar decomposition to those reviewed here. That probably implies a division of the within component into a pure within-effect and *intra*sectoral reallocation, which would call for a further methodological refinement.

But until then, the clearest policy conclusion emanating from this paper remains that of investing in innovation-related capabilities—be they new or incremental types of innovations—such as human capital and research and development. And for the analyst, the safest recommendation would be to use several approaches to measurement as a form of sensitivity analysis and also display those results to the readers.

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Table 1: Productivity Growth Decomposition: Industrialized Countries

Method	Country	Sector / Period / Source	Output / Share / Productivity	Within	Between	Cross	Entry	Exit
FHK (2001)	United Kingdom	Manufacturing						
		1980-1992, S1	GO / Labour / LP	47.99%	4.00%	-0.99%	41.99%	6.99%
		2000-2001 S2	GO / Labour / LP	48.00%	19.00%	-17.00%	35.00%	12.00%
		1980-1992, S1	GO / Labour / TFP	4.96%	14.97%	26.01%	42.03%	11.93%
FHK (2001)	United States	Manufacturing						
		1977-1987, S1	GO / Labour / LP	73.94%	7.99%	-10.99%	20.98%	7.99%
		1992 and 1997, S2	GO / Labour / LP	109.00%	-3.00%	-24.00%	-29.00%	49.00%
		1977-1987, S1	GO / Labour / TFP	48.04%	-8.00%	33.98%	20.99%	4.98%
FHK (2001)	Portugal	Manufacturing						
		2001-2002, S2	GO / Labour / LP	83.00%	-4.00%	-3.00%	0.00%	30.00%
FHK (2001)		Manufacturing						
	West Germany	2000-2002, S2	GO / Labour / LP	78.00%	17.00%	-8.00%	-2.00%	18.00%
	Germany	1993-2003, S3	GO / Labour / LP	118.60%	11.50%	-30.10%		
		1993-2003, S3	GO / Output / LP	57.605	-16.10%	58.50%		
FHK (2001)	Finland	Manufacturing						
		2000-02, S2	GO / Labour / LP	83.00%	-1.00%	10.00%	-10.00%	12.00%
FHK (2001)	Netherlands	Manufacturing						
		1992-2001, S2	GO / Labour / LP	78.00%	20.00%	-11.00%	24.00%	3.00%
FHK (2001)	Belgium	Manufacturing						
		1993-2003, S3	GO / Labour / LP	100.20%	9.10%	-9.30%		
		1993-2003, S3	GO / Output / LP	66.90%	-11.70%	44.80%		
		1993-2003, S3	GO / Labour / TFP	100.70%	16.30%	-17.00%		
		1993-2003, S3	GO / Output / TFP	78.30%	29.10%	-7.40%		

FHK (2001)	France	Manufacturing						
		1993-2003, S3	GO / Labour / LP	110.40%	11.40%	-21.80%		
		1993-2003, S3	GO / Output / LP	77.50%	-8.50%	30.90%		
		1993-2003, S3	GO / Labour / TFP	93.90%	21.30%	-15.20%		
		1993-2003, S3	GO / Output / LP	77.20%	3.00%	19.80%		
		1990-1995, S2	GO / Labour / LP	88.00%	10.00%	-15.00%	-5.00%	22.00%
FHK (2001)	Italy	Manufacturing						
		1993-2003, S3	GO / Labour / LP	194.40%	-412.10%	317.60%		
		1993-2003, S3	GO / Output / LP	-97.70%	95.40%	102.30%		
		1993-2003, S3	GO / Labour / TFP	95.10%	-34.60%	39.50%		
		1993-2003, S3	GO / Output / TFP	78.40%	58.60%	-37.00%		
FHK (2001)	Spain	Manufacturing						
		1993-2003, S3	GO / Labour / LP	116.40%	6.90%	-23.30%		
		1993-2003, S3	GO / Output / LP	82.20%	-21.10%	39.00%		
		1993-2003, S3	GO / Labour / TFP	116.90%	6.60%	-23.40%		
		1993-2003, S3	GO / Output / TFP	69.70%	8.90%	21.30%		

Note: Corresponding methods are described in the paper. LP = Labour Productivity, TFP = Total Factor Productivity, GO = Gross Output and VA: Value Added.

Sources:

S1: Brown, D. J. and J. S. Earle, (2008), "Understanding the Contribution of Reallocation to Productivity Growth: Lessons from a Comparative Firm-Level Analysis, " *IZA Discussion Paper No. 3683*, Bonn, Institute for the Study of Labor.

S2: Bartelsman, E. J., J. Haltiwanger and S. Scarpetta (2004), "Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries," *Tinbergen Institute Discussion Paper TI 2004-114/3*, Amsterdam: Tinbergen Institute. Numbers read off Figure 5.2, page 36.

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Table 2: Productivity Growth Decomposition: Transition Economies

Method	Country	Sector / Period / Source	Output / Share / Productivity	Within	Between	Cross	Entry	Exit
FHK (2001)	Hungary	Manufacturing						
		1990-2005, S1	GO / Labour / LP	54.98%	-3.13%	-27.52%	72.37%	3.30%
		1990-2005, S1	GO / Labour / TFP	21.98%	-4.86%	-1.08%	80.55%	1.26%
FHK (2001)	Romania	Manufacturing						
		1990-2006, S1	GO / Labour / LP	59.35%	8.38%	-15.83%	44.74%	3.34%
		1990-2006, S1	GO / Labour / TFP	52.23%	4.74%	-9.66%	49.72%	2.96%
FHK (2001)	Russia	Manufacturing						
		1992-2004, S1	GO / Labour / LP	-590.40%	359.6%	61.61%	-223.7%	292.93%
		1992-2004, S1	GO / Labour / TFP	-30.35%	67.28%	-23.54%	44.49%	42.12%
FHK (2001)	Ukraine	Manufacturing						
		1992-2006, S1	GO / Labour / LP	26.15%	11.47%	16.62%	41.34%	4.42%
		1992-2006, S1	GO / Labour / TFP	-0.39%	13.63%	30.79%	50.40%	5.57%
FHK (2001)	Lithuania	Manufacturing						
		1995-2005, S1	GO / Labour / LP	46.34%	4.02%	-1.82%	40.15%	11.30%
		1995-2005, S1	GO / Labour / TFP	41.26%	7.86%	-6.71%	49.22%	8.38%
FHK (2001)	Latvia	Manufacturing						
		2000-2002, S2	GO / Labour / LP	41.00%	40.00%	-24.00%	42.00%	-1.00%
FHK (2001)	Slovenia	Manufacturing						
		1997-2001, S2	GO / Labour / LP	68.00%	18.00%	-2.00%	15.00%	13.00%
FHK (2001)	Estonia	Manufacturing						
		2000-2001, S2	GO / Labour / LP	60.00%	-1.00%	-2.00%	25.00%	23.00%

Note: Corresponding methods are described in the paper. LP = Labour Productivity, TFP = Total Factor Productivity and GO = Gross Output.

Sources:

S1: Brown, D. J. and J. S. Earle, (2008), "Understanding the Contribution of Reallocation to Productivity Growth: Lessons from a Comparative Firm-Level Analysis, " *IZA Discussion Paper No. 3683*, Bonn, Institute for the Study of Labor.

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Table 3: Productivity Growth Decomposition: Developing Countries

Method	Country	Sector / Period / Source	Output / Share / Productivity	Within	Between	Cross	Entry	Exit
Syrquin (1986)	India	GDP						
		1980-1992, S1	VA / Labour and Output	64.80%	35.20%			
		1992-2004, S1	/ LP	68.20%	31.80%			
		1980-2004, S1		75.80%	24.20%			
		Manufacturing						
		1980-1992, S1	VA / Labour and Output	77.42%	22.58%			
		1992-2004, S1	/ LP	85.14%	14.86%			
		1980-2004, S1		87.25%	12.75%			
Syrquin (1986)	China	GDP						
		1980-1992, S1	VA / Labour and Output	87.30%	12.70%			
		1992-2002, S1	/ LP	107.80%	-7.80%			
		1980-2002, S1		94.00%	6.00%			
		Industry						
		1980-1992, S1	VA / Labour and Output	84.67%	15.33%			
		1992-2002, S1	/ LP	103.43%	-3.43%			
		1980-2002, S1		97.56%	2.44%			
Syrquin (1986)	Thailand	GDP						
		1980-2005, S3	VA/ Labour and Output	85.00%	15.00%			
			/ LP					
Syrquin (1986)	Malaysia	GDP						
		1981-1983, S5	VA/ Labour and Output	91.66%	8.34%			
		1984-1986, S5	/ LP	200.00%	-100%			
		1987-1989, S5		108.70%	-91.30%			
		1990-1992, S5		81.48%	18.52%			
		1993-1995, S5		84.21%	15.79%			
		1996-1997, S5		90.16%	9.84%			
FHK (2001)	Korea	Manufacturing						
		1988-93, S2	GO / Output / LP	72.00%	8.00%	-13.00%	15.00%	25.00%

FHK (2001)	Taiwan	Manufacturing 1986,1991 and 1996, S2	GO / Output / LP	74.00%	17.00%	-22.00%	17.00%	20.00%
FHK (2001)	Chile	Manufacturing 1985-1999, S2	GO / Output / LP	95.00%	25.00%	-50.00%	-35.00%	65.00%
FHK (2001)	Argentina	Manufacturing 1995-2001, S2	GO / Output / LP	125.00%	25.00%	-51.00%	-5.00%	10.00%
FHK (2001)	Colombia	Manufacturing 1987-1998, S2	GO / Output / LP	105.00%	20.00%	-45.00%	-20.00%	40.00%
Haltiwanger (1997)	Tanzania	Manufacturing 1990-95, S4	VA / Labour / LP	122.00%	13.00%	-36.00%		
Haltiwanger (1997)	Zambia	Manufacturing 1990-95, S4	VA / Labour / LP	357.14%	28.57%	-278.57%		
Haltiwanger (1997)	Kenya	Manufacturing 1990-95, S4	VA / Labour / LP	445.45%	281.80%	-629.09%		
Haltiwanger (1997)	Côte d'Ivoire	Manufacturing 1990-95, S4	VA / Labour / LP	99.00%	7.35%	-6.34%		
Haltiwanger (1997)	Ghana	Manufacturing 1990-95, S4	VA / Labour / LP	78.97%	66.15%	-43.59%		
Haltiwanger (1997)	Zimbabwe	Manufacturing 1990-95, S4	VA / Labour / LP	163.33%	33.33%	-96.67%		
Haltiwanger (1997)	Cameron	Manufacturing 1990-95, S4	VA / Labour / LP	144.94%	-25.84%	-13.48%		

Note: Corresponding methods are described in the paper. LP = Labour Productivity, GO = Gross Output and VA: Value Added.

Sources:

S1: Saccone, D. and V. Valli (2009), "Structural Change and Economic Development in China and India," *Working paper No. 7/2009*, Dipartimento di Economia, Università di Torino, Italy.

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