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Productivity in Services in Latin America and the Caribbean*

Elena Arias-Ortiz[1], Gustavo Crespi[2], Alejandro Rasteletti[3], and Fernando Vargas[2,4]

Abstract**

This paper studies productivity in Latin America and the Caribbean, with an emphasis on the service sector. It shows that the low levels of productivity observed in the region are not only a consequence of low productivity at the firm level, but also of misallocation of workers across firms. These problems are more severe in services than in manufacturing. We also found that the determinants of productivity and employment growth at the firm level are different in manufacturing and services. Furthermore, results suggest that institutional factors might be important for determining productivity growth and resource allocation, as there are large differences across countries in the region in the effect of productivity on employment growth as well as on the speed at which less productive firms can close their productivity gaps.

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1. Introduction

The service sector is increasingly important not only in developed economies, but also in developing ones. On average, in Latin America and the Caribbean (LAC), the service sector accounts for more than 60 per cent of both GDP and total employment (World Bank, 2012). While the share of the service sector has been increasing, its rate of productivity growth has remained stubbornly low compared to other sectors of the economy (IDB, 2010). Consequently, the service sector has pulled down the region's aggregate productivity levels.

This paper studies what lies behind the low levels of productivity and productivity growth in the service sector in the LAC region. Our results suggest that the low productivity is due to very low productivity at the firm level, as well as to a misallocation of workers across firms. For instance, we found that, in a typical LAC country, the average productivity of a firm in a typical service sector compared to that of a firm located at the productivity frontier of the same sector in the United States was just 8.8 per cent. Furthermore, only 2 per cent of firms in the service sector were found to have a productivity level that was 50 per cent or more than that of a similar firm in the United States that is on the technological frontier. This low productivity problem is aggravated by the fact that too many workers are employed in low productivity firms. If, for example, the allocation of workers across firms were as efficient as that observed in the manufacturing sector, the productivity of the service sector in a typical LAC country would be 27 per cent higher.

Improving productivity in services is central not only to improving the sector's performance, but also to improving the performance of the economy as a whole. Traditional services, such as transport, logistics, and wholesale trade, are the links between the different production blocks of the economy; hence, an increase in productivity has the potential to improve productivity in creating final goods as well. Knowledge-intensive business services (KIBS), such as telecommunications, software, and engineering, can strengthen the innovative capacity of the whole economy, improving a country's long-run growth potential (Europe Innova, 2011; OECD, 2001a; Sissons, 2011). Finally, manufacturing and services are becoming increasingly integrated; therefore, from a value chain (or value system) perspective, the competitiveness of the manufacturing sector depends to a great extent on the efficiency and value added in the production of services. In this respect, services are increasingly considered fundamental inputs and outputs of productivity growth for many sectors of the economy.

Despite the importance of the service sector in determining aggregate productivity, the determinants of productivity in services has typically been under-researched; though, this has changed over the past 15 years. Organisation for Economic Co-operation and Development (OECD) countries have been researching the dynamics of employment generation and productivity growth, which has led to renewed interest in understanding productivity in services (OECD, 2001b; Triplett and Bosworth, 2001). Results emerging from this research suggest that determinants of productivity growth in services are different from those in manufacturing[1] and that one-size-fits-all theories of productivity growth are misleading to the extent that services are a diverse group of sectors with regards to production and innovation (Tether, 2004). Moreover, some research suggests business services, telecoms, and financial intermediation are even more dynamic in terms of productivity growth than manufacturing.

In contrast to this evolving body of knowledge in developed countries, to the best of our knowledge, there are no systematic studies of how to promote productivity growth in services in LAC. Furthermore, the very few papers that study productivity levels in the service sector in LAC use a very high level of aggregation (de la Torre, Levy Yeyati, and Pienknagura, 2013; IDB, 2010), ignoring the heterogeneity of market services. As a result, it is not easy to identify the sources of productivity growth within a sector, information which is relevant for policy design.[2] This paper fills part of the knowledge gap by studying the determinants of productivity and productivity growth in the service sector in LAC, *at the firm level.*

Studying the determinants of productivity levels is important because firm-level productivity in the region is dispersed, even within specific economic sectors. Large dispersions in productivity are not unique to LAC, having also been identified in the United States and in various other countries (Bartelsman, Haltiwanger, and Scarpetta, 2004; Syverson, 2004). But the evidence suggests that productivity dispersion is higher in LAC than in the United States (Busso,

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[1] Results from different studies suggest that productivity growth in services is less based on R&D and more based on informal arrangements, on the adoption of information and communications technology (ICT), and on user–producer interactions. Further, productivity growth in services is found to be more sensitive to regulations and tax structures.

[2] Another problem with studies based on national accounts data is related to differences in how national statistics offices treat services. In particular, even in some developed countries, value-added in services tends to be credited by charging a "productivity factor" to input costs (Crespi, et al., 2006). This practice seriously affects the possibility of using national accounts data to calculate service sector productivity.

Madrigal, and Pagés, 2012). As large dispersions in productivity suggest that allocation of resources across firms is not efficient, the findings in the literature suggest that LAC is paying a high price in terms of lost output for not assigning resources to where they will provide the highest value. In this paper, we present evidence that this cost is higher in services than in manufacturing because productivity dispersion is higher in the service sector.

The theoretical literature has rationalized the existence of productivity dispersion in equilibrium as a result of market frictions, such as entry costs (Hopenhyan, 1992; Melitz, 2003) and learning processes (Jovanovic, 1982).[3] The severity of these market frictions can be affected by the institutional environment. This interplay between the business environment and the heterogeneity in firm-level productivity has been the focus of some recent papers (Bartelsman, Haltiwanger, and Scarpetta, 2013; Hsieh and Klenow, 2009; Restuccia and Rogerson, 2008). These studies suggest that market frictions tend to be larger when the quality of institutions is lower. This, in turn, results in an increase of firm-level productivity dispersion. In this paper, we present empirical evidence that there are large differences across countries in the region in how fast more productive firms increase their labour force and on how fast low productivity firms close their productivity gap. These two findings suggest that country institutions might be important determinants of aggregate productivity growth.

Our results also suggest that the quantitative importance of the determinants of firm productivity and employment growth is different in manufacturing and services, as well as in the different service sectors. Some determinants thought important for explaining productivity and employment growth in manufacturing, such as firm age and size, play a quantitatively smaller role in determining productivity and employment growth in services, particularly in KIBS. This is probably related to the differences in how innovation takes place in the manufacturing and service sectors, with innovation depending less on R&D investment in the service sector and depending more on informal arrangements and interactions.

The rest of the paper is organized around the different components of a commonly used decomposition of aggregate productivity (Olley and Pakes, 1996). According to this decomposition, aggregate productivity is the sum of two components: the average firm-level productivity and the allocation of resources across firms. Section 2 discusses the Olley–Pakes

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[3] In a neoclassical setting with frictionless markets, resources should be allocated to their highest value of use, and no productivity dispersion can emerge in equilibrium.

decomposition in detail and introduces the productivity measure and datasets used in this paper. In Section 3, we study the component of productivity related to average firm-level productivity. We present evidence that firms in LAC have productivity levels well below those observed among the most productive firms in the United States. We also present evidence that there is a large dispersion in productivity within industrial sectors in LAC, with a non-trivial share of low productivity firms that pull down the average. In Section 4, we focus on the second component of productivity and assess the extent to which more resources are allocated to more productive firms. In Section 5, we study the determinants of productivity growth at the firm level, as higher productivity growth increases the first component of aggregate productivity. We also examine whether the effect of the determinants on productivity growth are different in services and manufacturing. We found evidence that suggests that institutional factors might be relevant for understanding productivity growth, since across countries we found large diversity in the speed at which low productivity firms close their productivity gaps. Section 6 studies the determinants of employment growth and whether these determinants differ between the manufacturing and service sectors. Again we found evidence that suggests the importance of institutional factors because the effect of productivity on employment growth varied significantly across countries. We provide our concluding remarks in Section 7.

2. Aggregate Productivity: Measurement and Decomposition

2.1 Measuring Productivity

Measuring productivity is an intrinsically difficult task (Syverson, 2011). Ultimately, what researchers would like to measure is output obtained from a given set of inputs. For this reason, productivity measures are usually expressed as output per units of inputs. Labour productivity measures are probably the most commonly used measures in the productivity literature. We used the firm's total annual sales divided by the total number of employees as the labour productivity measure in this paper.

Despite being frequently used in the literature, measuring firm-level productivity through annual sales per worker has several problems. First, this measure does not control for the use of other inputs. For example, two producers using the same production technology can have different labour productivity if they happen to choose different combinations of capital and labour inputs. For this reason, researchers prefer a measure of productivity usually referred to as total factor productivity (TFP), which controls for other inputs. Second, the value of sales might not be a good indicator of the value-added produced in a sector since different sectors might have different production costs. In cases where TFP cannot be calculated, researchers tend to use value added per worker as a measure of productivity. Third, the value of sales depends on the prices charged by firms. But prices can be affected by factors unrelated to productivity, such as market power. For these reasons, researchers prefer using deflated productivity measures that reflect quantities instead of revenues as a measure of productivity. Given that we do not have data on capital stocks, production costs, or sale prices, we were forced to use annual sales as our productivity measure.

2.2 Datasets

In this study, we used two firm-level databases. The main dataset was the World Bank's Enterprise Surveys (ES) from 2010. The ES 2010 contains firm-level information for all 18 LAC countries in 2009 for a total of 14,657 observations. The ES gathered information for 2007 using recall questions. The ES excluded informal firms and formal microfirms with fewer than 5 employees and thus oversampled large firms, as the objective was to collect information about firms in the region that created the most jobs. The ES covers 13 sectors in manufacturing and 7 sectors in services, but not all sectors were surveyed in all countries. The samples have a large share of older firms, with almost 80 per cent having been in business for 10 years or more. A detailed technical explanation of the methodology, sampling, and contents of the ES is provided in Appendix 1.

We compared results in Latin America with those observed in the United States. Data for the United States came from the 2007 Survey of Business Owners (SBO), collected by the U.S. Census. The survey contains information on over 930,000 firms, but excludes very large firms with a large number of owners, as these firms might be easily identifiable. The difference in sampling design between the SBO and the ES causes the comparison of LAC vs. U.S. productivity to be optimistic in LAC's favour. The ES excludes small firms, which tend to be unproductive, while the SBO excludes large firms, which tend to be highly productive. Other differences between the two datasets are presented in Table 1.

Table 1. Main Characteristics of the Microdata Used

	Enterprise Survey 2010*	Survey of Business Owners 2007
Countries	18 Latin American countries + Caribbean**	United States
Years covered	2009 and 2007 (recall data)	2007
Observations	14,657	930,065
Sampling design	Firms operating in manufacturing and services, excluding microfirms (fewer than 5 employees)	Firms operating in all sectors, excluding those with more than four individual owners (e.g., publicly owned)
Sector classification	ISIC 3.1	NAICS
Variables	Performance measures (sales, employment) plus access to finance, corruption, infrastructure, crime, and competition	Performance measures (sales, employment) plus characteristics of owners
Limitations	Includes too many old firms	Excludes firms easily identifiable in one sector or with a very large number of owners

*For Brazil, the survey was carried out in 2009, implying that data covers fiscal 2008 and recall data covers 2006.
** The ES was implemented for the first time in Caribbean countries in 2010, with relatively small sample sizes. Thus, Caribbean countries are treated as one country to ensure statistical representativeness and includes the following countries: Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

2.3 Decomposing Aggregate Productivity

Since first introduced by Olley and Pakes (1996), economists have found it convenient to decompose aggregate productivity into two components. The first component is usually referred to as the *within* component of productivity; it measures the productivity of the average firm in the sector. The second component is usually referred to as the *between* component of productivity; it captures whether more productive firms are on average larger, as this increases aggregate productivity. The *between* component is usually interpreted as an indicator of efficiency in the allocation of resources in a sector because a positive component indicates that more resources are allocated to more productive firms.

More specifically, aggregate labour productivity in sector *s* in country *c* (p_{sc}) can be defined as:

$$p_{sc} = \sum_{i=1}^{N_{sc}} s_{isc} p_{isc} \tag{1}$$

where p_{isc} is the labour productivity of firm *i* in sector *s* and country *c*; s_{isc} is the share of labour allocated to firm *i* in the sector s and country *c*; and N_{sc} is the number of firms in sector *s* and country *c*.[4]

[4] The seminal work of Olley and Pakes (1996) used output shares as weights. Output shares were the appropriate weight in their case, since they decomposed total factor productivity. The work in this paper focuses on labour

Olley and Pakes showed that aggregate productivity can be rewritten as

$$p_{sc} = \overline{p_{\iota sc}} + \sum_{i=1}^{N_{ic}} (s_{isc} - \overline{s_{\iota sc}})(p_{isc} - \overline{p_{\iota sc}}) \quad (2)$$

where $\overline{p_{\iota sc}}$ and $\overline{s_{\iota sc}}$ are the unweighted averages of s_{isc} and p_{isc}, respectively. The first and second terms on the right-hand side of Equation 2 are the *within* and *between* components mentioned above.

Equation 2 is useful for analytical purposes because it clearly identifies the two sources of aggregate productivity. In a given country and sector, aggregate productivity can increase if, all else equal, the average firm becomes more productive ($\overline{p_{\iota sc}}$ increases) and/or workers are reallocated from the less productive firms to the more productive ones. In the rest of the paper, we use the Olley–Pakes decomposition to understand the difference in productivity between the service and manufacturing sectors in LAC. The *within* component is studied in the next section and Section 5, while the between component is studied in Sections 4 and 6.

3. The Enemy Within – Productivity Gaps in LAC

A well-documented fact in the productivity literature is that large differences in productivity across firms in narrowly defined sectors are ubiquitous (Syverson, 2011). This finding is important because aggregate productivity in a given country and industrial sector is a weighted average of the productivity of all firms in that country and industry. Therefore, low productivity firms drag down aggregate productivity. In this section, we present two types of evidence that show that there seems to be room to improve the average productivity of firms in the region. In the following subsection, we show that there are large productivity dispersions across firms within specific sectors, which indicates the presence of a non-trivial share of relatively unproductive firms in the region. In the following subsection, we present evidence that very few firms in the region have productivity levels that are close to those observed in the U.S. "productivity frontier." These features are more pronounced in services than in manufacturing.

3.1 Productivity Dispersion in LAC

While studying productivity dispersion, it is common to look at how productivity is distributed across firms within narrowly defined sectors. Table 2 summarizes the extent of dispersion

productivity instead. The algebraic decomposition of labour productivity indicates that labour shares must be used as weights in the aggregation.

observed in a typical sector in a typical LAC country. A typical sector or country is defined as the median country or sector, along with the characteristic being considered.[5] Results in Table 2 suggest that productivity dispersion in services is likely to be larger than in manufacturing. For instance, the differences in log productivity between firms at the 90th and 10th percentile of the productivity distribution are 2.66 log points in services and 2.53 log points in manufacturing. It is also interesting to notice that productivity dispersion is relatively large in more traditional sectors, namely low-tech manufacturing and traditional service sectors.

Table 2. Log Sales/Worker in Manufacturing and Services in LAC

	Manufacturing			Services		
	All	**Low-tech**	**High-tech**	**All**	**Traditional**	**KIBS**
Median	3.43	3.25	3.97	3.88	4.07	3.24
Standard deviation	1.00	1.01	0.96	1.11	1.11	0.80
IQ* range	1.30	1.23	1.23	1.24	1.27	0.97
90th–10th percentile range	2.53	2.54	2.39	2.66	2.74	2.08

* IQ = interquartile
Source: Authors' elaboration using ES 2010. Figures were calculated taking the median across sectors in a given country, and then taking medians across countries. Unweighted results. Weighted results are qualitatively similar.

The productivity dispersion observed in LAC is relatively large compared to other countries.[6] Syverson (2004), using highly disaggregated data from the manufacturing sector, reported an average interquartile (IQ) range of TFP of 0.66 log points for the U.S. manufacturing sector. He also estimated a 90th–10th percentile range of 1.42. Our estimates of labour productivity using the SBO data suggest an IQ range of 0.99 in manufacturing and 1.28 in services. The 90th–10th range figures are 2.06 for manufacturing and 2.60 for services.

The cost of productivity dispersion in LAC is relatively high in terms of lost output. If, for example, low productivity firms were as productive as the firm with the median productivity in the same sector, average labour productivity would increase by 12.9 per cent in a typical manufacturing sector in a typical country; the increase in the typical service sector would be 13.7 per cent. If, instead, low productivity firms were as productive as a firm at the 75th percentile, average labour productivity in typical manufacturing and service sectors in a typical

[5] This definition of "typical" is used throughout this paper. Given the large number of Caribbean countries in the sample, we decided to group them together before calculating the medians. The medians obtained without grouping the Caribbean countries would tend to reflect the reality of those countries, reducing the representativeness for LAC as a whole. Figures for the Caribbean are also obtained through medians of different Caribbean countries.

[6] Figures are not strictly comparable with those reported in Table 2, as the level of disaggregation and sectors included differ.

country would increase by 42.6 per cent and 44.1 per cent, respectively. Even if these figures are large, they do not take into account that the median firm or the firm at the 75th percentile might have a level of productivity that is low compared to a similar firm in a more developed country. This issue is explored in the next subsection.

3.2 Mind the Gap – LAC Firms and the U.S. Productivity Frontier

Here we assess the productivity of LAC firms compared with the most productive firms in the United States, which are used as a proxy for the "productivity frontier." To construct the technological frontier in the United States, we used the SBO data discussed earlier. The frontier is defined as the productivity of a firm at the top 5th percentile of the labour productivity distribution in a given sector in the United States. After constructing the frontiers for the different sectors, for each firm in the LAC dataset we generated a relative measure of the firm's productivity gap compared to the frontier. This measure is defined as the ratio of the firm's sales per worker to the sales per worker of a U.S. firm in the sector located at the productivity frontier. As the disaggregation of manufacturing sectors in the ES and SBO differ, the productivity frontier in manufacturing was calculated for the sector as a whole, not for specific manufacturing sectors, resulting in an upward bias in the gaps. The gaps were more severe for the less productive manufacturing sectors.

Our analysis of the relative productivity measure indicates that productivity gaps in the region are large, particularly in the service sector (Table 3). For instance, while the average relative productivity of a firm in a typical manufacturing sector in a typical country was 11.5 per cent of that of a firm at the U.S. technological frontier, the average relative productivity of a firm in a typical service sector was 8.7 per cent. If, instead of looking at the average firm, we focused on the median firm, the productivity gap of the median firm was much larger than that of the average firm (Table 3), with productivity falling by over a half in the case of a typical manufacturing sector and by almost a third for services.

Table 3. LAC Average Productivity Relative to U.S. Firms at the Productivity Frontier

	Manufacturing	Services		
Sales/worker	All	All	Traditional	KIBS
Mean	11.5	8.7	8.6	8.8
Median	5.2	5.9	6.1	4.7

Source: Authors' elaboration using ES 2010 and SBO 2007. Figures are calculated taking the median across sectors in a given country and then taking medians across countries. Unweighted results. Weighted results are qualitatively similar.

The large difference between the relative productivity of the median and average firms suggests the existence of some high productivity firms in LAC. The data indicates that, even though some highly productive firms exist, there are very few, particularly in services. We found that, in a typical country, 1 per cent of manufacturing firms and 0.2 per cent of service firms have productivity that is 90 per cent or higher of the U.S. productivity frontier (Table 4). The number was still relatively low when we looked at firms with productivity of 50 per cent or higher of that observed for a firm at the productivity of the frontier. Only 4.7 per cent of the manufacturing firms and 2 per cent of the service firms were at this level of productivity. These figures are low when compared to the United States. According to our calculations using the SBO data, 17.5 per cent of the firms in the United States have a productivity level 50 per cent or higher relative to the frontier.[7] In services, that figure is 14.3 per cent.

Looking at sectors within services, the data indicates that a typical KIBS firm presents larger productivity gaps than firms in traditional services (Table 3). But, at the same time, the average firm in KIBS has a lower productivity gap. This is likely a consequence of a larger share of firms in KIBS that have productivity 50 per cent or higher than that observed in the United States. The shares reached 3.6 per cent in KIBS (Table 4), while in traditional services it was only 1.6 per cent. But the data also suggest that there are few high productivity firms in KIBS. In a typical country, no KIBS firm had productivity that was 75 per cent or higher than the U.S. frontier. In traditional services, 0.8 per cent of firms were in this category.

[7] This figure is likely to be a lower boundary because of the way the productivity frontier was estimated for the manufacturing sector.

Table 4. Percentages of High Productivity Firms in LAC

	Manufacturing	Services		
Productivity	**All**	**All**	**Traditional**	**KIBS**
50 per cent of U.S. Frontier	4.7	2.0	1.6	3.6
75 per cent of U.S. Frontier	1.4	0.7	0.8	0.0
90 per cent of U.S. Frontier	1.0	0.2	0.3	0.0

Source: Authors' elaboration using ES 2010 and SBO 2007. Figures are calculated taking the averages within the sector specified and then taking the median across countries. The U.S. frontier was measured at the top 5th percentile of the distribution of firm productivity in the United States. Unweighted results. Weighted results are qualitatively similar.

The results presented in this section suggest that there is room to increase the average productivity of firms in LAC, particularly in the service sector. On the one hand, firms in LAC are highly heterogeneous in terms of productivity, which suggests that large gains in aggregate productivity could be attained if the productivity of the less productive firms were to be increased. On the other hand, LAC firms present relatively low levels of productivity compared to the U.S. productivity frontier. Both these problems are more acute in the service sector.

4. The Enemy Between Us – The Role of Allocative Efficiency

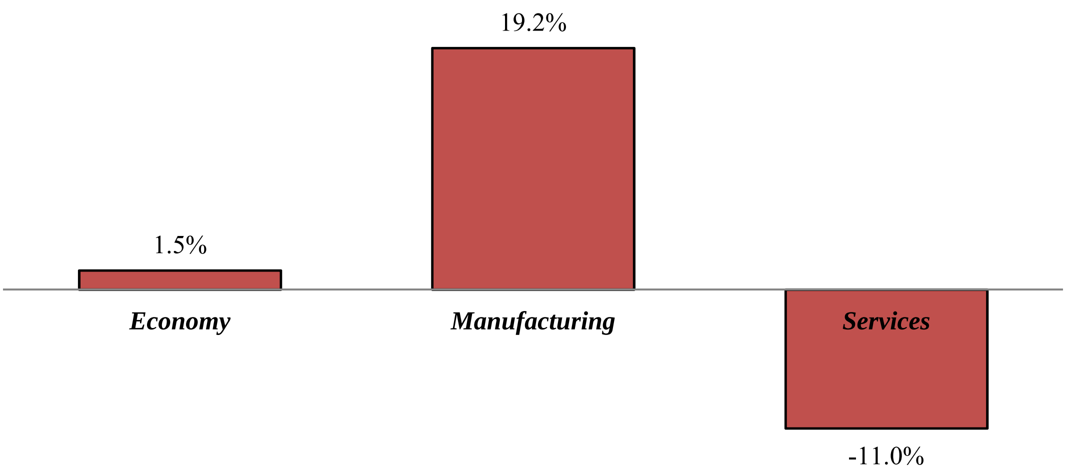
In this section, we study the *between* component of aggregate productivity by looking at how workers are allocated across firms with different productivity levels. We assessed the role played by market forces in allocating resources toward more productive firms. As comparisons of variables in levels across sectors and countries tend to be problematic, we focused instead on the relative contribution of the *between* component to aggregate productivity. We name this variable allocative efficiency (AE), which we define as:

$$AE_{sc} = \sum_{i=1}^{N_{ic}} \left[\frac{(s_{isc} - \overline{s_{isc}})(p_{isc} - \overline{p_{isc}})}{p_{sc}} \right] \quad (3)$$

To estimate the relative importance of AE in explaining aggregate productivity in the manufacturing and service sectors in LAC, we calculated the medians of AE_{sc} across different industries in the manufacturing and service sectors for the different countries in the sample. We then calculated the median across countries to obtain the LAC values. Results can therefore be interpreted as representative of a "typical industry" in a "typical country." Finally, we produced an economy-wide measure of AE. To do this, we calculated a weighted average of AE in manufacturing and services, using employment shares as weights. The economy-wide LAC figures correspond to the median of the countries' AEs.

Figure 1 presents our AE estimates. The results indicate that AE accounts for a low share of aggregate productivity in LAC. In the manufacturing sector, AE represents less than one-fifth of aggregate productivity in the typical industry in the typical country. In the service sector, AE reduces productivity by about 11 per cent. This last result is particularly striking, as it implies that if the workers in a typical service industry in a typical country in LAC were randomly reallocated across firms in their current industry, the aggregate productivity of that industry would increase by 11 per cent.

Figure 1. Allocative Efficiency in LAC *(median across countries and industries)*



These contributions to aggregate productivity seem low compared to the results obtained for the United States. Using the SBO sample, we estimated that AE accounts for 25 per cent of aggregate productivity in the manufacturing sector and for 7 per cent in the service sector.[8,9]

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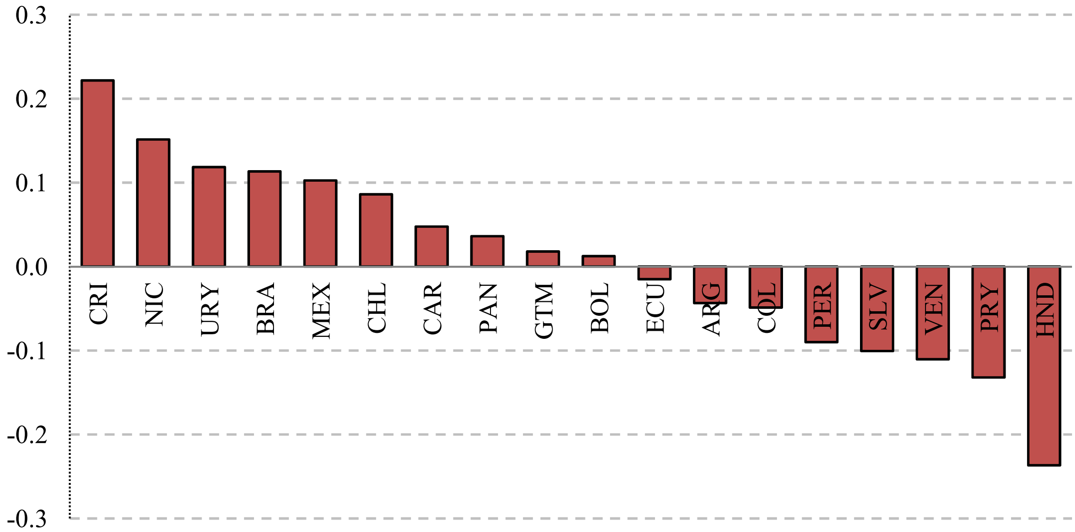
8 Results from the ES and the SBO surveys are not comparable because firm-size coverage and sector aggregates do not coincide. Results from the SBO are likely biased downward, as the sample does not include the largest firms, which tend to be the most labour-productive. Results from the ES are likely biased upward, as the ES does not include the smallest firms, which tend to be the least labour-productive.

9 Using multifactor productivity measures tends to produce higher results. Bartelsman, et al. (2013) reported an AE contribution to aggregate productivity of 51 percent for the economy as a whole in the United States. A study by Arnold, Nicoletti, and Scarpetta (2008) that looked at eight OECD countries reported contributions in the 15–40 percent range, both in manufacturing and services, with most contributions in the 20–30 percent range.

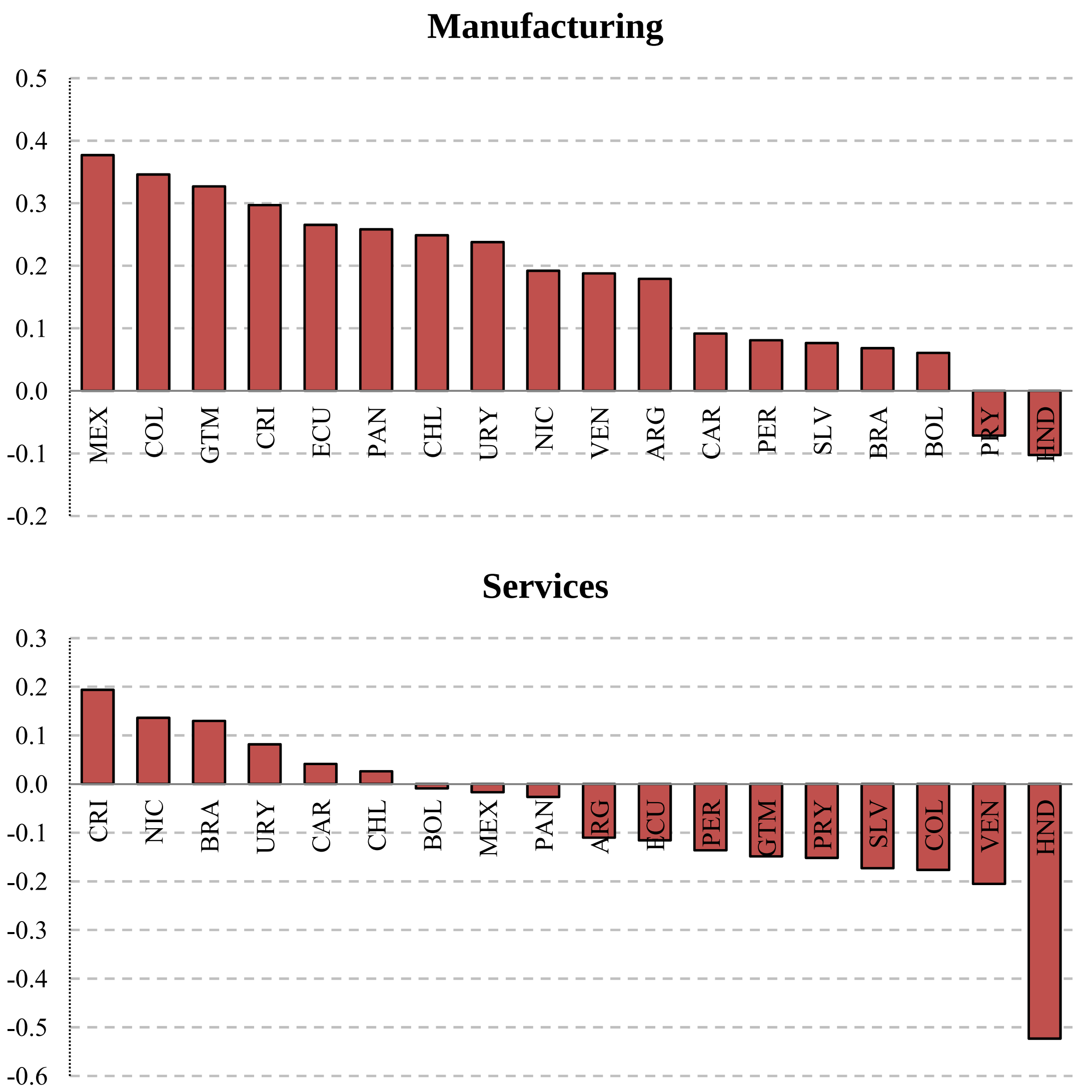
Figure 2. Allocation Efficiency by Country *(all sectors – medians)*



The data also reveals that very large differences exist in the role of AE across countries in LAC (Figure 2). While in most countries the contribution of AE to productivity was positive, in seven countries in our sample, AE reduced productivity. This result is mostly driven by the service sector, which in the typical country employs a large share of workers. Figure 3 shows that, while in only two countries AE had a negative effect on productivity in the manufacturing sector, for most countries in the sample, the contributions of AE to aggregate productivity were negative in the service sector.[10]

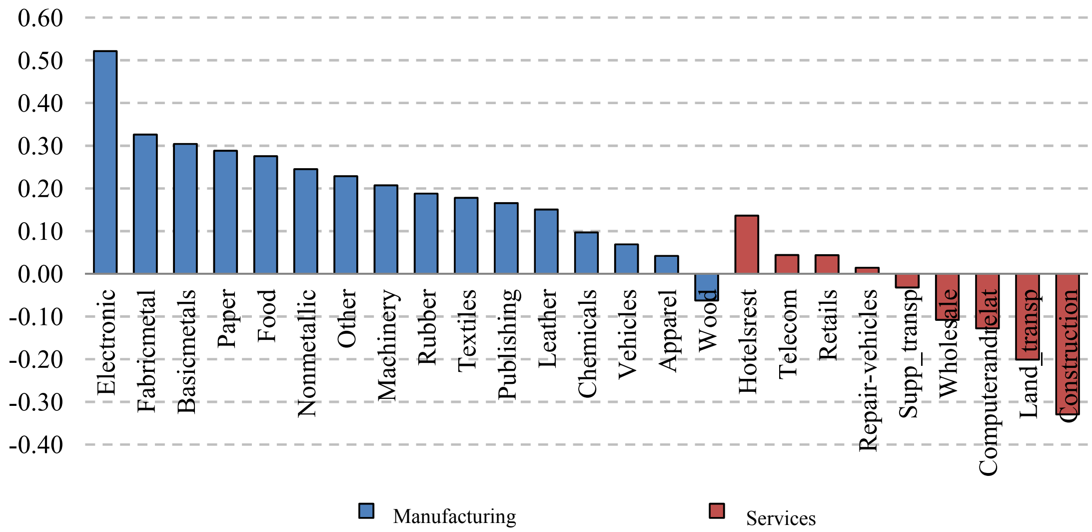
[10] Figures 2 and 3 need to be interpreted with caution, as the extent of the biases is likely to change across countries. More specifically, the AE estimates for countries with a large share of firms with fewer than 5 employees are likely biased upward if these firms are less labour-productive than larger firms. This argument also suggests that the bias is likely to be more severe in the service sector, which tends to present a larger share of small firms than the manufacturing sector.

Figure 3. Allocation Efficiency by Sector and Country *(all sectors – medians)*



In services, there is low productivity in most subsectors. Figure 4 presents the medians of AE across countries for the different sectors in our sample. With the exception of the hotel and restaurant industry, the contribution of AE to aggregate productivity in all service sectors was lower than the contribution of AE in any of the manufacturing sectors, excluding wood. Allocation efficiency in services was also low compared to AE in the U.S. sample. The largest difference was in construction. While the median contribution of AE to productivity in this industry was −31 per cent in LAC, the AE in the United States was 30 per cent. Large differences were observed in retail and wholesale trade. In LAC, the AEs were 4.4 per cent and −10.8 per cent, respectively, compared with 22.2 per cent and 7 per cent in the United States.

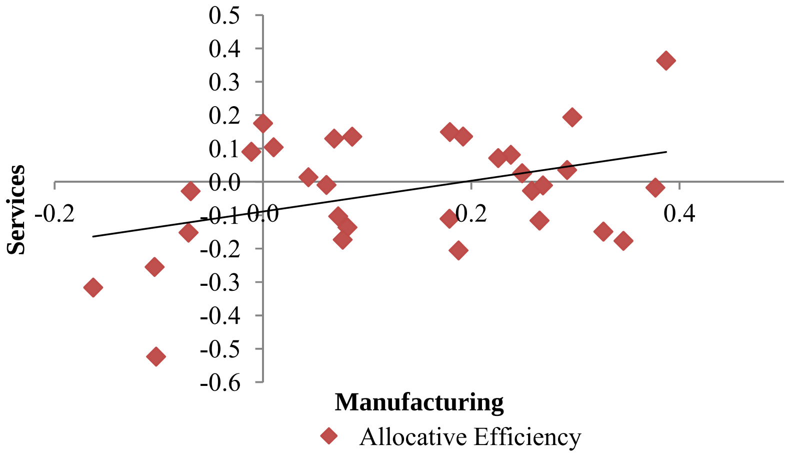
Figure 4. Allocation Efficiency by Sector *(average across countries – efficiency measured as medians)*



The low AE observed in some industries across the region imply a significant cost in lost output. Our calculations indicated that, in a typical country, closing the AE difference between services and manufacturing would increase productivity by 27 per cent in the service sector and by 17 per cent for the economy as a whole. But this exercise did not take into account that closing the AE gap between manufacturing and services within a country might still leave some countries with very low levels of AE. Potential productivity gains were much larger if, instead of closing AE gaps within countries, we closed AEs between countries within a given industry. If each industry in a given country were to have an AE equal to the highest observed AE for that sector in LAC, productivity would increase by almost 108 per cent in the service sector and 73 per cent in manufacturing, in a typical country. These increases would imply a 95 per cent productivity increase for the economy as a whole.

Given these large potential gains, understanding what drives AE is important. Analysis of the estimated AE suggests aggregate drivers and sector-specific drivers are both important. Aggregate drivers are likely to be relevant because we found that AEs in the manufacturing and service sectors tended to move together. More precisely, whenever AE explained a large share of aggregate productivity in the manufacturing sector in a given country, it also tended to explain a large share of aggregate productivity in the service sector in that same country, and vice versa (Figure 5). The estimated correlation coefficient between AE in services and manufacturing was 0.40, significantly different from zero at a 10 per cent confidence level. Sector-specific drivers are also likely to be important since we found that, for most countries, AE was larger in manufacturing than in services. This finding suggests there might be some extra constraints in the service sector that hinder the efficiency of resource allocation.

Figure 5. Sectoral Correlation in Allocative Efficiency



5. What Determines Productivity Growth?

One way to achieve higher levels of productivity is to make existing firms more productive since this increases the *within* component of aggregate productivity. In this section, we study the determinants of firm-level productivity growth in LAC. Two different set of variables affect productivity growth. On one hand, growth can depend on a firm's or firm owner's individual characteristics, as these can affect a firm's capacity to innovate and absorb existing technology. On the other hand, growth can depend on variables related to the environment in which a firm operates, as institutions are likely to affect a firm's behaviour. In this section, we explore the relative importance of these variables in the manufacturing and service sectors.

5.1 Econometric Model

Our basic estimation follows an approach developed by Griffith, Redding, and Van Reenen (2004). They presented a framework in which productivity growth can take place through new discoveries and by imitating the discoveries of other firms. Griffith, et al. (2004) called the first mechanism *innovation* and the second *technology transfer*. For the technology transfer mechanism to exist, the technology recipient must experience a technology gap. To measure the potential for technology transfer, the authors used a productivity gap measure, which was defined as the distance to the productivity frontier. The likely finding was that a higher distance to the frontier would increase the potential for technology transfer. Griffith, et al.'s econometric model was developed for a panel of industries. We developed an alternative version of their model, which we estimated in our cross-section of firms.

As a starting point for the econometric model, we assumed a very general knowledge production function where knowledge generation depends on firm-level characteristics associated with internal creativity capabilities (X_{ijt}) relevant for innovation. The technology absorption component was assumed to be independent of the firm's effort and could be therefore thought of as a *spillover effect*.[11] Furthermore, we assumed that productivity of a firm that was not located that the productivity frontier (P_{ijt}) was related to the productivity frontier according to a standard autoregressive distributed lag relationship, where a firm's productivity was co-integrated with productivity at the frontier.

More specifically,

$$\ln P_{ijt} = \alpha_0 + \alpha_1 \ln P_{ijt-1} + \alpha_2 \ln P_{jt}^F + \alpha_3 ln\ P_{jt-1}^F + \beta X_{ijt} + \mu_{ijt} \qquad (4)$$

where X_{ijt} are firm characteristics that are considered a priori related to innovation and P_{jt}^F is the productivity level of a firm at the technological frontier. μ_{ijt} is the error term, which includes country-specific fixed effects. Under the assumption of long-run homogeneity ($\alpha_2 + \alpha_3 = 1 - \alpha_1$), Equation 4 has the following error correction representation:

$$\ln P_{ijt} - \ln P_{ijt-1} = \gamma\left[\ln P_{jt}^F - \ln P_{jt-1}^F\right] - \delta\left[\ln P_{ijt-1} - \ln P_{jt-1}^F\right] + \beta X_{ijt} + \mu_{ijt} \qquad (5)$$

Intuitively, the first two terms on the right-hand side of Equation 5 capture technology spillovers. The first term, $\gamma \Delta \ln P_{jt}^F$, allows productivity growth in the frontier to have a direct effect on firm level productivity growth in non-frontier firms. The second term, $\delta \ln\left(P_{ijt-1}/P_{jt-1}^F\right)$, corresponds to the relative productivity of a non-frontier firm with regards to the best practice in its sector, which can be interpreted as a measure of the size of the technology gap. Therefore, the model allows the technology transfer mechanism to have a differential impact on a firm's productivity depending on their relative productivity. The parameter δ

[11] In the Griffith, et al. (2004) model, the extent of technology transfer depended on R&D efforts. As we did not have information on R&D efforts, we were forced to model technology absorption as independent of R&D efforts.

captures this differential effect, while γ captures the strength of the direct link between productivity growth in non-frontier establishments and growth in the frontier.[12]

5.2 Results

In this subsection, we present the results of the estimation of Equation 5. Productivity growth was measured as the difference in log sales per worker between 2007 and 2009. The set of variables related to the firm's innovative capacities (X_{ijt}) included in the estimation were the log level of employment, the percentage of full-time workers with at least a bachelor's degree, as well as dummies related to the firm's age, whether the firm exports, if it is owned by foreigners, and if it has its own website. The productivity of a firm at a frontier (P_{jt}^{F}) was defined as the productivity of a firm located at the top 5th percentile of the labour productivity distribution in a given sector and country. Finally, we assumed that the error term (μ_{ijt}) can be decomposed into a country-sector fixed effect and a white noise process. The fixed effects were controlled using country-sector dummies.

Our results indicate that both innovation and technology transfer are important to understand firm-level productivity growth (Tables 5 and 6). In regards to innovative capacity, we found that firms with a larger workforce tended to experience higher rates of productivity growth, with the effect being larger in manufacturing than in services. We also found that a more educated workforce increased productivity growth, as productivity growth was positively correlated with the share of the firm's workers that had at least a bachelor's degree. These findings might be related to the fact that larger firms and firms with a more educated workforce have the potential to generate more knowledge, either through direct investment on R&D activities or through learning-by-doing, which is beneficial for productivity growth. The other firm characteristics considered did not show a significant effect on productivity growth in the whole sample or across the different subsectors. This might be because they are not as directly linked to the firm's innovative capacities.

We also found evidence of productivity spillovers. More specifically, we found that firms operating in sectors where the productivity frontier grew at a faster rate also grew at a faster rate. This spillover effect was observed in manufacturing and services, and we did not find evidence

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[12] This model assumes that the steady state of the industry may be characterized by a continuum of plants operating with different levels of relative productivity even in the long run. More specifically, in the long run, plants do not converge to a common minimum unit cost (as it is assumed in the standard neoclassical microeconomics textbooks) but to their own minimum unit cost, which depends on firm characteristics (X_{ijt}), a priori related with firm internal innovation capacities, such as size, age, integration in international markets, and foreign ownership.

of significant differences in the extent of spillover across sectors. Nevertheless, the spillover effects seemed small compared to those reported by Griffith, et al. (2004) for a sample of industries in 12 OECD countries. They found a spillover effect of 66.9 per cent within a year. Our results indicate a 14 per cent spillover.[13]

Table 5. Productivity Growth Model

	Full sample				Services only		Manufacturing only	
	Coefficient	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Relative productivity	-14.296***	0.79	-14.589***	0.92	-11.828***	1.19	-16.202***	1.19
Productivity growth frontier	0.279***	0.08	0.161***	0.05	0.111***	0.04	0.381**	0.15
Employment (2007)			3.049***	0.35	2.041***	0.46	3.724***	0.47
Young firm (<10 years)			1.146	0.89	1.186	1.06	1.141	1.34
Export firm (>10%)			2.064	1.28	0.664	1.66	2.258	1.55
Firms owned by foreigners (>50%)			3.473*	2.05	3.82	2.45	3.144	3
Firm has own website			3.317***	0.93	1.877	1.37	4.407***	1.24
% full-time workers with at least a bachelor’s			10.379***	2.31	7.138**	2.93	14.072***	3.55
Constant	-25.500***	1.33	-40.928***	2.71	-29.961***	2.65	-47.480***	3.88
Country-sector fixed effects	Yes		Yes		Yes		Yes	
R-squared	0.209		0.238		0.203		0.259	
N	10,341		9,326		3,557		5,769	

[13] Results are not comparable as Griffith, et al. (2004) used a sector-level TFP measure of productivity, while we used a sales-per-worker measure. The model specification is also different.

Table 6. Productivity Growth model per Sector of Activity

	High-tech		Low-tech		Traditional services		KIBS	
	Coefficient	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Relative productivity	-15.504***	2.44	-16.453***	1.36	-12.084***	1.35	-10.126***	1.98
Productivity growth frontier	0.889***	0.13	0.359***	0.15	0.081*	0.05	0.347**	0.14
Employment 2006 (log)	3.770***	0.91	3.675***	0.53	2.187***	0.51	1.095	0.77
Young firm (<10 years)	2.208	3.43	0.913	1.42	0.594	1.13	4.712	3.3
Export firm (>10%)	-0.309	3.01	3.290*	1.79	0.643	1.92	0.074	3.72
Firms owned by foreigners (>50%)	13.377	8.23	-1.162	2.51	3.506	2.62	3.923	6.32
Firm has own website	5.131	3.84	4.317***	1.26	2.245	1.52	-1.091	2.58
% FT workers with at least bachelor's	8.092	5.63	16.157***	4.42	8.421**	3.53	2.394	4.59
Constant	-46.715***	8.7	-47.070***	4.29	-31.118***	3.05	-19.636***	3.24
Country-sector fixed effects	Yes		Yes		Yes		Yes	
R-squared	0.206		0.279		0.200		0.251	
N	1,192		4,577		3,029		528	

We also found that firms that were further away from the technological frontier tended to show higher productivity growth than firms that were closer to the frontier. This differential effect on technology absorption led to a convergence of productivity across firms. The speed of this convergence was higher in manufacturing than in services, but the process seemed to be slow. Our estimates indicated that a 10 basis points drop in relative productivity only increased the growth rate in a three-year period by 1.07 basis points.[14] We also found that this convergence process was slower in services, particularly in traditional services.

Even though the sizes of the spillover and convergence effects tended to be low in the region, we found a large variation in the size of these effects across countries. When we re-estimated Equation 5 interacting country dummies with relative productivity and productivity frontier growth, we obtained a large variation in the marginal effects of the variables (Figures 6 and 7). These variations suggest that institutions might affect firm-level productivity growth.

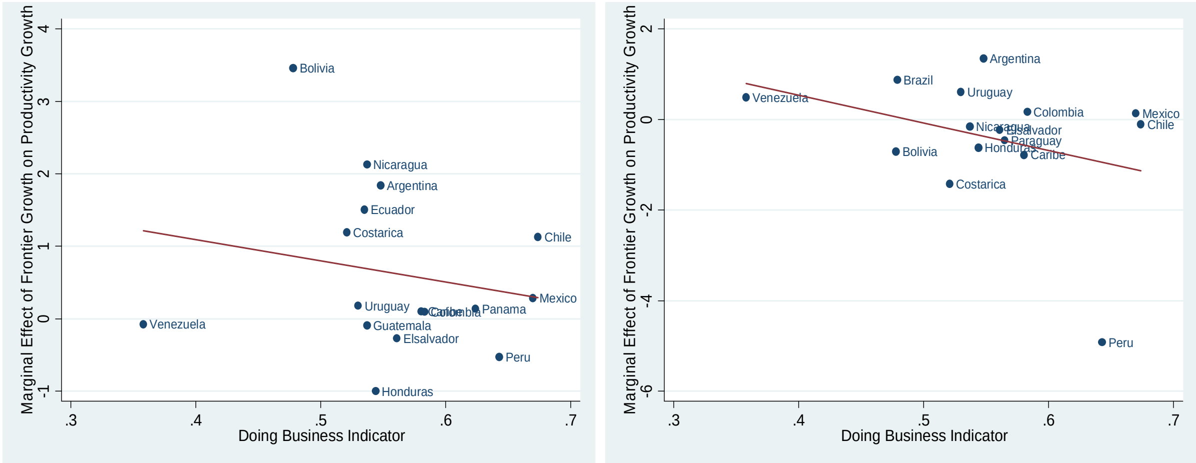
To assess whether the quality of the country's business environment affects the size of the spillover and convergence effects, we regressed the marginal effects on a constant and an index of the quality of the business environment. We found that the correlations of the quality of the business

[14] Griffith, et al. (2004), using a measure of a log TFP difference as a measure of relative productivity, estimated that, in OECD countries, a 10 basis points drop in relative productivity increased the growth rate in the following year by 0.8 basis points.

environment and the size of these effects were not statistically significant.[15] This might be related to the fact that there is not enough variation in business climate across countries in the region.

Figure 6. Spill-over Effects

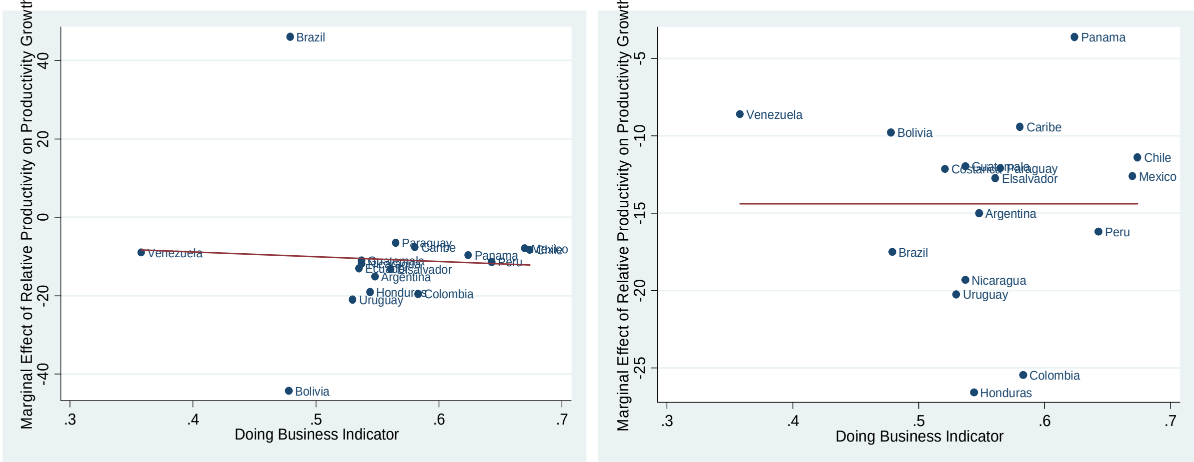
Services **Manufacturing**



Note: The values of the vertical axis are the sum of the coefficient on productivity frontier growth and the interaction term of the country dummy and productivity frontier growth.

Figure 7. Regional Average of Convergence Speed

Services **Manufacturing**



Note: The values of the vertical axis are the sum of the coefficient on relative productivity and the interaction term of the country dummy and relative productivity.

[15] For frontier growth, when we regressed the country-specific marginal effects on a constant and a doing-business index, we found a coefficient of −2.9 in services, with a standard error of 3.9. For manufacturing, the coefficient was −6.1 and the standard error, 4.7. For relative productivity, the coefficients in services and manufacturing were −12.1 and −0.1, respectively, with standard errors of 57.5 and 20. We ran a similar regression using the economic freedom index and results were qualitatively similar.

6. What Determines Employment Growth?

In the previous section, we discussed whether a better business environment fostered productivity growth, thus leading to a higher *within* component of aggregate productivity. In this section, we explore whether a better business environment also improves the second component of aggregate productivity, namely the *between* component. To look at this issue, we explored what determines employment growth. As mentioned above, the *between* component of productivity measures the co-movements of productivity and firm size in cross sectional data. For this relationship to emerge, we would expect more productive firms to show more rapid employment growth than less productive firms. We tested this hypothesis.

6.1 Econometric Model

To study what determines employment growth, we followed a strategy similar to that used by Evans (1987). The model starts from recognizing that the firm size (S_{ijt}), as measured by the number of employees, equals the number of employees last period (S_{ijt-1}) plus the growth in employment. More specifically,

$$S_{ijt} = G(\cdot)S_{ijt-1}\mu_{ijt} \qquad (6)$$

where $G(\cdot)$ is a function that equals one plus the employment growth rate and μ_{ijt} is the error term. Taking logs of Equation 6, we obtain our baseline estimating equation, namely,

$$\ln S_{ijt} - \ln S_{ijt-1} = \ln G(\cdot) + \varepsilon_{ijt} \qquad (7)$$

where ε_{ijt} is a logarithmic of the error term.

In order to estimate Equation 7, we needed to establish which determinants to include in the growth function $G(\cdot)$. To that end, we considered the variables with the most attention in the literature on firm growth. These variables can be grouped into three sets of characteristics: the firm, the firm owner, and the environment in which the firm operates.

For the firm's characteristics, we focused on the two with the most attention in the literature on firm growth: size and age. A number of theories either assume or imply that firm growth is independent of firm size (Lucas, 1978; Jovanovic, 1982). This is usually referred to as Gibrat's law.[16] The debate in the literature on whether Gibrat's law holds in actual data is still ongoing. While some studies suggest a negative relationship between size and employment

[16] See Sutton (1997) for an excellent literature review of Gibrat's Law.

growth (Birch, 1979; Neumark, Wall, and Zhang, 2011), others suggest no systematic relationship between these variables (Haltiwanger, Jarmin, and Miranda, 2013). The relationship between age and employment growth seems to be less controversial. Theoretical models tend to predict higher employment growth when a firm is young. The negative relationship usually reflects a Bayesian learning process, either about productivity type (Jovanovic, 1982) or about demand (Foster, Haltiwanger, and Syverson, 2012). This prediction has been confirmed in empirical studies (Evans, 1987; Haltiwanger, Jarmin, and Miranda, 2013).

For firm owner's characteristics, the theoretical literature has emphasized the role of managerial abilities in determining the optimal size of a firm (Lucas, 1978; Cagetti and De Nardi, 2006). As long as labour market frictions prevent firms from instantaneously reaching optimal size, managerial talent has the potential to affect firm growth. Despite the emphasis on managerial capacity, the empirical literature has faced difficulties determining the importance of this variable, as managerial ability is hard to measure. Some recent experimental studies in developing countries have shown that improving managerial capacities leads to better performance (Bloom, Eifert, Mahajan, McKenzie, and Roberts, 2013).

Finally, there is also literature regarding the context in which a firm operates. The empirical literature has shown that job creation and destruction are sensitive to the business cycle as well as sectoral and idiosyncratic shocks (Davis and Haltiwanger, 1992). The literature also emphasizes the role of institutions in general, and labour market institutions in particular, in job creation (Nickell and Layard, 1999).

As mentioned earlier, our main variable of interest is whether employment growth is higher for more productive firms. A firm's productivity is an endogenous variable that might be affected by variables in any of the three sets of characteristics; however, it is likely to be a relevant variable in explaining employment growth. Theoretical models of labour friction, such as Mortensen and Pissarides (1994), tend to predict that firms with higher productivity and unfilled vacancies search for workers, resulting in higher employment growth for those firms.

Having identified from the theoretical and empirical literature the main determinants of employment growth, we estimated the following reduced-form equation[17]

[17] This specification corresponds to a first order Taylor expansion of Equation 7, assuming the effects of the different groups of determinants on employment growth are independent.

$$\ln S_{ijt} - \ln S_{ijt-1} = \alpha_0 + \alpha_1 \ln S_{ijt-1} + \alpha_2 \ln A_{ijt-1} + \alpha_3 \ln S_{ijt-1} \ln A_{ijt-1} + \alpha_4 \ln P_{ijt-1} + \sum \alpha_k X_{ijt} + \sum \alpha_k F^C_{ijt} F^S_{ijt} + \varepsilon_{ijt} \quad (8)$$

where S_{ijt} stands for the number of employees; A_{ijt} is the firm's age; and P_{ijt} is productivity. X_{ijt} refers to the set of variables related to managerial abilities, and F^C_{ijt} and F^S_{ijt} are variables related to sector and country characteristics.

6.2 Results

In this subsection, we present the results of the estimation Equation 8. Employment growth is measured as the log difference of full-time workers between 2007 and 2009. The variables related to the managerial abilities (X_{ijt}) included in the estimation were the percentage of full-time workers with at least a bachelor's degree, whether the firm exports, if it is owned by foreigners, and if it has its own website. Finally, we assumed that the error term (ε_{ijt}) can be decomposed into a sector-fixed effect, a country-fixed effect, and a white noise process. Results should be interpreted carefully because of the sample selection problem. Only firms that have survived for at least three years were used in the estimation sample, so results are not representative of the universe of firms.

Our results suggest that firm and firm owner characteristics matter in determining employment growth. In regards to firm characteristics, we found that large firms tended to show lower employment growth than small firms, and that small young firms tended to grow more rapidly than older firms (Table 7, rows 3 and 4). We found that these effects were quantitatively larger in manufacturing than in services (Table 8). Not many significant differences emerged regarding the effects of these characteristics on the growth of firms in KIBS and traditional services, except firm age (Table 8). Young firms tended to grow much more rapidly in traditional services.

For firm owner's characteristics, we found that firms owned by foreigners and firms with a website tended to grow at a higher rate. We found that these effects were quantitatively larger in manufacturing than in services, with foreign ownership not having a significant effect on employment growth in the traditional service sector. Firms with a higher percentage of workers with at least a bachelor degree grew more slowly in traditional and low-tech services. In manufacturing, the effect was also negative but insignificant. In the high-tech and KIBS sectors, the effect was positive but insignificant.

Table 7. Employment Growth Model *(full sample)*

	Full sample				Services only		Manufacturing only	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Labour productivity (2007) (log)	2.901***	0.3	3.376***	0.33	2.637***	0.49	3.788***	0.43
Employment (2007) (log)			−3.211***	0.27	−2.132***	0.33	−3.948***	0.36
Young firm (<10 years)			10.418***	1.77	9.401***	2.75	12.525***	2.18
Employment × young firms			−2.833***	0.56	−2.720**	0.92	−3.317***	0.66
Export firm (>10%)			0.426	0.62	−1.192	0.94	1.186	0.73
Firms owned by foreigners (>50%)			1.807**	0.84	−0.6	1.18	3.463**	1.14
Firm has own website			4.200***	0.53	3.460***	0.8	4.794***	0.68
% FT workers with at least bachelor's			−1.727	1.61	−1.866	2.33	−1.109	2.08
Constant	−25.783***	3.18	−23.177***	3.21	−18.453***	5.32	−25.230***	4.01
Country-sector fixed effects	Yes		Yes		Yes		Yes	
R-squared	0.118		0.168		0.143		0.209	
N	10,996		10,929		3,744		6,155	

Table 8. Employment Growth Model *(sectors)*

	High-tech		Low-tech		KIBS		Traditional services	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Labour productivity (2007)	3.163***	0.75	3.984***	0.5	1.560**	0.76	2.793***	0.56
Employment (2007)	−3.033***	0.68	−4.193***	0.42	−2.391***	0.65	−2.078***	0.38
Young firm (<10 years)	16.832***	4.87	11.575***	2.38	3.166	3.2	10.793***	3.36
Employment × Young Firms	−5.538***	1.53	−2.829***	0.72	−1.933*	1.08	−2.928***	1.12
Export firm (>10%)	0.683	1.32	1.359	0.87	−1.301	2.59	−1.253	0.92
Firms owned by foreigners (>50%)	3.972	2.64	3.215**	1.24	4.394	3.62	−1.47	1.22
Firm has own website	4.296**	1.59	4.984***	0.76	4.607**	1.49	3.337***	0.87
% FT workers with at least bachelor's	2.681	2.51	−3.007	2.77	3.7	3.53	−3.372	2.81
Constant	−21.589**	6.94	−26.560***	4.64	−5.943	7.96	−20.546**	6.06
Country-sector fixed effects	Yes		Yes		Yes		Yes	
R-squared	0.216		0.207		0.213		0.13	
N	1,346		4,809		662		3,112	

In regards to the effect of productivity on employment growth, our results were consistent with the hypothesis that more productive firms tend to grow more rapidly than less productive firms (Table 7). But we found that the effect of productivity on employment was quantitatively small. Results for the full sample in row 1 of Table 7 imply that, given two firms in the same country and the same sector with the same observable characteristics except that one is a log point more productive than the other, the former would experience growth in employment in the three following years just 3.4 basis points higher than the latter. We also found that the effect of productivity on employment growth was particularly small in services, with an effect 1.5 basis points lower. Our point estimates also indicated that the effect was the smallest in KIBS (Table 8), but as the effect was imprecisely estimated because of the small sample size, we could not reject the possibility that the effect in KIBS was the same as in traditional services. These results seem consistent with our descriptive findings, discussed in Section 4, suggesting that allocative efficiency does not play an important role in LAC.

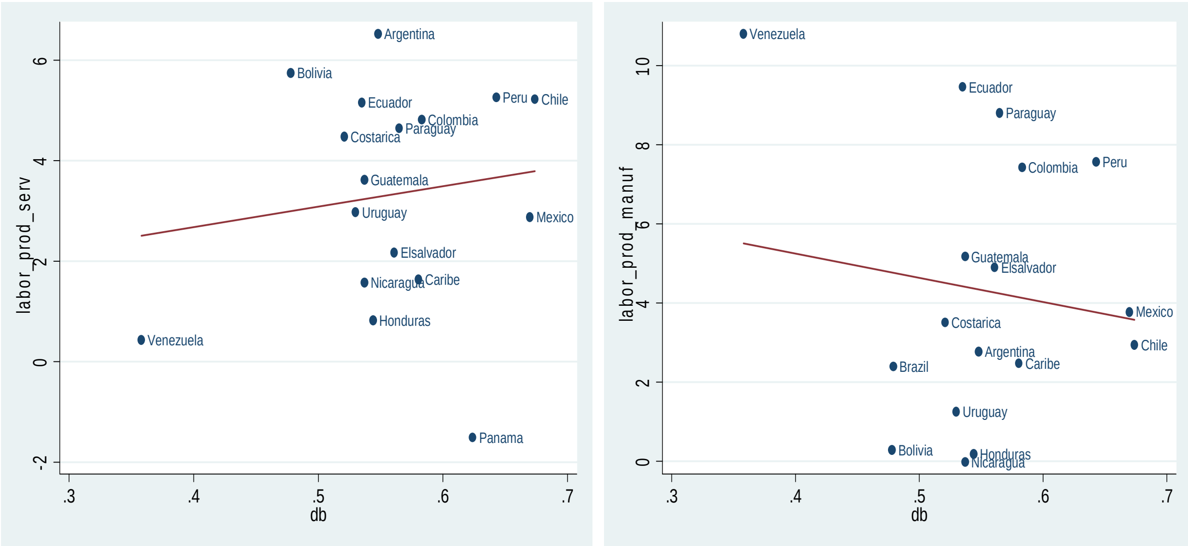
Even though the effect of productivity on employment growth was small, we found evidence that there is a large variation in this effect across countries. When we re-estimated Equation 8 interacting country dummies with lagged productivity, we obtained a large variation in the marginal effects of the variables (Figure 8). These variations suggested that country institutions might affect allocative efficiency.

As above, we tried to assess whether the quality of the country's business environment affected the rewards of frontier growth and productivity backwardness. To explore this possibility, we regressed the marginal effect on a constant and an index of the quality of the business environment. We found that the correlations were not statistically significant.[18] This might be related to the fact that there is not enough variation in business climate across countries in the region.

[18] For frontier growth, when we regressed the country-specific marginal effects on a constant and a doing business index, we found a negative coefficient of 4.1 in services, with a standard error of 6.1. For manufacturing, the coefficient was 7.6 and the standard error, 11.6. We also ran a similar regression using the economic freedom index and results were qualitatively similar.

Figure 8. Rewards to Productivity in 2007 per Country

Services **Manufacturing**



Note: The values of the vertical axis are the sum of the coefficient on lagged productivity and the interaction term of the country dummy and lagged productivity.

7. Conclusions

This paper shows that the low productivity levels observed in LAC are the result of low average productivity at individual firms and a poor allocation of workers across firms. Even if these problems are present in both the manufacturing and service sectors, they are more acute in the latter. We also show that there are large differences in the severity of these problems across countries in the region.

This paper also sheds some light on the determinants of productivity and employment growth, and the evidence suggests that institutions might matter, as the size of different effects varied substantially across countries in the region. Future research should undertake a more detailed analysis of how firms innovate in the manufacturing and service sectors and how these processes are affected by institutions. Such analysis could unveil why firm characteristics and the economic environment have differential effects on productivity and employment growth in the manufacturing and service sectors. It could also detect key constraints to the innovation process, something crucial for policy design.

References

Arnold, J., G. Nicoletti, and S. Scarpetta. 2008. "Regulation, Allocation Efficiency and Productivity in OECD Countries: Industry and Firm-Level Evidence." OECD Economics Department Working Paper No. 616. Paris: Organisation for Economic Co-operation and Development.

Bartelsman, E., J.C. Haltiwanger, and S. Scarpetta. 2004. "Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries." The World Bank, Policy Research Working Paper Series 3464. Washington, DC: The World Bank.

———. 2013. "Cross-Country Differences in Productivity*:* The Role of Allocation and Selection?" *American Economic Review* 103(1):305–34.

Birch, D.L. 1979. "The Job Generation Process." Unpublished report prepared by the MIT Program on Neighborhood and Regional Change for the Economic Development Administration. Washington, DC: U.S. Department of Commerce.

Bloom, N., B. Eifert, A. Mahajan, D. McKenzie, and J. Roberts. 2013. "Does Management Matter? Evidence from India." *Quarterly Journal of Economics* 128(1): 1–49.

Busso, M., L. Madrigal, and C. Pagés. 2012. "Productivity and Resource Misallocation in Latin America." IDB Working Paper 206. Washington, DC: Inter-American Development Bank.

Cagetti, M., and M. De Nardi. 2006. "Entrepreneurship, Frictions, and Wealth." *Journal of Political Economy* 115(5): 835–70.

Crespi, G., C. Criscuolo, J. Haskel, and D. Hawkes. 2006. "Measuring and Understanding Productivity in UK Market Services," *Oxford Review of Economic Policy* 22(4): 560–72, Winter.

Davis, S., and J. Haltiwanger. 1992. "Gross Job Creation, Gross Job Destruction, and Employment Reallocation." *Quarterly Journal of Economics* 107(3): 819–64.

de la Torre, A., E. Levy Yeyati, and S. Pienknagura. 2013. "Latin America and the Caribbean as Tailwinds Recede: In Search of Higher Growth." LAC Semiannual Report. Washington, DC: The World Bank.

Europe Innova. 2011. "Meeting the Challenge of Europe 2020. The Transformative Power of Service Innovation." Report by the Expert Panel on Service Innovation in the EU. Brussels: Europe Innova.

Evans, D. S. 1987. "Tests of Alternative Theories of Firm Growth." *Journal of Political Economy* 95(4): 657–74, August.

Foster, L., J. Haltiwanger, and C. Syverson. 2012. “The Slow Growth of New Plants: Learning about Demand?” NBER Working Paper 17,853. Cambridge, MA: The National Bureau of Economic Research.

Griffith, R., S. Redding, and J. Van Reenen. 2004. “Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries.” *Review of Economics and Statistics* 86: 883–95.

Haltiwanger, J., R. Jarmin, and J. Miranda. 2013. “Who Creates Jobs? Small Versus Large Versus Young.” *Review of Economics and Statistics.*

Hopenhayn, H. 1992. “Entry, Exit, and Firm Dynamics in Long Run Equilibrium.” *Econometrica* 60(5): 1127–50.

Hsieh, CT. and P. J. Klenow. 2009. "Misallocation and Manufacturing TFP in China and India." *The Quarterly Journal of Economics* 124(4): 1403–48, November.

IDB (Inter-American Development Bank). 2010. “The Age of Productivity: Transforming Economies from the Bottom Up.” Edited by C. Pagés. Washington, DC: Inter-American Development Bank.

Jovanovic, B. 1982. “Selection and Evolution of Industry.” *Econometrica* 50(3): 649–70.

Lucas, R. 1978. “On the Size Distribution of Business Firms.” *Bell Journal of Economics* 9(2): 505–23.

Melitz, M. 2003. “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity.” *Econometrica* 71(6):1695–725.

Mortensen, D., and C.A. Pissarides. 1994. “Job Creation and Job Destruction in the Theory of Unemployment.” *Review of Economic Studies* 61(3): 397–415.

Neumark, D., B. Wall, and J. Zhang. 2011. “Do Small Businesses Create More Jobs? New Evidence for the United States from the National Establishment Time Series.” *Review of Economics and Statistics* 93(1): 16–29.

Nickell, S.J., and R. Layard. 1999. “Labour Market Institutions and Economic Performance.” In: Ashenfelter and Card (eds.). *Handbook of Labor Economics*. Vol 3C. Philadelphia, PA: Elsevier.

Olley, S., and A. Pakes. 1996. “The Dynamics of Productivity in the Telecommunications Equipment Industry.” *Econometrica* 64(6): 1263–97.

OECD (Organisation for Economic Co-operation and Development). 2001a. “Drivers of Growth: Information Technology, Innovation and Entrepreneurship.” Science, Technology and Industry Outlook. Paris: Organisation for Economic Co-operation and Development.

———. 2001b. “Innovation and Productivity in Services.” OECD Proceedings. Paris: Organisation for Economic Co-operation and Development.

Restuccia, D., and R. Rogerson. 2008. “Policy Distortions and Aggregate Productivity with Heterogeneous Establishments.” *Review of Economic Dynamics* 11(4): 707–20.

Sissons, A. 2011. “Britain’s Quiet Success Story. Business Services in the Knowledge Economy.” A Knowledge Economy Programme Report. Lancaster, UK: The Work Foundation, Lancaster University.

Sutton, J. 1997. “Gibrat’s Legacy.” *Journal of Economic Literature* 35(1): 40–59.

Syverson, C. 2011. “What Determines Productivity?” *Journal of Economic Literature* 49(2): 326–65.

———. 2004. “Product Substitutability and Productivity Dispersion?” *The Review of Economics and Statistics* 86(2): 534–50.

Tether, B. 2004. “Do Services Innovate (Differently)?” CRIC Discussion Paper No 66. Manchester, UK: Centre for Research on Innovation & Competition, The University of Manchester.

Triplett, J., and B. Bosworth. 2001. “Productivity in the Services Sector.” In: *Services in the International Economy*, Robert Stern (ed.). Ann Arbor, MI: University of Michigan Press.

The World Bank. 2012. “World Development Indicators.” Washington, DC: The World Bank.

Appendix 1. The Enterprise Surveys

A typical ES is a firm-level survey of a representative sample of an economy's private sector. The World Bank has been conducting ES since 2000 for key manufacturing and service sectors in every region of the world. The ES cover a broad range of business environment topics, including access to finance, corruption, infrastructure, crime, competition, and performance measures.

Enterprise Surveys in Latin America are jointly funded with the IDB, and surveys in the Caribbean are jointly funded with IDB and COMPETE Caribbean. These surveys includes the following countries: Antigua, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, and Venezuela.

The survey represents formal (registered) companies with 5 or more employees. Firms with 100 per cent government/state ownership are not eligible to participate in an ES. The sampling methodology for ES is stratified random sampling. The strata for ES are firm size, business sector, and geographic region within a country. The firm size strata are 5–19 (small), 20–99 (medium), and 100+ employees (large). Enterprise Surveys oversample large firms. Geographic regions within a country are selected based on which cities/regions collectively contain the majority of economic activity.

The manufacturing and service sectors – the business sectors of interest – correspond to ISIC codes 15–37, 45, 50–52, 55, 60–64, and 72 (ISIC Rev.3.1). Service firms include construction, retail, wholesale, hotels, restaurants, transport, storage, communications, and IT. Sector breakdown is usually manufacturing, retail, and other services. For larger economies, specific manufacturing subsectors are selected as additional strata on the basis of employment, value-added, and total number of establishments.

The sample size varies with the size of the economy. Typically between 1,200 and 1,800 interviews are conducted in larger economies, 360 interviews in medium-sized economies, and 150 in smaller economies. The survey is answered by business owners and top managers.

For further information, please visit the official Enterprise Survey web page: http://www.enterprisesurveys.org.

Appendix 2. Robustness Check

The following shows our assessment of the variance in our measure of labour productivity when using valued-added (VA) per worker instead of total sales, which is a more typical measure of labour productivity at an industry level. We estimated two measures of sales per worker in the United States. The first used data from the 2007 Economic Census[19], aggregated at economic activity[20] and size category[21] levels, and the second used microdata from the Survey of Business Owners[22] (2007). Value-added per worker was estimated using data from national accounts, provided by the GGDC 10-Sector Database, for manufacturing and services sectors, for eight LAC countries and the United States.

Table 9. Productivity Relative to the United States, for Selected LAC Countries
(manufacturing and services)

	National Accounts		U.S. Economic Census & Enterprise Survey				Survey of Business Owners & Enterprise Survey			
	VA per worker		Sales per worker (unweighted)*		Sales per worker (weighted)*		Sales per worker (unweighted)*		Sales per worker (weighted)*	
Country	Manuf.	Service	Manuf.	Service	Manuf.	Service	Manuf.	Service	Manuf.	Service
Argentina	0.23	0.16	0.45	0.35	0.45	0.41	0.66	0.53	0.66	0.61
Bolivia	0.02	0.03	0.08	0.12	0.06	0.17	0.12	0.18	0.09	0.26
Brazil	0.17	0.11	0.22	0.17	0.22	0.12	0.32	0.26	0.32	0.18
Chile	0.25	0.19	0.52	0.46	0.61	0.52	0.76	0.69	0.88	0.79
Colombia	0.09	0.08	0.34	0.33	0.29	0.31	0.49	0.50	0.43	0.47
Costa Rica	0.14	0.17	0.19	0.21	0.19	0.17	0.27	0.31	0.28	0.25
Mexico	0.18	0.32	0.31	0.19	0.42	0.11	0.45	0.29	0.60	0.17
Peru	0.13	0.16	0.24	0.25	0.26	0.17	0.35	0.37	0.38	0.25
Average	0.15	0.15	0.29	0.26	0.31	0.25	0.43	0.39	0.46	0.37

*Refers to the use, or not, of the expansion factors of the Enterprise Survey.
Source: GGDC 10-Sector Database, ES 2010, U.S. Economic Census 2007, and SBO 2007.

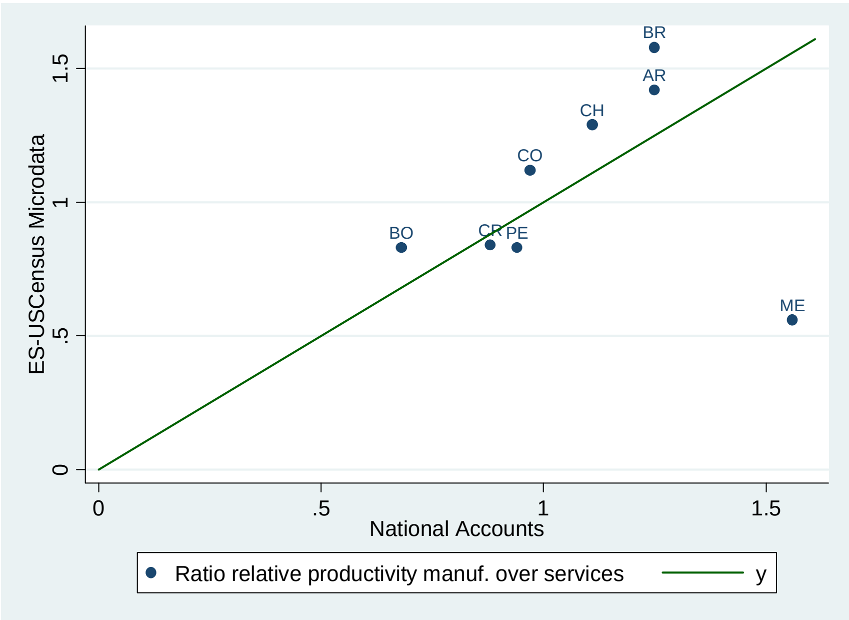
Table 9 shows that, on average, for this sample of countries, manufacturing and services represent the same proportion of U.S. productivity. For Argentina, Brazil, and Chile,

[19] To make fully comparable sectors, we used concordance tables from NAICS 2007 to ISIC 3.1, provided for the United States Census Bureau and the United Nations Statistics Division.
[20] 6-digit code of NAICS 2007.
[21] Defined by the number of employees.
[22] This database does not include information of publicly owned firms. These are normally the largest and more productive firms of each country; therefore it is expected to obtain lower levels of productivity compared to those obtained from Economic Census. Also, with this database is not possible to translate NAICS economic activities to the corresponding ISIC 3.1 code. For this reason, definition of manufacturing and services sectors in LAC and US, although similar, not necessarily involves same economic activities.

manufacturing productivity is closer to the United States than the service sector. The opposite is true for Costa Rica, Mexico, and Peru. Bolivia and Colombia show smaller differences between the two sectors.

This relationship tends to be maintained when ES data is used, with the remarkable exception of Mexico. Relative productivity is closer to that obtained using national accounts when the ES data are unweighted. As we expected, values closer to the U.S. average productivity were found when SBO data was used; nevertheless, the relationship between relative productivity in manufacturing and services was maintained. Figure 9 presents the ratio of relative productivity to the United States for manufacturing over services, using SBO and national accounts data, for the different countries. If the relationship between relative productivity of manufacturing and services, using both databases, is maintained, observations should be close to the 45-degree line.

Figure 9. Scatter Plot Ratio of Relative Productivity of Manufacturing over Services, National Accounts vs. SBO



Source: Authors' elaboration using data from GGDC 10-Sector Database, ES 2010 and SBO 2007.

Estimations of relative productivity constructed with data from the ES seem to be consistent with the relationships found using national accounts data.

When the service sector was disaggregated, we found that the transport and communication sector had relative productivity levels similar to or higher than the manufacturing sector. Furthermore, the wholesale, retail and hotel, and particularly, the construction sectors were far below those relative productivity levels. Either way, these findings should be treated carefully. Table 10 shows that, as the sample size used for comparisons decreased (i.e., working with subsectors), the variability of the results of comparing ES with the national accounts productivity measures increased.

Table 10. Ratio of Relative Productivity of Manufacturing over Different Service Sectors

	National Accounts			ES - US Economic Census			ES - SBO		
Country	Construction	Wholesale, Retail & Hotel	Transport & Telecomm.	Construction	Wholesale, Retail & Hotel	Transport & Telecomm.	Construction	Wholesale, Retail & Hotel	Transport & Telecomm.
Argentina	1.84	1.39	1.52	1.03	1.41	1.71	1.44	1.50	1.18
Bolivia	2.43	1.05	0.39	0.87	1.26	0.20	1.22	1.33	0.14
Brazil	0.89	2.36	1.45	4.51	1.25	0.91	6.32	1.32	0.62
Chile	0.99	1.74	1.38	1.29	1.24	1.29	1.81	1.31	0.88
Colombia	0.70	1.51	0.94	1.36	1.23	0.22	1.91	1.30	0.15
Costa Rica	1.24	0.82	0.75	1.02	0.99	0.54	1.43	1.04	0.37
Mexico	1.05	0.52	0.46	1.83	1.60	1.48	2.56	1.69	1.02
Peru	0.54	0.89	0.98	1.91	1.08	0.65	2.68	1.14	0.44
Average	**1.21**	**1.28**	**0.98**	**1.73**	**1.26**	**0.87**	**2.42**	**1.33**	**0.60**

Source: GGDC 10-Sector Database, ES 2010, U.S. Economic Census 2007, and SBO 2007.

These results suggest that, to obtain more robust results, it is necessary to work with the largest sample sizes available. In order not to lose any useful data from smaller countries, it is necessary to aggregate them into larger regions. In particular, the study in this paper worked with data of the Caribbean countries aggregated as a whole region.

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