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ABSTRACT

In this paper, I analyze the Latin American development problem using a model with input-output linkages, sectorial productivity gaps, and sector-specific distortions. I provide a characterization of the sectorial linkages and distortions in the region, and quantify the gains in aggregate output of closing productivity gaps and eliminating distortions. I provide policy design recommendations for the region by identifying the sectors where opportunities areas for policy improvement are present.

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RELACIONES ENTRE INSUMOS Y PRODUCTOS, DISTORSIONES SECTORIALES ESPECÍFICAS Y EL PROBLEMA DE DESARROLLO DE AMÉRICA LATINA

Leal, J.

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RESUMEN

En este documento, analizo el problema de desarrollo de América Latina a partir de un modelo que incluye relaciones entre insumos y productos, brechas de productividad y distorsiones sectoriales específicas. Proporciono una caracterización de las relaciones inter-sectoriales y distorsiones en la región, y cuantifico las ganancias en el producto agregado que se obtienen como resultado de cerrar las brechas de productividad y eliminar las distorsiones. Ofrezco recomendaciones sobre el diseño de políticas para la región mediante la identificación de los sectores en los que existen oportunidades de mejora.

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Input-output linkages and sector-specific distortions in the Latin American development problem

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Abstract

In this paper, I analyze the Latin American development problem using a model with input-output linkages, sectorial productivity gaps, and sector-specific distortions. I provide a characterization of the sectorial linkages and distortions in the region, and quantify the gains in aggregate output of closing productivity gaps and eliminating distortions. I provide policy design recommendations for the region by identifying the sectors where opportunities areas for policy improvement are present.

1 Introduction

During the last three decades the Latin American region's GDP per capita has remained stagnated relative to the US, showing little catch-up. The so called "Latin American development problem" (Restuccia, 2009) has proven difficult to understand in its roots, but many authors point towards the idea that the poor functioning of institutions and

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policies in the region have set the incentives that lead to inefficient allocations and low productivity.

One important dimension of the problem consists on understanding which sectors are the key ones for the development problem. Understanding this, would be useful in several ways. First, it would help identify “problem sectors” and shed some light on the type of policies and institutions that lead to low productivity in such particular sectors. Second, it would help private and public entities to focus their limited resources into more specific tasks regarding the performance of such key sectors.

One typical answer to the question of “which sectors are the key for economic development” consists on looking at the productivity gap of each sector. The basic idea is that those sectors where the gap is large, are the ones responsible for the entire aggregate productivity gap. However, in a recent paper (Leal, 2015), I argued that in order to correctly assess the importance of each sector on economic development, one not only needs to take into account the sectorial productivity gap, but it is also necessary to take into account the role that each sector plays in the input-output network. The reason is that sectors that are important suppliers of intermediate inputs, tend to play a higher role in economic development.

To illustrate the argument, take the retail trade sector. The productivity gap in retail trade tends to be smaller than in other sectors that are more manufacture-oriented such as plastics or oil refining. However, since many sectors in the economy use retail trade as an intermediate input, improving the productivity of retail trade will have an important impact on the performance of many sectors, and, at the end, on aggregate productivity.

In this paper, I study the key sectors for economic development in Latin American countries and analyze the opportunities for policy making in the region. I use an input-output model that allows me to distinguish the importance of each sector in the economy in terms of its linkages with other sectors. There are many sectors in the economy, and the output of each of them, can be used as an intermediate input in the production of the rest. This way, the performance of one sector is linked to the performance of other sectors in the economy.

I also study how the development problem is related to the presence of sector-specific distortions in the countries of the region. These distortions affect the way sector are

connected with each other, as well as labor market costs for firms. For this purpose, I perform a comprehensive characterization of sector-specific distortions in Latin American countries (section 4), including an analysis of the differences in magnitude and dispersion of distortions among these countries. Moreover, I analyze the way in which distortions correlate across countries and the sectors that stand out as those with the largest distortions in the region.

I calibrate this model for a rich set of Latin American countries where data is readily available: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru. I identify the sector-specific distortions in each country and industry, and perform a number of counterfactual exercises. For this purpose, I face an identification problem which consists on the fact that I observe factor shares that are a function of distortions and technological parameters in the model. The problem is how to separate the value of these two. To solve this problem, I assume that the US is a relatively undistorted economy and that some industry-specific technological parameters are common across countries. This way, I can separate the value of distortions from the value of parameters by comparing factor shares in Latin America against factor shares in the US.

Regarding the characterization of sector-specific distortions in Latin America, I find that these are present across the region in different degrees, with some countries such as Argentina and Mexico displaying large distortions in general, while Chile and Costa Rica, displaying low distortions (Figure 4). Some countries, such as Brazil exhibit low values of distortions in general, but a high dispersion, which is also of potential harm in terms of resource allocation (Figure 5). Some groups of countries in Latin America seem to share a common pattern of distortions across industries (Table 1). The distortions in Argentina, for example, show a correlation of 80% with those in Mexico. In turn, the highest correlation of the Brazilian distortions is with those in Peru, while the highest correlation of the Chilean distortions is with the ones present in Costa Rica. Finally, the distortions in the Latin American region are present across a variety of sectors, including Agriculture, Mining and production of related materials, as well as across a number of Services. In turn, the largest distortions within Services are in Financial intermediation, Health, Education, and Trade, among others.

Next, I perform a series of counterfactual exercises to evaluate the importance of sectorial productivity gaps and distortions. In the first counter-factual exercise of the paper, I close the productivity gap in each sector individually and quantify the aggre-

gate response of GDP per capita. By ranking these aggregate responses across sectors, I identify the key sectors in each country. This response is determined by both, the size of the gap in the sector, and the degree of influence of the sector (its multiplier), which, in turn, is determined by the input-output linkages.

For that goal, in section 5, I first present the main characteristics of industrial multipliers. Industry multipliers show a strong correlation across countries in the region. Typically, Agriculture, Mining and Services exhibit larger multipliers than Manufacturing. Nevertheless, some important differences stand out when we look closer to individual countries. For example, Chile's Mining sector and related industries have multipliers that are much higher than the typical ones found in the region. Mexico, stands out in Construction and Trade, Brazil in Agriculture and Chemicals, while Argentina shows larger than average multipliers in a number of Manufacturing industries.

The first important result in section 5 arises from the aforementioned counterfactual exercise: for all countries analyzed, a number of Services are among the sectors that would give the biggest gains in aggregate output when their individual gap is closed. Thus, it is clear that the role of Services in the development problem of the region is more important than previously considered by the literature. This happens, despite the fact that many manufacturing sectors display large productivity gaps. Note, on the other hand, that the high multipliers of Services play a crucial role in this result. These sectors include Wholesale and Retail Trade, Business Activities, and Construction. Three non-services industries are important as well: Food and Beverages, Coke and Refined Petroleum, and Agriculture. For the case of Brazil, Other Community, Social and Personal Services is also an important sector, and for the case of Mexico, Real Estate. Chile's Mining sector does not appear in this list. The reason for this is that this sector, although an important one in Chile in terms of input-output linkages, already operates with large productivity, therefore, it is not important in terms of the aggregate productivity **gap**.

Next, I move to compute the aggregate effect of removing distortions. As I show in Leal (2017), this could bring gains through different channels, including an improvement in the allocation of resources and an increase in the supply of intermediate inputs. The main finding is that when these distortions are closed all together, there are substantial gains in aggregate productivity. For the case of Mexico, this gain is 15% and for the case of Brazil is 7%. Furthermore, countries could obtain roughly two-thirds of these

aggregate gains by focusing on eliminating wedges in the top-ten industries with the largest degrees of influence.

Regarding the interpretation of markups, there could be several interpretations, but one possibility is that the presence of markups is associated with lack of competition. The computed markups could be indicating the existence of severe competition problems in Mexico in sectors such as Mining, Inland Transportation, and Financial Services, as well as problems in Agriculture, and Retail and Wholesale Trade. The data for Brazil could be indicating the existence of competition problems in sectors such as Transportation and Financial Services.

I also computed labor wedges in each country and sector. The interpretation of this kind of distortions is perhaps less straight-forward. These distortions increase the labor costs that firms face, without directing such extra rents to the workers. This phenomenon can be rationalized with the presence of rent extracting groups, including union leaders, bureaucracy, and organized crime. The size of this kind of wedges is bigger than the size of markups: the unconditional mean for Mexico is 1.54, while for Brazil is 1.30; these compare to 1.30 and 1.18 for the case of markup wedges, correspondingly. Also, I find that the correlation between the wedges in the two countries is higher for the case of labor wedges than for markups. Mexico presents severe labor wedges in sectors such as Chemicals, Rubber and Plastics, Construction, Wholesale and Retail Trade, and Post and Telecom. Brazil exhibits severely large labor wedges in sectors such as Mining, Transportation activities, Post and Telecom, and Business services.

In conclusion the main takeaway of the paper is that input-output relationships are important to determine which sectors are crucial for economic development in Latin America and that the design of economic policy for development should take into account not only the specific input-output interactions, but also, the specific distortions present in each country. Furthermore, the focus on improving the performance of Service sectors is a safe bet for the countries in the region.

Literature review This paper is related to a branch of the development literature that focuses on understanding the role of intermediate inputs in economic development. Duarte et al. (2015) argue that when input-output linkages are taken into account, the role of non-traditional services in economic development is as large as the role of

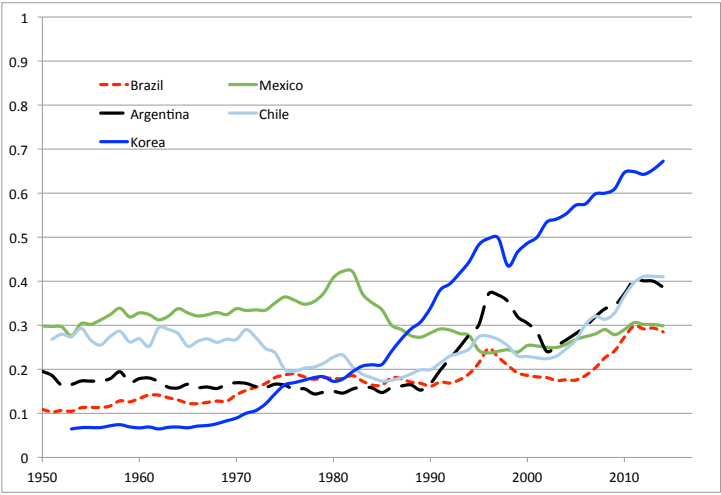
manufactures. Fadinger et al. (2016) argues that the degree of influence of each sector is an important factor to take into account, and Bartelme and Gorodnichenko (2015) argue that sector-specific distortions play an important role in development. In Leal (2017), I argue that the problem of economic development in Mexico needs to be studied from the perspective of both, input-output linkages and sector-specific distortions. I find that distortions affect our assessment regarding which sectors are the key for development by altering our measures of industrial multipliers and of sectorial productivity. The current paper is part of this recently born literature and focuses on the role of input-output linkages and sector specific-distortions in the Latin American development problem. To my knowledge, this is the first paper to present a comprehensive analysis of distortions and its main characteristics in the countries of the region, including: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico and Peru.

2 Facts

In this section, I present several facts of the Latin American (LA) region that are relevant for the goals in this paper. First, I would like to describe the extent of the development problem in the region. Figure 2 presents the evolution of GDP per capita for five main Latin American countries: Argentina, Brazil, Chile and Mexico. The numbers are presented relative to the US in order to clearly show the degree of catch up with respect to this country. The figure shows that the region has barely kept pace with the growth in GDP per capita in the US (which corresponds to 1 in the y-axis). There is little or no catch up before the 1980s and then some periods with catch up and some with substantial declines. By 2010, GDP per capita in these countries remains around 35% with respect to the US. The development problem of Latin America appears more dramatic when we look at the experience of Korea, which started in 1950 with a GDP per capital level substantially below the one in the US (6%) and in 60 years achieved a development level that is almost 70% as good as in the US.

As has been documented elsewhere, a large fraction of the income per-capita differences across countries is explained by differences in total factor productivity. Less has been said about sectorial productivity across countries. Is the low-productivity phenomenon in poor countries present across all sectors, or can we find sectors where productivity gap is low and others where the productivity is high? The development literature has

Figure 1: GDP per capita relative to the US for Argentina, Brazil, Chile, Mexico, and Korea



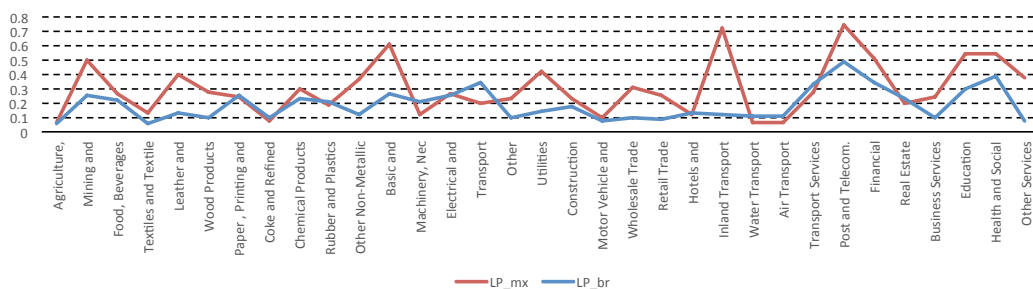
Source: Penn World Tables

usually argued that productivity in poor countries is relatively low in manufactures and high in services.

Next, I would like to analyze the status of relative productivity across sectors in the two biggest Latin American countries: Mexico and Brazil. Figure 2 presents (gross output) labor productivity in these countries relative to the US for a number of broadly defined industries. In the x axis the sectors are organized in the following way: first Agriculture on the far left, then Mining, then 14 Manufacturing industries in the center-left, and finally 16 service industries in the center-right. In general, we see in the figure that, for both countries, the industries in the left have low relative productivity, while the sectors in the right tend to show high relative productivity with respect to the US. There are exceptions to this general characterization, for example, Mining and Basic Metals in Mexico are highly productive, while Inland transportation has a very low relative productivity in Brazil. Finally, notice that, loosely speaking, Brazil tends to have lower productivity than Mexico.

One important dimension to be studied in this paper is the presence of “sector-specific distortions” that affect the way firms undertake economic decisions, and can have an impact on the allocation of resources and aggregate productivity. In section 3, I present a model where differences across countries in the intensity of utilization of intermediate

Figure 2: Relative productivity by sector: Mexico and Brazil



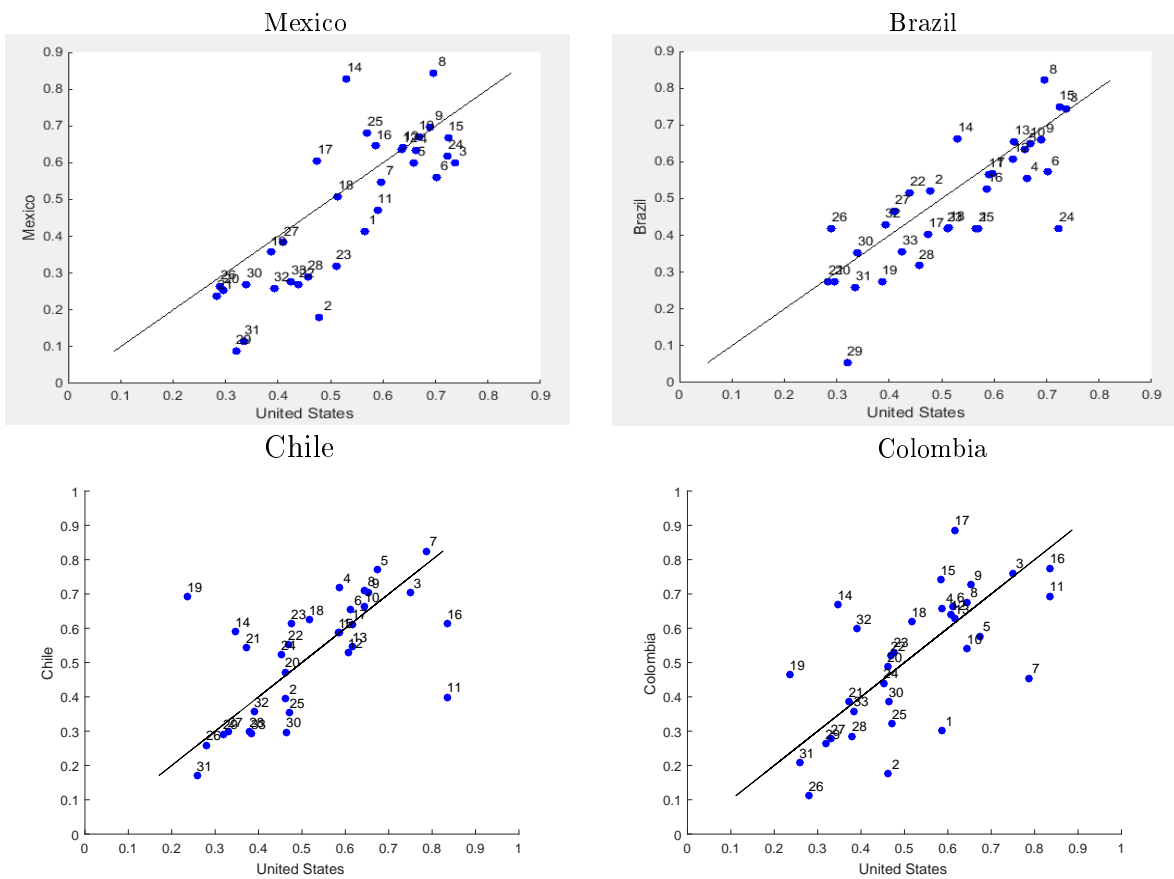
inputs by firms can be interpreted as the presence of wedges. In Figure 3, I present the share of intermediate inputs (with respect to gross output) for Brazil, Mexico, Chile, Colombia and the US. I am interested in comparing the shares in Latin American countries with respect to the ones present in the US. The Figure also includes a 45 degree line, so that these differences can be evaluated visually. For these Latin American countries, the figure shows that the utilization of intermediate inputs is depressed with respect to the US in Mexico and Brazil, while the picture is more mixed for Chile and Colombia. The case of Colombia shows a much higher variability in input shares, when compared to the US case, but these differences do not seem to be biased towards a single direction. The case of Colombia contrasts with the case of Mexico, where the majority of the sectors show a depressed share of intermediate inputs with respect to the US. Chile, on the other hand, seem to have smaller differences with the US. According to the model that we will present in the next section, this feature of Latin American data can be interpreted as the presence of distortions that lead to low productivity. Please see the Appendix and Section 4 for the intermediate shares of other Latin American countries.

3 Model

3.1 Description of the model

In this section we present a model with input-output linkages. The economy has N sectors, each one with a representative firm that has access to the following production function:

Figure 3: Intermediate input shares for Brazil, Mexico, and the US



$$Q_i = A_i(H_i)^{\alpha_i(1-\sigma_i)} \prod_{j=1}^N d_{ij}^{\sigma_{ij}}, \quad (1)$$

where Q_i is gross output, H_i is hours worked, d_{ij} is the amount of intermediate inputs from sector j that is demanded by sector i , A_i is a productivity parameter, and α_i , and σ_{ij} are technological coefficients, with $\sigma_i = \sum_{j=1}^N \sigma_{ij}$. Gross output (Q_i) from each sector can be used either as final consumption or as an intermediate input in the production of other sectors:

$$Q_j = c_j + \sum_{i=1}^N d_{ij}, \forall i = 1, \dots, N,$$

where c_j is final consumption of sector j .

There is one final good producer that combines the final consumption of all sectors into a single final good, using the following production function:

$$Y(c_1, \dots, c_N) = c_1^{\beta_1} c_2^{\beta_2} \dots c_N^{\beta_N}.$$

There is a representative household that maximizes utility subject to a budget constraint:

$$\max_{\{C\}} \{u(C)\}$$

$$s.t. \ C = wH + \Pi + T \quad (2)$$

where C is aggregate consumption, Π represents profits, and T are transfers from the government. The solution to this problem is straight forward: simply consume all available income.

The problem of the final good producer is given by:

$$\max_{\{c_i\}} \left\{ c_1^{\beta_1} c_2^{\beta_2} \cdots c_N^{\beta_N} - \sum_{i=1}^N p_i c_i \right\}$$

with first order conditions given by $\beta_i = \frac{p_i c_i}{Y}$, $\forall i$. Thus, the Cobb-Douglas coefficients of the final good production function are equal to the corresponding shares of final consumption in GDP.

The problem of the representative firm in sector i is given by:

$$\max_{H_i, \{x_{ij}\}} \left\{ (1 - \tau_i) p_i A_i (H_i)^{\alpha_i (1 - \sigma_i)} \prod_{j=1}^N d_{ij}^{\sigma_{ij}} - (1 + \phi_i) w H_i - \sum_{j=1}^N p_j d_{ij} \right\}$$

where τ_i is a distortion that resembles an output tax and that can also be interpreted as the presence of a markup, and ϕ_i is a distortion that resembles a labor tax. This problem leads to the following first order conditions:

$$(1 - \tau_i) \alpha_i (1 - \sigma_i) \frac{p_i Q_i}{H_i} = (1 + \phi_i) w, \quad \forall i \quad (3)$$

$$(1 - \tau_i) \sigma_{ij} \frac{p_i Q_i}{d_{ij}} = p_j, \quad \forall i, j \quad (4)$$

3.2 Equilibrium features

In this section we describe a set of important equilibrium features that are important for our results. The first one is that the way sectoral shocks affect aggregate outcomes is related to the input-output structure of the model. In fact, it can be shown that the effect of a change in productivity of industry i is given by:

$$dy = m_i da_i \quad (5)$$

where da_i represents the change in log productivity of sector i , dy is the change in log GDP, and m_i is known as the degree of influence of sector i and it is determined by the

way this sector is connected with the rest of the economy. To be precise $m = \beta'(I-B)^{-1}$, where $m = (m_1, m_2, \dots, m_N)$. Note that $(I-B)^{-1}$ is known as the Leontief inverse matrix. A typical element l_{ij} of this matrix gives the change in sales of sector j needed to achieve an increase in final consumption expenditures in sector i of \$1 dollar. This effect captures all first and second round effects that occur through the input-output network. Thus, equation 5 gives the total change in GDP taking into account the fact that many sectors are affected through input-output relationships in the economy when the productivity of one of them changes.

Equation 5 can be used to quantitatively assess which sectors would give the biggest gains in GDP when closing its corresponding productivity gaps. Note that if all degrees of influence were equal across sectors ($m_i = \bar{m}, \forall i$) then the sector with highest productivity gap (da_i) would be the one that would give the biggest gain. Conversely, if the productivity gaps were the same across all sectors ($da_i = d\bar{a}, \forall i$), then, the sector with the highest degree of influence m_i , would be the one that would give the biggest gain in GDP. Thus, the gain in GDP of closing the productivity gap of a given sector will be determined by both factors: the size of the gap, and its degree of influence. In section XXX we present a quantitative assessment of GDP gains of a counter-factual exercise where productivity gaps are closed in each sector.

The presence of wedges in the first order conditions of the firm's problem, distorts the equilibrium allocation of labor. Abstracting from labor wedges, this allocation is given by:

$$\frac{H_i}{H} = \frac{\alpha_i(1 - \sigma_i)(1 - \tau_i)\tilde{m}_i}{\sum_{s=1}^N \alpha_s(1 - \sigma_s)(1 - \tau_s)\tilde{m}_s}, \quad (6)$$

where $\tilde{m} = \beta'(I - \tilde{B})^{-1}$, is a vector similar to the vector of influence but computed using the matrix \tilde{B} instead, for which the typical element is $(1 - \tau_i)\sigma_{ij}$. As a result, labor is misallocated away from those sectors with high markup wedges, and into sectors with low markup wedges. Furthermore, notice that if all sectors face the same markup wedge ($\tau_i = \tau, \forall i$), then it cancels out of equation 6 and no misallocation occurs. Finally, notice that reducing a single wedge can either: increase or decrease the extent of misallocation. To see how it can increase misallocation, consider a situation where all sectoral markups are positive and equal to τ , and no misallocation is present. If a single markup is reduced

to zero, then misallocation will arise in such economy, because markups will differ across sectors. In summary, the economy gains when markup dispersion is reduced and loses when markup dispersion increases.

The presence of markups has also an impact on the way gross output is allocated between final consumption and intermediate uses. In particular, when the markup wedge is positive, then the purchases of intermediate inputs are depressed relative to a situation without wedges. Thus, for a given level of gross output the presence of a markup represents an increase in final consumption and value added. As a result, when a markup is reduced, this force tends to increase GDP.

Finally, there is also a direct effect of the markup wedge on aggregate output, because it acts as a tax on the supply of an input. These three positive and negative effects combine to produce the final effect of the elimination of markups on aggregate GDP. As a result, the final effect of reducing a single markup can end up being either positive or negative, depending on whether misallocation is reduced or not with such a change. In section 5, I present the results of a counter-factual exercise that eliminates the distortions present in the sectors of Latin American economies.

4 A characterization of sector-specific distortions in Latin America

In this section, I report the main characteristics of sector-specific distortions in Latin America. I take data on IO tables for several countries from the OCDE Statistics webpage for 2011. Given the data availability, I focus on the cases of: Argentina, Brazil, Chile, Colombia, Costa Rica, Perú, and México. Nevertheless, the set of countries analyzed is rich enough to provide a general characterization of the distortions in Latin America.

I focus on distortions that affect the share of intermediate inputs in gross output. To obtain the value of distortions, I proceed as follows. First, note that from the first order condition of the representative firm i , in country c (in the case of a closed economy):

$$\frac{\sigma_i}{\psi_i^c} = \frac{\sum_{j=1}^N p_j^c x_{ij}^c}{p_i^c Q_i^c}, \quad \forall i, j \quad (7)$$

where c stands for country and i for sector. The equation says that the share of intermediate inputs in gross output of industry i , in country c , is jointly determined by a technological parameter (σ_i) and a sector-specific distortion (ψ_i^c). The problem is how to identify, separately, the value of these two. The identification strategy that I follow, consists on assuming: 1) that the parameter σ_i is common to all countries, and 2) that we can pin-down the value of σ_i by looking at the US data, by assuming that it is a relatively un-distorted economy, with $\psi_i^{US} = 1$. Given the value of the distortion in the US, we can use the equation above when $c = US$, to obtain the value of σ_i . This procedure is particularly simple, as the share of intermediate inputs in gross output is easily obtained from the data. Then, given the value of σ_i , we can apply the same equation to the case of the Latin American countries studied, and obtain the corresponding values of ψ_i^c .

Figure 4 presents the simple averages of markups across industries for the countries under consideration. We observe that for all the countries analyzed, their averages are above one. This means that, in general, the purchases of intermediate inputs (with respect to gross output) are depressed in Latin America relative to the case of the US. The case of Mexico is particularly remarkable as the average of distortions is larger than 1.3. This could be related to the fact that Mexico is known to exhibit largely concentrated markets, with low competition. Below, I discuss the connection of sector-specific distortions with the presence of markups stemming from the lack of competition. Figure 5 shows the standard deviation of distortions in my sample of Latin American countries. Intuitively, the higher the dispersion of distortions across industries, the stronger is the resource misallocation channel.

By comparing the two previous figures, we observe that Chile and Costa Rica exhibit small average distortions and low standard deviations. This means that their corresponding ψ_i 's, are, in general, close to one. In contrast, the cases of Mexico and Argentina exhibit large average distortions and large standard deviations (with both, the average, and the standard deviation in Mexico being significantly larger than in Argentina). These two countries can potentially experience the largest negative consequences of the presence of sector-specific distortions. Note also the difference between the cases of Brazil and Chile. While both countries exhibit the same average distortion, Brazil shows a much higher standard deviation, which makes distortions in this country, typically, more harmful.

Figure 4: Average Distortions in Latin American Countries

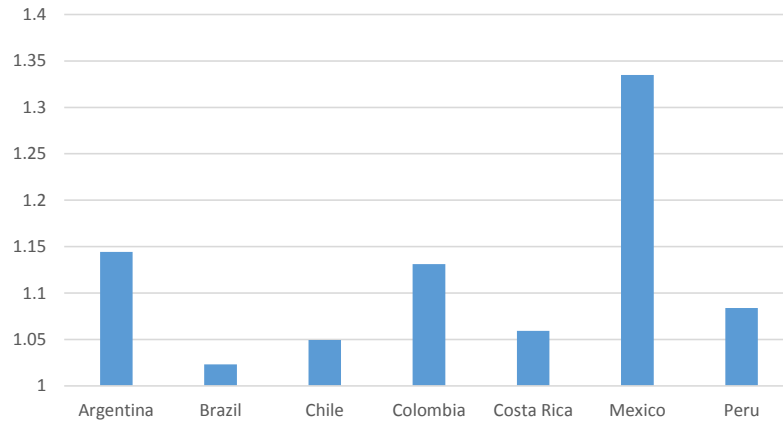


Figure 5: Standard Deviation of Distortions in Latin American Countries

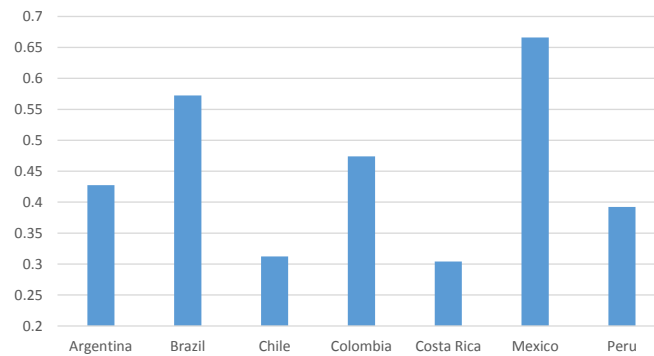


Table 1: Correlation Matrix of Distortions in Latin America

	Argentina	Brazil	Chile	Colombia	Costa Rica	Mexico	Peru
Argentina	1.0	0.7	0.4	0.5	0.6	0.8	0.7
Brazil		1.0	0.2	0.6	0.2	0.7	0.8
Chile			1.0	0.3	0.5	0.3	0.4
Colombia				1.0	0.1	0.8	0.8
Costa Rica					1.0	0.3	0.4
Mexico						1.0	0.7
Peru							1.0

Table 1 presents the correlation matrix of distortions for the countries in consideration. We observe that, in general, the distortions in Chile and Costa Rica, are not correlated with the distortions in the rest of the Latin American countries in the sample. In contrast, the distortions in Mexico, Colombia, Brazil and Argentina, show a high correlation among them. It is outstanding the correlation between the distortions of some of these countries, which can reach up to 80%. Colombia is more similar to México and Perú, than to the rest; while Brazil is more similar to Perú and Argentina than to the rest of Latin America.

Regarding which sectors are the ones with the largest distortions, Figure 6 presents the average distortion per industry (across countries). The sectors with the largest distortions (above one) are: Real estate activities, Education, Mining, Agriculture, Public Administration, Financial Intermediation, production of Motor Vehicles, Basic Metals and Wood extraction. The sectors of Trade, Health, and Mineral products also show distortions significantly above one in some countries. There are two sectors with distortions lower than one (which represents an implicit subsidy): production of Electronic Equipment and Utilities.

Moreover, we observe in Figure 7 that Real estate activities show a large markup in all countries except Chile and Costa Rica. Education also has a large markup in the region, except in Brazil. In turn, the Agricultural sector has a large markup in Mexico, Colombia, and Perú, but is not as large in Chile, Costa Rica and Brazil. Chile, itself, exhibits a large markup only in the production of Basic Metals, while in the rest of the industries, markups are close to those in the United States, implying the presence of no distortions in this country. Note also that in the cases of the sectors of Utilities and Electronic equipment –where the corresponding distortions are less than one in all countries– the exception seems to be the United States.

Figure 6: Average distortions per industry

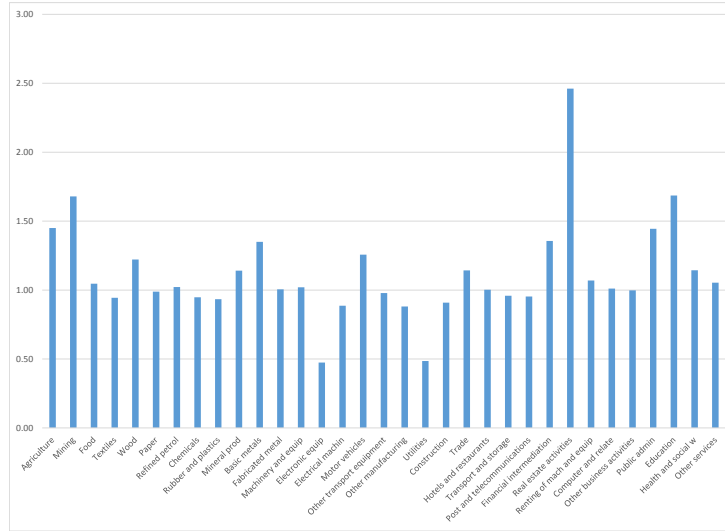
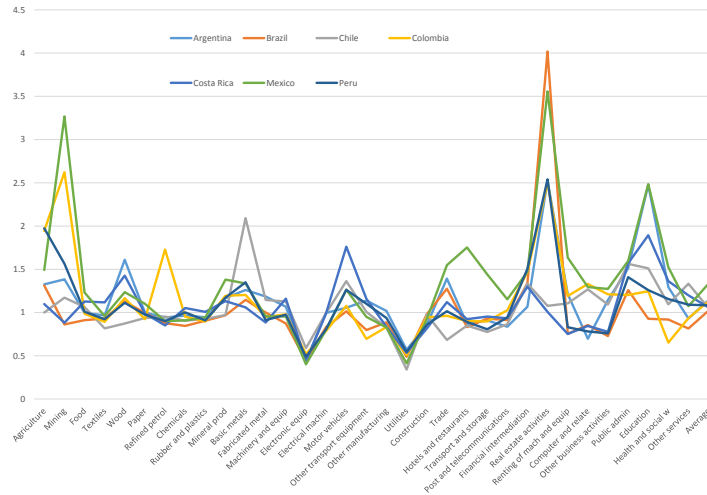


Figure 7: Sector-specific distortions in Latin American countries



In summary, sector specific-distortions in Latin America are present across the region in different degrees, with some countries such as Argentina and Mexico displaying large distortions in general, while Chile and Costa Rica, displaying low distortions (Figure 4). Some countries, such as Brazil exhibit low values of distortions in general, but a high dispersion, which is also of potential harm in terms of resource allocation (Figure 5). Some groups of countries in Latin America seem to share a common pattern of distortions across industries (Table 1). The distortions in Argentina, for example, show a correlation of 80% with those in Mexico. In turn, the highest correlation of the Brazilian distortions is with those in Peru, while the highest correlation of the Chilean distortions is with the ones present in Costa Rica. Finally, the distortions in the Latin American region are present across a variety of sectors, including Agriculture, Mining and production of related materials, as well as across a number of Services. In turn, the largest distortions within Services are present in the sectors of Financial intermediation, Health, Education, and Trade, among others.

5 Which are the key sectors for economic development in Latin America?

In this section, I proceed to obtain the gains in aggregate productivity associated with closing productivity gaps of individual sectors, while keeping the value of the distortions in place. As I explained in the model section, this gain depends on both, the productivity gaps and the degrees of influence of each sector.

To obtain a measure of productivity gaps in each country and sector, I use relative prices by industry, which, to my knowledge, is only available in Inklaar and Timmer (2013). This information exists only for the main five economies of Latin America: Argentina, Brazil, Chile, and México. Thus, I proceed to compute measures of relative labor productivity in each of these countries for all industries with respect to the US. Then, I make use of an equilibrium relationship that connects labor productivity to the fundamental productivity parameters in the model. This way, I am able to recover such fundamental productivity gaps.

To compute the size of the degrees of influence (the multipliers) it is necessary to perform a calibration exercise. The calibration is performed using the equilibrium relationships

that connect consumption shares and specific pairs $-ij-$ of intermediate-input shares to the value of the parameters β_i , and σ_{ij} , $\forall ij$, while also taking into account the presence of sector-specific distortions in each country.

Multipliers (degrees of influence) The first set of results, corresponds to the multipliers in Latin America. It is important to clarify that, despite I have assumed that some parameters of technology are common across countries, I do allow for the multipliers to differ, since I do not assume that the whole input-output structure is identical across countries. Keep in mind that only a couple of common technological parameters per industry are assumed (σ_i and α_i). More details of this calibration strategy can be found in Leal (2017)

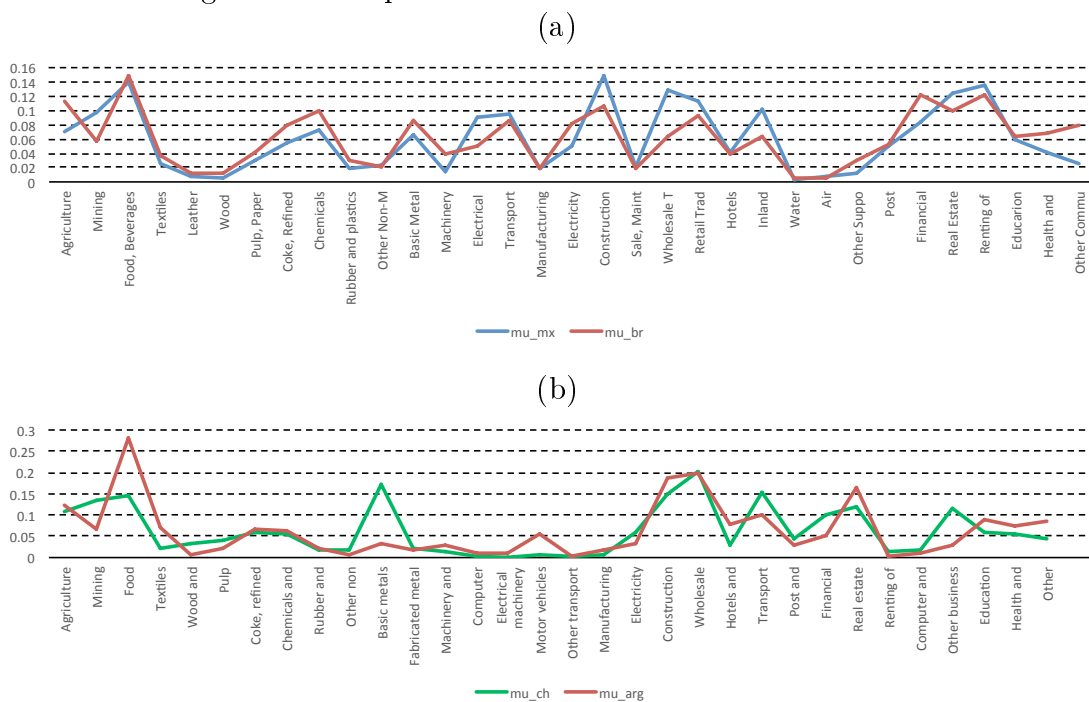
It is interesting to analyze the degree in which these multipliers differ across countries. Figure 8 shows the multipliers in each industry for four of the richest Latin American countries. Panel (a) shows the multipliers for Mexico and Brazil in each industry, while panel (b) presents the multipliers for Argentina and Chile. The sectors are presented in the x-axis in the order they are usually found in the data, from left to right: Agriculture, Mining, 14 manufacturing industries, and 17 service sectors. The two figures differ in terms of the sectoral definitions, as one comes from the WIOD and the other from the OCDE stats.

We can see that, in the cases of Mexico and Brazil, Agriculture and Mining have relatively large multipliers; that the group of manufacturing industries have low to medium-level multipliers; and that Services have, in general, high multipliers. There are exceptions to this classification: the production of Food and beverages has a large multiplier relative to the other manufacturing industries; while Air and water transportation have very low multipliers relative to the multipliers of the other Services.

With respect to the differences between Brazil and Mexico, we see that there is a strong correlation between the two sets of multipliers. Construction stands out as a sector with a very large multiplier in Mexico, but not so high in Brazil. Something similar happens with the case of Wholesale trade and Inland transportation. In contrast, Agriculture and Chemical production are more influential in Brazil than in Mexico as well as Financial and Health services.

Regarding the cases of Argentina and Chile, there is also some correlation, but at the

Figure 8: Multipliers in the industries of Latin America



same time, some important differences. Chile, for example, has a multiplier in the production of Basic metals that is 5 times as big as the one in Argentina. This reflects, of course, the importance of Cooper and other metals in the Chilean economy. It is also interesting the case of Business services which have a degree of influence in Chile that is 3 times bigger than in Argentina. In contrast, manufactures seem to be much more important in Argentina than in Chile: the production of Textiles, has a multiplier that is three times bigger in Argentina, than in Chile. Similarly, the production of Electrical machinery and Motor vehicles in Argentina have multipliers that are substantially larger than in Chile.

In summary, industry multipliers show a strong correlation across countries in the region. Typically, Agriculture, Mining and Services exhibit larger multipliers than Manufacturing. Nevertheless, some important differences stand out when we look closer to individual countries. For example, Chile's Mining sector and related industries have multipliers that are much higher than the typical ones found in the region. Mexico, stands out in Construction and Trade, Brazil in Agriculture and Chemicals, while Argentina shows larger than average multipliers in a number of Manufacturing industries.

Closing productivity gaps The interaction of productivity gaps, along with the multipliers, will ultimately determine the importance of each sector in economic development. Figure 2 in section 2 presented relative productivity with respect to the US for Mexico and Brazil. We observed that the two countries differ in terms of the relative productivity of their sectors.

Next, I present the results of a counter-factual exercise where the productivity gaps are eliminated sector by sector in Argentina, Brazil, Chile, and Mexico. I use equation 5 to obtain a quantitative assessment of the effect on aggregate output, when the gap of industry i , in country c , is closed. The results are presented in Figure 9. In panel (a), I present the results for Brazil and Mexico, while in panel (b) those for Argentina and Chile.

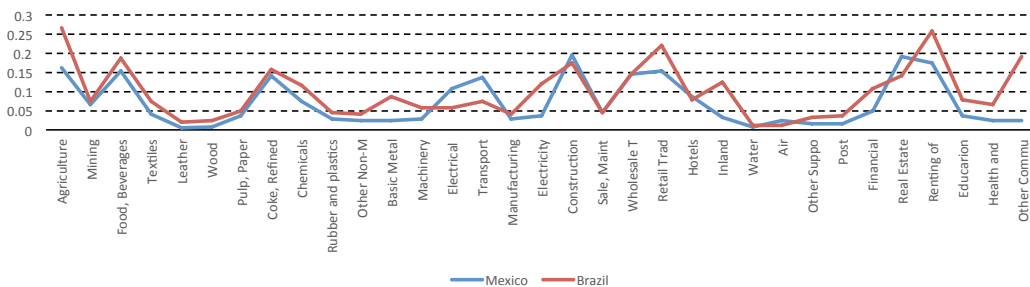
We observe the first important result in the figure: for all countries analyzed, a number of Services are among the sectors that would give the biggest gains in aggregate output. This happens, despite the fact that many manufacturing sectors display larger productivity gaps. Note that the higher multipliers of Services play a crucial role in this result. These sectors include Wholesale and Retail Trade, Business Activities, and Construction. Three non-services industries are important as well: Food and Beverages, Coke and Refined Petroleum, and Agriculture. For the case of Brazil, Other Community, Social and Personal Services is also an important sector, and for the case of Mexico, Real Estate. Chile's Mining sector does not appear in this list. The reason for this is that this sector already has large productivity, thus it is not important in terms of the aggregate productivity gap.

Table 2 presents the top ten sectors for the four countries in the analysis, which confirm the results in Figure 9. Sectors in bold are common across countries.

Effect of removing distortions Next, I would like to present the results for the computation of the counter-factual exercise of eliminating wedges. For this purpose, let me focus my attention in the two largest Latin American countries: Mexico and Brazil. It is worth to take a closer look at the characteristics of markups in these two countries. Figure 10 repeats the level of markup wedges described in section 4 for these two countries. We observe that, in both cases, markup levels are relatively close to 1, and that, for the majority of the sectors, markups are larger than one. Also notice that

Figure 9: Effect of closing productivity gaps in Latin America

(a)



(b)

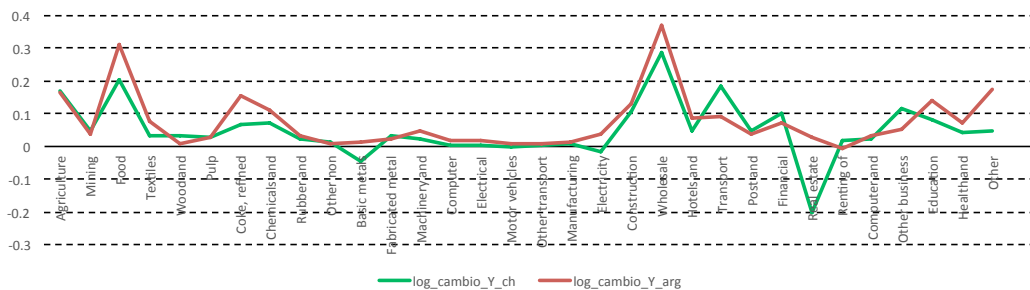


Table 2: Key (top-ten) sectors for economic development in Brazil and Mexico

Ranking	Mexico	Brazil	Chile	Argentina
1	Construction	Agriculture	Trade	Trade
2	Real Estate	Other Business Activities	Food, Beverages	Food, Beverages
3	Other Business Activities	Retail Trade	Transport	Other Services
4	Agriculture	Other Commu	Agriculture	Agriculture
5	Food, Beverages	Food, Beverages	Other Business Activities	Coke, Refined Petroleum
6	Retail Trade	Construction	Construction	Education
7	Wholesale Trade	Coke, Refined Petroleum	Financial Intermmediation	Construction
8	Coke, Refined Petroleum	Wholesale Trade	Education	Chemicals
9	Transport Equipment	Real Estate	Chemicals	Transport
10	Electrical	Inland Transportation	Coke, Refined Petroleum	Hotels and Rest

both countries exhibit large markups in Real Estate, which creates a strong correlation between the markup values of the two countries. However, when we abstract from such out-layer (second graph in the figure), we observe much more variation across sectors, and the correlation disappears.

Notice that these two countries have large markups in Real Estate and Financial Services, but also, marked differences in Mining, Hotels, Inland Transportation, Water Transportation, Education, Health, and Personal Services where either Mexico or Brazil have large markups. The fundamental cause for the large markup levels in these sectors rely on special policies that are idiosyncratic to each country. As was discussed previously in the paper, one possible reason for the existence of a large markup in a given sector is the lack of competition in such market. For example, Mexico has a large markup level in Mining, which would be consistent with the presence of the state-owned monopoly in oil production, as well as with lack of competition in the extraction of other minerals. When interpreted this way, the markup wedge is indicating the existence of severe competition problems in Mexico in Mining, Hotels, Inland Transportation, Financial Services, and Education, as well as problems in Agriculture, Retail and Wholesale trade, Business Services, Health, and Personal Services. The data for Brazil is indicating the existence of problems in Car sales, Transportation, as well as in Financial Services. Note that, in general, Brazil exhibits lower markup values than Mexico, which, according to this interpretation, indicates less competitive problems in that country. The unconditional mean of markup wedges for Mexico is 1.30, while for Brazil is 1.18.

Table 3 presents an index by the OECD that measures the presence of policies and regulations that reduce competition in economic sectors. The Table compares the best practices in OECD countries to the case of Mexico. It shows that regulation in Mexico is high and heterogeneous across sectors. Although the sectorial classification used in this Table is not directly comparable with the one used in this paper, the main message of the Table is consistent with the results from our markup measures in the sense that it indicates a substantial and widespread presence of market power in Mexico across sectors.

Figure 11 presents the results for the labor wedges in the two countries of analysis. The correlation between the wedges in the two countries is 63% when all sectors are considered and 45% when the production of Electrical equipment is not taken into

Table 3: OECD indicators of sector's regulation

	2013	Best practice (OECD)	Mexico
Retail distribution		0.6	2.11
Electricity		0.87	5.81
Gas		0	4.25
Telecoms		0.27	1.13
Post		0.67	2.33
Rail		0.25	4
Airlines		0	2
Road		0	1.5
Accounting		0.96	2.52
Legal services		0.56	1.58
Architectural		0	1.94
Engineering		0	2.13

Figure 10: Markup wedges for Mexico and Brazil

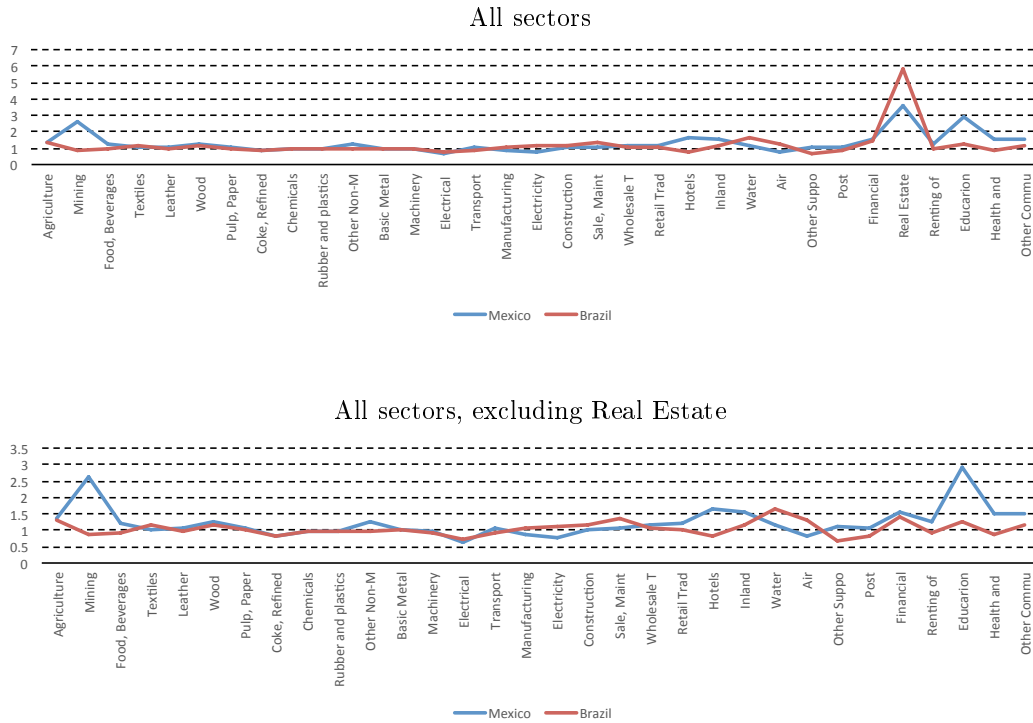
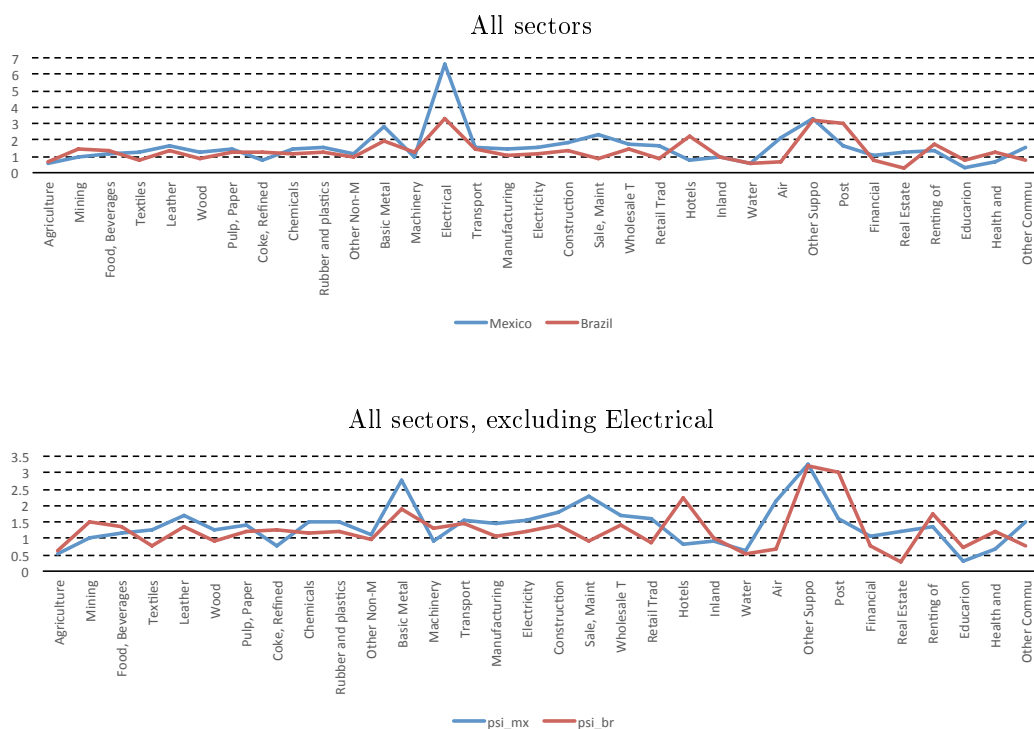


Figure 11: Labor wedges



account. This large correlation is also visible in the figure. I also observe that the size of labor wedges is much larger than the size of the markup wedges. The unconditional mean for Mexico is 1.54, while for Brazil is 1.30, these compare to 1.30 and 1.18, correspondingly, for the case of markup wedges.

Mexico presents severe labor wedges in Leather, Chemicals, Rubber and plastics, Basic metals, Construction, Car sales, Wholesale and Retail trade, Post and telecom, Air transportation, and Transportation activities. Brazil exhibits severely large markup wedges in Mining, Basic Metals, Hotels, Transportation activities, Post and Telecom, and Business services.

Effect of eliminating sector-specific distortions Next, I present the results of a number of counter-factual exercises where I modify the value of wedges and quantify its effect on aggregate output and hourly wages. I first quantify the increase in aggregate output, when all wedges are eliminated at once. Mechanically, I compute the change in aggregate output when all wedges are set to 1. Table 4 presents the results of this

Table 4: Counter-factual exercises with respect to wedges

	Change in Y	
	Mexico	Brazil
Eliminate all wedges (markup+labor)	1.15	1.07
Eliminate only markups	1.02	1.01
Eliminate only labor wedges	1.01	1.01
Eliminate all wedges in top-ten industries	1.10	1.05
Eliminate only markups in top-ten industries	1.07	1.03
Eliminate only labor wedges in top-ten industries	1.00	1.00

counter-factual exercise. We see that Mexico would increase aggregate output by 15%, while Brazil would increase it by 7%.

A second counterfactual exercise consists on eliminating each kind of wedge, separately. First I eliminate only the markups and compute the effect on aggregate output of this exercise. The result is that there are almost no gains from this exercise on aggregate output. The reason for this is that the misallocation effect of the presence of labor wedges is emphasized when markups are independently eliminated. The gains from eliminating markups are compensated by the increase in the losses from labor misallocation associated to the presence of labor wedges. Similarly, when only labor wedges are eliminated and markup wedges are left unchanged the gain in aggregate output is very low. In this case, the increase in the losses associated to labor misallocation is given by the presence of markups.

A third exercise is to focus our attention only on the top-ten most influential sectors in each country. For this exercise, I identify the ten industries that display the largest degrees of influence and proceed to eliminate wedges only in such top-ten sectors. In this case, around two thirds of the total gain in aggregate output is achieved when the distortions in these influential sectors are eliminated. Notice also that large gains are present when only markups are eliminated in these top-ten industries.

6 Conclusion

I have analyzed the problem of economic development in a set of countries of Latin America from the perspective of input-output linkages and sector-specific distortions.

I have rooted the analysis in the idea that the input-output structure of the economy is crucial for understanding the relative importance of each sector in development. I have also studied the presence of sector-specific distortions, which have an impact on aggregate productivity.

The main takeaway of this analysis is that input-output relationships are important to determine which sectors are crucial for economic development in Latin America and that the economic policy design should take into account not only the specific input-output interactions in each country, but also the specific distortions present in each country and each sector. Moreover, spending political capital on improving the performance of Service sectors (such as Trade, Business Services, Transportation and Financial Intermediation) is a safe bet for the countries in the region.

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Appendix

Figure 12 presents how intermediate input shares in the industries of Latin American countries compare to those in the US. The Figures for Mexico and Brazil slightly differ from the picture presented in Figure 3 because a different data source was used there. Here the data source is OECD Stats.

Figure 12: Intermediate input shares for Brazil, Mexico, and the US

