Key sectors in Mexico's economic development: a perspective from input-output linkages with sector-specific distortions*

Julio Leal
Banco de Mexico

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Abstract

Which sectors are key for development? I calibrate a multi-sector model with input-output linkages, sector-specific distortions, and heterogeneity in sectorial productivity for the case of Mexico. When these features are taken into account, it turns out that the least efficient sectors are not necessarily those that create more harm on aggregate productivity. I show –through counterfactuals– that closing the productivity gaps in a subset of highly influential and distorted sectors leads to substantial gains in aggregate productivity, and that the role of Services in Mexico's development problem is larger than previously thought. In addition, several margins in the economy are affected by sector-specific distortions, including labor *misallocation*. I quantify and decompose the aggregate effect of the removal of these distortions into its main economic channels. The focus on Mexico allows for a more direct link of distortions with policy recommendations.

Keywords: key sectors, economic development, input-output linkages, sectorial productivity, cross-sector misallocation

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1 Introduction

Which sectors make poor countries so unproductive? The literature has traditionally analyzed this question using value-added economies where inter-connections across sectors do not play a central role. This naturally emphasizes the presence of "problem sectors" with abnormally low productivity as the main reason behind the aggregate productivity gap between rich and poor countries. However, this approach does not takes into account that –in addition to the size of their productivity gaps– the way sectors are inter-connected with each other through input-output relationships can affect our assessment regarding the importance of each of them on economic development (a notable exception is Duarte and Restuccia, 2015). Neither it takes into account the way in which such connections can be affected by the presence of sector-specific distortions, and its corresponding impact on development.

In this paper, I use a multi-sector model with input-output relationships based on Long Jr and Plosser (1987), Acemoglu et al. (2012), and Jones (2011b), that helps me to address this question from a novel perspective. In the model, there are N sectors that produce different goods and the output of each sector can be used either as a consumption good or as an intermediate input in the production of the other sectors. Thus, the output of a given sector contributes directly to the production of its own consumption good, but it also contributes indirectly to the production of the rest of the consumption goods in the economy -through its use as an intermediate input. Some sectors play a crucial role in the input-output network because they are important suppliers in the economy. Thus, improving productivity in a sector with a high "degree of influence" –a term introduced by Acemoglu et al. (2012)– gives more aggregate gains than doing it in a sector with a low degree of influence.

In addition, the paper takes into account the presence of sector-specific distortions that affect the purchases of intermediate inputs and the amount of labor hired at the sector level. This important feature of the model plays a crucial role in my assessment regarding which sectors are key for development. On the one hand, their presence reduces aggregate productivity by generating resource misallocation, and affecting other margins in the economy, including the split of gross output between intermediate and final uses. On the other hand, their presence affects measured productivity at the sector level, obscuring the assessment regarding the size of the fundamental productivity gaps. Indeed, measured productivity is a function of both, sector-specific distortions and fundamental productivity. Moreover, sectors with large distortions exhibit an "artificially" large measured productivity.

The first contribution of the paper is to show that eliminating productivity gaps in a few *key sectors* leads to large gains in aggregate productivity. These gains represent a substantial fraction of the total gains that would arise if gaps were simultaneously removed in all sectors. The policy implication of this result is direct: by focusing on improving productivity on a few key sectors, the country could experience large aggregate gains. Moreover, I find that if only productivity gaps are taken into account –as in the previous literature– the role of manufacturing and agriculture in development is over emphasized, and the role of services is under emphasized. Behind these results are the two distinctive features of the model: the variation of degrees of influence, and the variation in sector-specific distortions across sectors.

What type of distortions are studied in this paper? First, motivated by the comparison of intermediate input shares between Mexico and the US, I study a "markup wedge" that affects the first order conditions of the firm, and has an impact on the purchases of inputs. In particular, the presence of markups in Mexico, depresses the intermediate input shares relative to the US. Second, motivated by the differences in labor income shares between these two countries, I study a "labor wedge" that reduces the labor income share at the sector level. These distortions are similar to the ones analyzed by Chari et al. (2007) and are the sectoral analogy to the firm's idiosyncratic distortions studied by the literature on resource misallocation across plants, ignited by the seminal paper of Restuccia and Rogerson (2008). Nevertheless, in the model here, their presence affects the economy not only by generating resource misallocation, but through additional and important channels that are not present in the value-added economies used before. The second important contribution in the paper is to quantify and decompose the aggregate effect of the removal of these distortions and to analyze the key economic channels through which these affect the economy.

I calibrate this model to Mexico, a prominent developing economy with rich data that can be used to shade light on the interpretation of the distortions studied in the paper. Since the observed intermediate input shares and labor income shares are a function of both, distortions and technological parameters, there is an identification problem between these two. I identify the value of distortions by assuming that the US is a relatively undistorted economy and by comparing input and labor shares between Mexico and the US. An additional calibration challenge is how to identify the value of the fundamental productivity gaps. I distinguish between measured and fundamental productivity gaps at the sector level. The procedure takes into account the fact that, in equilibrium, measured productivity gaps are a function of both: fundamental gaps and distortions. It consists on numerically solving for the equilibrium and looking for the set of fundamental productivity parameters that is needed to replicate the observed measured gaps across sectors, while taking into account the differences in sector-specific distortions between the two countries.

The calibrated economy is one where substantial variation in the degrees of influence across sectors is present. Services tend to have high degrees of influence relative to Manufactures. Markups are large, which reflects a very concentrated economy, and is consistent with the available data on Mexico indicating the generalized presence of market concentration across sectors.[1] Finally, the correlation between the measured productivity gaps and the fundamental ones is far from perfect.

Given the calibrated economy, I perform several counterfactual exercises that allow me to quantify the impact of the two kinds of wedges on aggregate output. First, I focus on eliminating all wedges (productivity gaps and distortions) simultaneously in all sectors. I obtain that aggregate output would increase by a factor of 4.02, which is roughly consistent with the gap in GDP per capita that is obtained using data from Inklaar and Timmer (2013) and the PWT. As expected, productivity gaps have larger effects than sector-specific distortions: if I only close productivity gaps, keeping the value of distortions in place, Mexico's output increases by a factor of 3.55; in contrast, if I remove all distortions, while keeping productivity gaps in place, output increases by a factor of 1.13. However, the role of complementarity between the two kinds of wedges is important: the sum of the effect of removing each kind separately is smaller than the effect of removing both of them them jointly.

Then, I move to study the effect of removing productivity gaps in subsets of sectors and one by one, while keeping the sector-specific distortions in place. The main conclusion from this exercise is that by focusing on eliminating gaps in a subset of *key sectors* it is possible to obtain 80% of the gains that arise from eliminating all productivity gaps, simultaneously. These key sectors are those where the degree of influence and the productivity gaps are large. A corollary of this exercise is that the important role of a number of Services in economic development has been relatively under-appreciated by the previous literature. The reason why closing productivity gaps in Services gives large gains in this paper is two-fold. On one side, Services tend to have high degrees of influence; on the other side, the presence of distortions is more prevalent in Services, which tends to artificially increase *measured* labor productivity in these sectors.

Regarding the second main contribution, I theoretically show (section 3.1.3) that sector-specific distortions affect three margins in the economy: 1) the allocation of labor, 2) the supply of intermediate inputs, and 3) the allocation of gross output between final and intermediate uses. I quantify the importance of each of these margins when all distortions are eliminated simultaneously –while keeping the productivity gaps fixed– and show that the first

[1] In particular, I show that the set of sectors where my calibrated markups are significantly larger than one has an important overlap with the set of sectors in which the Mexican Antitrust Agency has shown concerns of possible non-competitive practices.

two channels are positive, while the second one is negative (section 5.2.3). That is, the removal of distortions improves the allocation of labor and increases the supply of intermediate inputs; but it also negatively affects the use of gross output as final consumption.

In addition to the previous exercise, I also performed a number of exercises where distortions are removed in subsets. I show that focusing on removing distortions on the top ten industries with the highest influence would achieve 60% of the total gains. However, I also show that it is possible to exacerbate labor misallocation when only one type of distortion is eliminated. The reason for this is that the dispersion of the remaining distortions might result even worse than in the original situation, aggravating the problem of labor misallocation. Finally, I also performed counterfactual exercises where I removed distortions one by one. This exercise highlights again the importance of the degree of influence for the aggregate effect of individual distortions. In particular, I find that this effect is bigger in those sectors where both, distortions, and degrees of influence are large. Given the interpretation of the markup wedges, the policy implication of these results is that Mexico could experience substantial gains by focusing on increasing competition in Services. In general, the results for the markup and labor wedges, indicate that Mexico could gain by removing policies and regulations, as well as deterring rent-seeking activities that are expensive for firms and do not represent higher wages for workers. Identifying who gets the rents linked to these distortions (monopolists, union leaders, trade associations, organized crime, and others) is essential to improve labor allocation, the supply of intermediate inputs, and aggregate productivity.

One final important contribution in the paper is to show that the use of an input-output (IO) economy is relevant for the questions at hand, as opposed to the use of a value-added economy. The reason for this is that using an IO economy allows me to study sector-specific distortions that affect margins that –by definition– do not exist in value-added economies. This has important consequences for the quantitative results. In particular, in addition to the differences between measured and fundamental productivity gaps, the weights applied to these gaps differ between the two models. In the IO economy, the appropriate weights are given by the degrees of influence, while in the value-added economy the weights are given by the value added shares. In section 3.1.2, I theoretically show that the connection between degrees of influence and value added shares can be seriously affected by the presence of sector-specific distortions, and in section 5.2.2, I compare the main quantitative results when a value-added economy is used instead of the baseline IO economy.

Related literature. A long tradition of studies argues that the productivity gap in poor countries is higher in manufactures than in services (e.g., Balassa (1964); Samuelson (1964);

and more recently, Buera et al. (2009), and Herrendorf and Valentinyi (2012)). This is also true in the recent data from Inklaar and Timmer (2013), and in Herrendorf and Valentinyi (2012). This literature concludes that the "problem sectors" should be in manufactures. However, this literature did not take into account the role of input-output linkages, nor the presence of sector-specific distortions.

A recent branch of the literature on development accounting and the sources of cross-country income differences, incorporates the study of intermediate inputs (e.g. Moro (2011), Jones (2011a, a), and Grobovšek (2012)). In particular, Duarte and Restuccia (2015) study sectoral productivity differences across countries in manufacturing, traditional and non-traditional services using an input-output model. They show that inferring sectoral productivity gaps across countries using simple developing accounting tools can lead to very different results, when compared to the productivity differences that are obtained using the input-output model. They conclude that taking into account input-output linkages is important for identifying "problem sectors". My paper is consistent with this view. However, I also show that, for the case of Mexico, taking into-account sector-specific distortions affects our inference regarding the sectoral productivity differences between this country and the US.

There are two contemporaneous (unpublished) papers that also study the relationship between linkages and economic development, which are close to my work. They focus, either on the analysis of sector-specific distortions (Bartelme and Gorodnichenko (2015)), or on the analysis of sectoral productivity differences (Fadinger et al. (2016)). Both works use databases that include several countries around the world. My paper differs in several dimensions from these works. First, the economic channels through which distortions affect productivity are clearly identified in my paper and a quantitative assessment of the relative importance of each of these channels is provided. For example, the existence of these channels crucially depends on the assumption that the rents form the distortions are given back to the household, which is not highlighted by the papers above.[2] Moreover, by looking at these different economic channels, I am able to carefully study novel counterfactual exercises and explain why aggregate productivity can be reduced when only a subset of the distortions is removed (see section 5.2.3). Second, in addition to sector-specific distortions, my paper also studies productivity gaps at the sector level, as well as the interaction between these two kinds of wedges. This allows me to provide an assessment of the extent of complementary between the two (see section 5.2). Third, my paper directly addresses the connection be-

[2]As I show in a working paper version of this article, Leal (2015b), when these rents are not given back to the economy, sector-specific distortions are isomorphic to productivity parameters and do not generate labor misallocation. Its effect on aggregate productivity should be the same as the effect of changes in sectoral productivity.

tween IO economies and value-added economies and how the presence of distortions affects such a link (see section 3.1.2 and my companion paper Leal (2015a)). I show that, when sector-specific distortions are present, using a simple value-added economy is misleading for the questions at hand (see section 5.2.2). In particular, my paper highlights the way in which sector-specific distortions affect *measured* productivity at the sector level, as well as the way in which the connection between the degree of influence and the value added shares is broken by the presence of these distortions. These two characteristics of distortions have an impact on the ranking of the sectors in terms of their importance for economic development. Finally, by focusing on the case of Mexico, I am able to provide a reasonable interpretation of the distortions studied in the paper based on relevant facts, as well as to provide more tangible policy recommendations.

My paper is also related to the literature on resource misallocation across plants (e.g., Restuccia and Rogerson (2008) and Hsieh and Klenow (2007)). There is growing interest on extending the study of resource misallocation beyond the dimension of plants. Jones (2011b, b) argues that misallocation might be enhanced in input-output economies. I make a quantitative assessment of the importance of sector-specific distortions showing that labor misallocation is not the only margin that is affected by these wedges.

The paper is also related to the literature on structural transformation (e.g. Restuccia et al. (2008) and Herrendorf et al. (2013)). Herrendorf et al. (2012) argue that the economic channel (and the preference specification) that explains structural transformation depends on whether the analysis uses value-added data or expenditure data. The input-output structure reconciles these two perspectives. Here, I explain the way in which the IO economy is connected to the value-added economy (see section 3.1.2), contributing to this line of research. In fact, in my companion paper Leal (2015a), I show that an IO economy can be fully equivalent to a value-added economy, under certain standard conditions on preferences and technology. Here, I show that the presence of sector-specific distortions modifies this equivalence, and, by looking at the case of Mexico, I show that this could occur in a quantitatively meaningful way.

The paper is also related to the literature of economic networks such as in Acemoglu et al. (2012) and Acemoglu et al. (2015). This literature has focused on the role of networks in business cycles. This paper is an application of the concept of "degree of influence" coined by Acemoglu et al. (2012) to the literature of economic development. The literature that studies the low labor income share in developing countries is also related. For example, Ayala and Chapa (2014) argue that this share is low in Mexico even after correcting for the measurement issues addressed by Gollin (2002). It is also related to the literature studying a generalized recent decline of the labor share across countries, such as in Karabarbounis and Neiman (2014). In this paper, I argue that the low labor income share in Mexico is explained by the presence of the markup wedge, which in turn, might be related to lack of competition in product markets.

The organization of the paper is as follows. Section 2 presents relevant facts, section 3 presents the model and discusses the effect of distortions, section 4 presents the calibration strategy, section 5 the results, and section 6 concludes.

2 Facts

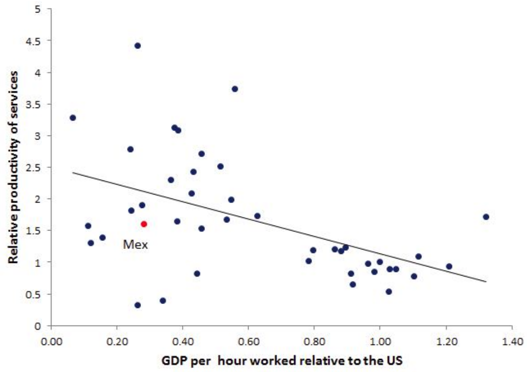
In this section, I present several relevant facts for the questions at hand. These are related to the determinants of the "degree of influence"[3] in each sector and to the presence of sector-specific distortions. The variability on degrees of influence and distortions across sectors are two key elements of the analysis in this paper.

2.1 Productivity gaps in manufacturing and services

First, I present facts related to the productivity gaps across sectors and document that in poor countries these gaps tend to be larger in Goods (Manufactures and Agriculture) and smaller in Services. A first piece of evidence is presented in Figure 1, where I use data from Inklaar and Timmer (2013) and plot their estimates of the relative productivity of Services against GDP per hour worked across countries. As the figure shows, the poorer is the country, the larger is the relative productivity of Services, and, thus, the larger is the productivity gap in Manufactures. A second piece of evidence is the one found in Herrendorf and Valentinyi (2012), where the authors compute Total Factor Productivity (TFP) for three main aggregates: GDP, Services and Goods, for Latina America (LA) and the US. They report the ratio of TFP in the US to TFP in LA. The data from Herrendorf and Valentinyi (2012) is presented in Table 1. The table tells a story similar to the one in Figure

[3] The concept of "degree of influence" is taken from Acemoglu et al. (2012) and it captures the idea that the stronger the inter-connections of a given sector are, and the higher its final consumption share is, the more "influential" a sector will be in the aggregate economy.Acemoglu et al. (2012) did not consider variation in consumption shares across sectors. However, once this variation is allowed in the model it turns out to be important for the vector of influence.

Figure 1: Relative productivity of services



Source: Inklaar and Timmer (2013).

Notes: The Figure shows productivity of Services relative to productivity of Manufactures calculated by Inklaar and Timmer (2013). To compare the data across countries, the authors compute PPP prices at the industry level for a set of developed and developing countries.

Table 1: TFP: US vs. Latin America.

Categories	Ratio	Value
Aggregate	TFP^{US}/TFP^{LA}	2.30
Services	TFP_s^{US}/TFP_s^{LA}	1.86
Goods	TFP_g^{US}/TFP_g^{LA}	3.58

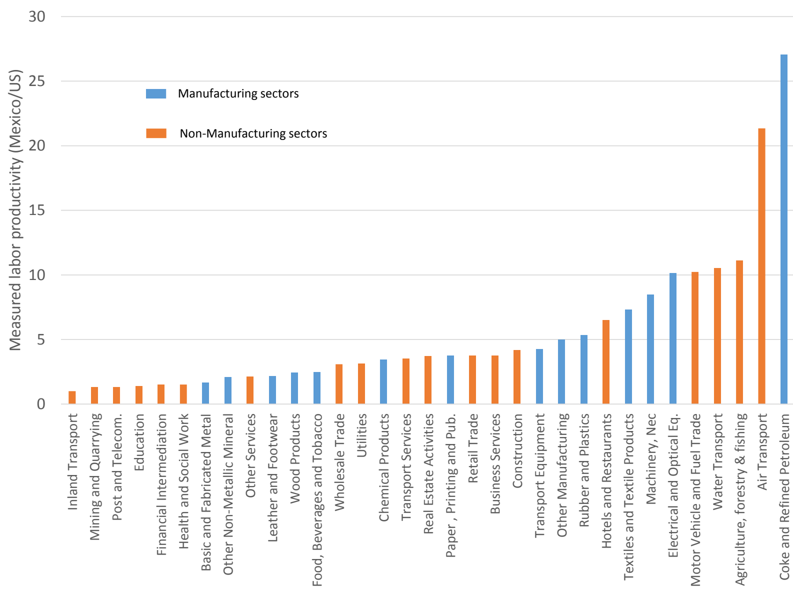
Source: Herrendorf and Valentinyi (2012). The Table presents TFP measures computed by Herrendorf and Valentinyi using data from the Penn World Tables.

1: the productivity gap is high in Goods and relatively low in Servicesq. A third and final piece of evidence is the data on labor productivity that can be constructed using Inklaar and Timmer's PPP estimates at the industrial level and data on value added and hours worked from the World input-output database (WIOD). This is a more disaggregated data that allows me to explore differences across more narrowly defined sectors. I present such measures in Figure 2 for the Mexican sectors. The main message is similar to the one implied in the previous figure and table. The Agriculture productivity in the US is higher by a factor of 11 with respect to the one in the US, the simple average of these gaps within Manufactures is 6.1, while the corresponding one for Services is 5.0.

2.2 Sectoral interconnections

Mexican sectors exhibit considerable heterogeneity in the interconnections among them as measured using the information in the input-output tables. Figure 3 shows a network map for the Mexican economy. Each circle is a sector. The area of the circle is determined by the final consumption share of the sector. A string between two circles indicates that the

Figure 2: Measured labor productivity (Mexico/US).



Source: Own calculations using data from Inklaar and Timmer (2013) and WIOD. Notes: The Figure shows Measured Labor Productivity using value added divided by total hours worked by persons engaged. To compare the data between the two countries, I have used the PPP price estimates by Inklaar and Timmer (2013).

economic transactions between them are significant (i.e., above some threshold[4]). The close to the center of the picture a sector is, the more interconnections the sector has. The figure shows that there is great heterogeneity across sectors in terms of consumption shares and number of inter-connections. Intuitively, the larger the consumption share of a sector, and the stronger its inter-connections, the more important role the sector will play in the economy.[5] In the Figure, sectors 20 and 21 seam to have many strings connecting them with the rest. These two sectors correspond to two important input suppliers in the economy: Retail and Wholesale Trade.

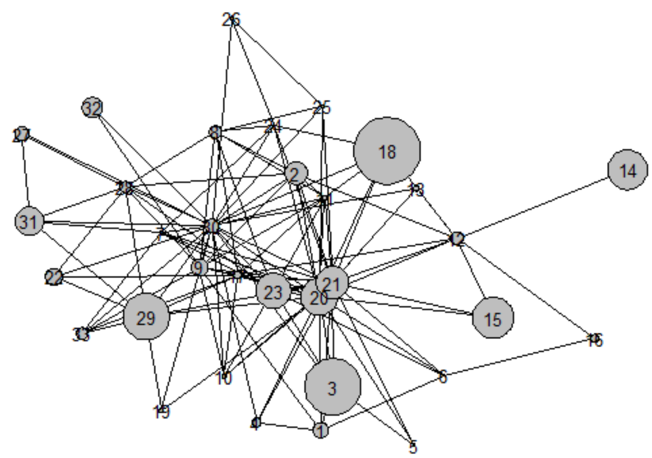
2.3 Variation in input shares as wedges

The use of variation in input shares to identify distortions on the optimal behavior of firms has a precedent in the literature (see below). When the production function is Cobb-Douglas and

[4]Specifically, I define the threshold in terms of the share of intermediate inputs from sector j in the gross output of sector i. If this ratio is higher than 0.025, a line is drawn between the two sectors. See Figure 3.

[5]These two features of a sector will be important determinants of the "degree of influence" introduced in section 3.

Figure 3: Network map of Mexican Sectors.



Source: Author's calculation. The Figure presents the input-output network map for the Mexican economy. Each circle is a sector. The size of the circle corresponds to the consumption expenditure share of each sector. If two sectors are engaged in an economically meaningful relationship, a line between the two corresponding circles is drawn. The more inter-connected a sector is, the closer to the center of the picture the sector is positioned.

the firm operates under perfect competition, the first order conditions imply the equalization of input shares to the corresponding coefficients of the production function. As a result, variation in input shares –across countries, time, and sectors– might be indicative of the presence of distortions.

In general, variation in input shares can occur for several reasons, a simple one being the existence of taxes. Taxes distort the equalization of marginal products and marginal costs because part of the product has to be put aside by the firm in order to comply with tax laws. More generally, any regulation, pecuniary or not, that affects either, the marginal cost of inputs to the firms, or their marginal revenue, might create variation in input shares.

Markups and market power. One source of variation in input shares that is addressed in this paper is the presence of market power (see section 5.1.2). As explained by Cole and Ohanian (2013), deviations from perfect competition in product markets break the equality between the marginal revenue product of inputs and the price of those inputs (the marginal cost). The reason is that under imperfect competition firms set a markup of price over marginal cost, which depresses the quantity of inputs hired by the firm. One early contribution with the same basic idea is Hall (1988) who uses the ratio of labor compensation to total revenue at the sector level, to study the relationship between price and marginal cost in US industries. More recently, De Loecker (2011) uses a similar property of firm's maximization to identify markups in exporting industries.

One economy which is commonly believed to be very concentrated is Mexico. Two facts give support to this idea. First, in contrast to the US, which had a strong and operating antitrust authority since the end of the 19th century, Mexico only reached such status in 2013.[6] Throughout most of the entire twentieth century, Mexico did not have an antitrust authority at all (see, Van Fleet, 1995 and Van Fleet, 2015). For this reason, the pro-competitive culture nowadays is seriously limited.[7] Second, Mexico ranks among the worst in the "Extent of market dominance" index from the World Economic Forum.[8] Mexico ranks 103 out of

[6]The first antitrust commission was created in 1992. However, it was only until 2013 that the commission was granted by congress the power to punish anti-competition behavior with jail time and large fines (e.g., 10% of sales).

[7]An illustrative case is the one of a trade association of the transportation industry that used to enforce agreements among its members to simultaneous increase prices. The association would do so by posting the agreement in its website, using press releases describing the agreement, and providing training for workers of the member firms to "correctly" apply the increases (See COFECE, 2015).

[8]This index is constructed with the following question among business managers: "In your country, how do you characterize corporate activity? [1 = dominated by a few business groups; 7 = spread among many firms]."

Table 2: 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
Telecommunication	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

Notes: The Table presents an index by the OECD (see Koske et al., 2014) that measures the presence of policies and regulations that reduce competition in various economic sectors. The table compares the best practices of OECD countries to the case of Mexico in the sectors where the index is available.

140 alongside with Guinea, Tunisia and Jamaica. In contrast, the United States ranks 11 in this index, close to Netherlands. Moreover, the severity of this problem seams to vary across sectors. Table 2 presents an index by the OECD (see Koske et al., 2014) that measures the presence of policies and regulations that reduce competition in various economic sectors. The table compares the best practices of OECD countries to the case of Mexico in several sectors.

Intermediate inputs shares. Figure 4 shows that the shares of intermediate inputs in gross output in the Mexican industries have a strong correlation with the corresponding shares in the US. If a share is relatively high for an specific industry in the US, then, the corresponding Mexican industry also has a relatively high share. Despite this close correlation, the data also shows that the intermediate inputs shares in Mexico are depressed relative to the US ones, giving support to the idea that Mexico is a highly concentrated economy.

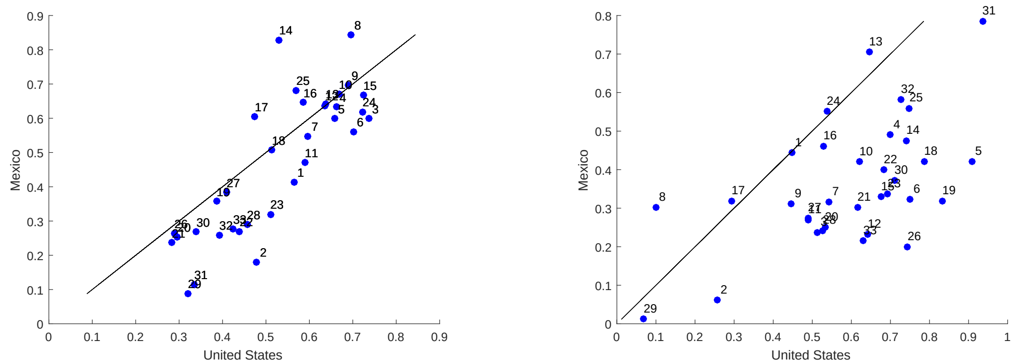
Labor income shares. In México, the labor income share is low, as in many developing countries.[9] Figure 4 presents a scatter plot of the sectoral labor shares for Mexico and the United States calculated using WIOD data.[10] The Figure shows that labor shares are

[9]It is commonly believed that this is due to the measurement errors emphasized by Gollin (2002). The main argument made by Gollin is that in developing countries, there is a substantial fraction of labor income that is mistakenly recorded as non-labor income in national accounts. The main reason for this is the large presence of self-employment and unpaid family workers in developing countries.

[10]The WIOD makes a correction of labor compensations in developing countries to take into account the large presence of self-employment (see Timmer et al., 2012 for details), however it does not takes into account

Figure 4: Input shares: Mexico vs. US

(a) Intermediate input share in gross output (b) Labor income share in value added



Source: Author's calculation using data from WIOD.

positively correlated between Mexico and the United States, however, Mexico consistently exhibits lower labor shares. Given the measurement problems emphasized by Gollin (2002), I performed a correction following the methodology proposed by Conesa et al., 2007. Due to the lack of information by sector, I did this exercise only for aggregate data.[11] A naive calculation of this share gives 28%, while the resulting "corrected" share is 42%. The correction still leaves the Mexican share below the 60%, which roughly corresponds to the US aggregate labor share.

In the next sections, I use a model that helps me to rationalize the previous facts and that is useful to quantitatively assess the importance of sectoral productivity gaps and sector-specific distortions on economic development.

3 Model

Consider an economy with N inter-connected sectors as in Long Jr and Plosser (1987), Jones (2011b), and Acemoglu et al. (2012). The supply of labor (H) is exogenous and each sector uses labor and commodities from all other sectors (including its own) to produce. The production function of a representative firm in sector i is given by the following Cobb-Douglas technology:

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the presence of unpaid family workers.

[11] The methodology departs from the observation that the concept of "labor compensations" in National Accounts unambiguously corresponds to labor income. Thus, the idea is to identify the fraction of GDP that includes this concept and its corresponding capital income. Since ambiguous income is recorded as Net Mixed Income from the household sector, this is subtracted from GDP (together with Net indirect taxes), and then the ratio of "labor compensations" to this "adjusted" GDP is obtained.

$$Q_i = A_i H_i^{\alpha_i(1-\sigma_i-\lambda_i)} \prod_{j=1}^{N} x_{ij}^{\sigma_{ij}} M_i^{\lambda_i}, \tag{1}$$

where x_{ij} represents the intermediate demand that industry i makes from industry j, and M_i is its corresponding demand of an imported intermediate good. A_i and H_i represent an exogenous productivity term, and labor used in sector i, respectively. Also, I define $\sigma_i = \sum_{j=1}^{N} \sigma_{ij}$, which corresponds to the parameter that controls the importance of intermediate goods in gross output. Notice that this production function exhibits Decreasing Returns to Scale (DRS).

The output from each sector Q_j, can be used either as consumption (c_j), or as an intermediate input in the production of the other sectors. Thus, the resource constraint of sector j is given by:[12]

$$Q_j = c_j + \sum_{i=1}^{N} x_{ij}, \forall j = 1, ..., N.$$

Consumption $(c_1, ..., c_N)$, in turn, is combined to produce a single final good, according to the following function:[13]

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

where $0 < \beta_i < 1, \forall i$, and $\sum_{i=1}^{N} \beta_i = 1$.

Problem of the representative household. The problem of the representative household is shown next for future reference:

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

$$s.t.\ C = wH + \Pi + T \tag{2}$$

[12] This equation constitutes the most important difference between value-added economies and input-output (IO) economies. While in the IO economy production has two possible uses, in a simple value-added economy, consumption is the only possible use for production.

[13] Alternatively, I could have used a utility function to generate the demand side of the economy.

where C is aggregate consumption, w is the price of labor, Π are aggregate profits, and T are transfers. These transfers are financed with the rents associated with the distortions that affect optimal decisions of firms (see below). Provided u is increasing, the solution for this problem is trivial: the household will consume all the available income.

Problem of the final good producer. The problem of the final good producer consists on choosing $\{c_i\}$, taking $\{p_i\}$ as given, to solve:

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

The first order conditions are given by:

$$\beta_i (Y/c_i) - p_i = 0, \ \forall i. \tag{3}$$

$$\Leftrightarrow \beta_i = \frac{p_i c_i}{Y}, \ \forall i$$

The first order conditions of the problem above imply that the consumption shares are constant and equal to the coefficients in the production function (β_i). The Cobb-Douglas assumption here and in the problem of the firm in sector i next, imply that the allocation of labor across sectors will be independent[14] of sectoral productivity (see section 3.1.3).

Problem of the representative firm in sector i. There exists a representative firm in each sector. Each firm faces distortions that are sector-specific. The main difference between this kind of wedges and the productivity gaps is that I assume that the rents from distortions are given back to the household as a lump-sum transfer. Thus, while these distortions directly affect the purchases of inputs at the firm level, the associated rents increase the resources available for consumption at the household level. In contrast, productivity affects intermediate inputs and the resources available for consumption (through lower wages and profits), both, at the firm, and household levels, respectively.

[14] The reason for this is the presence of complementarity across sectors: an increase in the productivity of sector i, also increases the productivity of sector$j$, because the j has more of i to produce with. Under Cobb-Douglas, the marginal products of all sectors are shifted proportionally, and thus, the allocation of labor is not altered.

I assume three types of sector-specific distortions: τ_i, ψ_i, and ϕ_i. The first distortion (τ_i) represents output taxes that I will be able to pin-down using data on tax revenues at the industry level. The second distortion (ψ_i) enters in the firm's problem in a way that resembles an output tax, but it is designed to capture other distortions that are not captured by the tax revenue data. One possible interpretation for this wedge is that a markup is in place due to the existence of imperfect competition, as explained previously. I will refer to ψ_i as the "markup" and will be defined in such a way that if $\psi_i > 1$, then it means that marginal revenue is above marginal cost, and vice-verse. The last distortion, ϕ_i, introduces a wedge between the marginal revenue product of labor and its marginal cost, and it enters in the firm's problem as a payroll tax. I refer to it as "labor wedge". Note that I define this wedge such that if $\phi_i > 1$, then the marginal productivity is higher than the wage.

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

$$\max_{H_i, \{x_{ij}\}, M_i} \left\{ \frac{(1-\tau_i)}{\psi_i} p_i A_i (H_i)^{\alpha_i(1-\sigma_i-\lambda_i)} \prod_{j=1}^{N} x_{ij}^{\sigma_{ij}} M_i^{\lambda_i} - \phi_i w H_i - \sum_{j=1}^{N} p_j x_{ij} - p_{M,i} M_i \right\}$$

and the first order conditions (FOCs) are as follow:

$$\frac{(1-\tau_i)}{\psi_i} \alpha_i (1-\sigma_i-\lambda_i) \frac{p_i Q_i}{H_i} = \phi_i w, \ \forall i \tag{4}$$

$$\frac{(1-\tau_i)}{\psi_i} \sigma_{ij} \frac{p_i Q_i}{x_{ij}} = p_j, \ \forall i, j \tag{5}$$

$$\frac{(1-\tau_i)}{\psi_i} \lambda_i \frac{p_i Q_i}{M_i} = p_{M,i}, \ \forall i \tag{6}$$

The interpretation of the above conditions is straight-forward, the household chooses labor, and intermediate inputs to equalize the (distorted) marginal revenue to the (distorted) marginal cost in each case. Note that the markup ψ_i affects the three conditions above: it increases marginal revenue above marginal cost for all inputs. In contrast, the labor wedge, ϕ_i, affects the first order condition associated with the choice of hours (4) only. This feature of distortions will be useful for identification in the Calibration part.

Equilibrium. With this, I can provide a definition of competitive equilibrium. Given import prices, taxes, and wedges $\{p_{M,i},\ \tau_i,\ \phi_i,\ and\, \psi_i\}$, a competitive equilibrium consists in quantities $\{H_i, x_{ij}, M_i, c_i\}$; and prices $\{p_j\}$ and w, $\forall i, j = 1, ..., N$; such that:

1. $\{c_i\}$ solves the representative final good producer problem at the equilibrium prices.
2. H_i,$\{x_{ij}\}$ and M_i solve sector's i producer problem at the equilibrium prices.
3. Markets for labor, and goods $j = 1, ..., N$ clear.

3.1 Analysis of equilibrium

In this section I describe the features of equilibrium that are important for the results in the paper. I am interested in the aggregate effects of changes in the two kind of wedges analyzed here: productivity gaps and sector-specific distortions. Let $A = \{A_1, A_2, ..., A_N\}$ be the vector that collects the set of all sectoral productivity parameters in the economy, and define the vectors of output taxes (τ), markups (ψ), and labor wedges (ϕ) in an analogous way. Additionally, define vector Γ as the collection of sector-specific distortions, $\Gamma = (\tau, \psi, \phi)$. Let also $Y(A, \Gamma)$ be the value of equilibrium output when productivity and sector-specific distortions take the particular values (A, Γ). To start, note that it can be shown (see Jones, 2011b) that equilibrium aggregate output is given by:

$$Y(A, \Gamma) = \tilde{A}(\Gamma) \left(\prod_{i=1}^{N} A_i^{\mu_i} \right) H^{\bar{\alpha}} \tag{7}$$

where H is aggregate labor, $\bar{\alpha}$, and μ_i, $\forall i$ are constants that depend only on parameters, while $\tilde{A}(\Gamma)$ is a constant that depends on both, fundamental parameters and sector-specific distortions. In particular, note that the effect of changing sector-specific distortions will be captured by the $\tilde{A}(\Gamma)$ term, while the effect of closing productivity gaps will be captured by $\left(\prod_{i=1}^{N} A_i^{\mu_i} \right)$.

3.1.1 Effect of changing the productivity gaps.

I first analyze the effect of changes in sectoral productivity. I am interested in the change in aggregate output when the productivity in a given sector is multiplied by a certain factor,

$x_i \geq 0$. Let A_i^0 be the baseline productivity level, and A_i^1 be the value of productivity that is achieved with the described change. Then, the factor x_i is given by:

$$x_i = \frac{A_i^1}{A_i^0}, \quad \forall i = 1, ..., N.$$

Note that if A_i^1 is interpreted as the productivity in the US in sector i, and A_i^0 as the corresponding one in Mexico, then, $x_i - 1$ is equal to the productivity gap between the two countries. Abusing language, I refer to x_i either as relative productivity in sector i, or as the "productivity gap". I am interested in the effect on aggregate output when $x_i \neq 0$, while the rest of the wedges remains unchanged. This effect will be given by:

$$\frac{Y(A^1, \Gamma)}{Y(A^0, \Gamma)} = \prod_{i=1}^{N} x_i^{\mu_i} \tag{8}$$

where μ_i is known as the degree of influence of sector i, and note that the expression above is independent of the level of distortions. Notice also that μ_i measures the elasticity of aggregate output to a 1% change in the productivity of sector i.

The vector of influence. For illustrative purposes, let me focus for a moment on the case of the closed economy. In this case, the degree of influence of a sector depends on its consumption expenditure share, and on the importance of the sector in the input-output network. In particular, let m_i be the degree of influence of sector i in the closed economy. The vector of influence $m = (m_1, m_2, m_3, ..., m_N)$ is given by:

$$m = \beta' (I - B)^{-1} \tag{9}$$

where $\beta' = (\beta_1, \beta_2, ..., \beta_N)$ is a vector containing the consumption expenditure shares, B is a NxN matrix with typical element given by σ_{ij}, and $(I - B)^{-1}$ is known as the Leontief inverse. The interpretation of an element, l_{ij}, of the Leontief inverse is that it gives the percentage change in gross output of sector i, led by a 1% increase in the productivity of sector j. This includes all the direct and indirect effects that occur through the input-output network.[15]

[15] In particular, note that $l_{jj} > 1$, because the original increase of 1% in the productivity of sector j gets multiplied through the input-output network. Note that in order to increase sector's j output by 1%, it is necessary to also increase the use of intermediate inputs. This leads to an increase in production of all the inputs that j uses in its production process. In turn, the demand for j as an intermediate input also has to increase due to the fact that the rest of the sectors ($s \neq j$) use sector's j inputs in their corresponding production processes.

Furthermore, since gross output is proportional to consumption, l_{ij} is also the percentage change in final consumption of sector i associated with the 1% increase in productivity of sector j.[16]

According to this interpretation, an element of the vector of influence, $m_j = \sum_{i=1}^{N} \beta_i l_{ij}$, represents the total increase in aggregate consumption (or GDP), led by a 1% increase in the productivity of sector j, and it is equal to the sum of the changes in consumption of individual sectors, weighted by the expenditure shares β_i, $\forall i$. As a result, for the degree of influence of a sector, it matters its contribution to the production of final consumption in all sectors, including final consumption in its own sector. Crucially, the way the production of sector j reaches other sectors is through its use as an intermediate input in the corresponding production processes of the rest of the sectors.

Finally, for the case of an open economy, the degree of influence is given by:

$$\mu = \frac{m}{1 - m\lambda}, \tag{10}$$

which, corresponds to the vector of influence in the closed economy, m, multiplied by a constant that depends on import shares.

3.1.2 The degree of influence vs. the value added share.

An important feature in the model is how the vector of influence is related to the value added shares. This is relevant, because in a simple multi-sector value-added economy the elasticity of aggregate output to a change in the productivity of a given sector, is given by its value-added share. In contrast, in the input-output economy used here, the elasticity is given by the degree of influence of the sector. It is also relevant to study how this relationship is affected by the presence of sector-specific distortions. For illustrative purposes, let me focus on the case of the closed economy and lets consider first the case of the economy under no distortions. It can be shown that, in equilibrium, the Dommar weights (the ratio of sales to the GDP, or $\frac{p_j Q_j}{Y}$) are equal to the corresponding degrees of influence:

$$m_j = \frac{p_j Q_j}{Y}, \ \forall j$$

[16] Note that a percentage change in gross output of a given sector is tied to a similar percentage change in its final consumption.

To gain some intuition, note that the Dommar weight of sector j can be expressed as a function of its consumption expenditure share, and its importance in the input-output network, which exactly correspond to the two determinants of the degree of influence:[17]

$$\frac{p_j Q_j}{Y} = \beta_j + \sum_{i=1}^{N} \sigma_{ij} \frac{p_i Q_i}{Y}, \ \forall j$$

In turn, it can also be shown that, in equilibrium, the value added of a sector is proportional to gross output: $NVA_i = (1 - \sigma_i) p_i Q_i$, with the term $(1 - \sigma_i)$ representing the importance of value added in gross output for sector j. As a result, the relationship between the degree of influence, m_i, and the value-added share of a sector, $\nu_i = \frac{NVA_i}{Y}$, is given by:

$$\nu_i = (1 - \sigma_i) m_i, \ \forall i \tag{11}$$

where the value added share is equal to the degree of influence, m_i, multiplied by $(1 - \sigma_i)$.

Let me now take the case of the distorted economy when output taxes are positive and denote with a tilde the value of a variable in this new equilibrium. The degree of influence of a sector is still given by equation 9 and is still equal to m_i. The reason for this is that distortions only affect the constant $\tilde{A}(\Gamma)$ in equation 7, and do not affect the second term in the equation. Thus, distortions affect the GDP level, but do not affect the elasticity of GDP to changes in productivity. In contrast, note that the Dommar weights in this economy are now given by:

$$\tilde{m}_j \ = \ \beta_j + \sum_{i=1}^{N} (1 - \tau_i) \sigma_{ij} \tilde{m}_i, \ \forall j$$

where I have denoted the value of the Dommar weights in this distorted economy with a tilde: $\tilde{m}_j = \frac{\tilde{p}_j \tilde{Q}_j}{\tilde{Y}}$. Note that the presence of distortions reduces the purchases of intermediate inputs, which affects the Dommar weights in the expression above, and, as a result $m_j \neq \tilde{m}_j$. This in turn, has a repercussion on the equilibrium value added shares:

$$\tilde{\nu}_i \ = \ (1 - (1 - \tau_i) \sigma_i) \tilde{m}_i, \ \forall i. \tag{12}$$

In summary, the degree of influence is closely related to the value added share of a sector in the undistorted economy. However, the introduction of distortions creates a disconnect between these two concepts.[18] In section 5.2.2, I analyze the empirical relevance of this

[17]Note that to obtain this expression, I depart from the resource constraint for sector j and use first order conditions to substitute for c_j and x_{ij}.

[18]The introduction of distortions has two opposing effects on the value added share of a sector. On the

important feature of equilibrium.

3.1.3 The effect of distortions.

In this section, I am interested in the effect of eliminating sector-specific distortions –while keeping productivity gaps unchanged– on aggregate output. For didactic purposes, I will discuss the case of the closed economy and focus on an economy facing only output taxes. The effect of eliminating markup wedges will be similar to that of output taxes, while the effect of eliminating labor wedges will be addressed at the end of this section.

Consider two economies that differ on their levels of distortions: $\tau^1 \neq \tau^0$. Define $Y^0 = Y(A, \tau^0)$, and $Y^1 = Y(A, \tau^1)$ as the two levels of aggregate output corresponding to the two equilibria under consideration. It can be shown that the effect of changing all distortions simultaneously will be given by:

$$\begin{aligned} ln\left(\frac{Y^1}{Y^0}\right) &= \sum_{i=1}^{N} m_i \alpha_i (1-\sigma_i) ln\left(\frac{\tilde{\theta}_i^1}{\tilde{\theta}_i^0}\right) \\ &+ \sum_{i=1}^{N} m_i \sigma_i ln\left(\frac{1-\tau_i^1}{1-\tau_i^0}\right) \\ &+ \sum_{i=1}^{N} m_i (1-\sigma_i) ln\left(\frac{\tilde{m}_i^0}{\tilde{m}_i^1}\right) \end{aligned} \tag{13}$$

The expression above contains three terms which correspond to the three margins that are affected when output taxes are modified. From top to bottom, these margins are: 1) the allocation of labor, 2) the supply of intermediate inputs; and 3) the allocation of gross output between final and intermediate uses. Consider now how these margins operate when all distortions are simultaneously eliminated (i.e., $\tau^1 = 0$, while $\tau^0 > 0$).

Regarding the first margin, the first term shows a weighted average of the changes in the allocation of labor across sectors when output taxes are eliminated. Notice that $\tilde{\theta}_i^0$ corresponds to the equilibrium allocation of labor in sector i under the presence of distortions:

one hand, it reduces its Dommar weight ($\tilde{m}_i$), but on the other, it reduces the importance of value added in gross output, $(1-(1-\tau_i)\sigma_i)$.

$$\tilde{\theta}_i^0 = \frac{\tilde{H}_i}{H} = \frac{\alpha_i(1-\sigma_i)\,(1-\tau_i)\,\tilde{m}_i}{\sum_{s=1}^{N}\alpha_s(1-\sigma_s)\,(1-\tau_s)\,\tilde{m}_s}$$

The presence of distortions prevents the equalization of the marginal products of labor across sectors and misallocates labor away from those sectors with large taxes and into those with small ones. When all taxes are simultaneously eliminated, a reallocation of labor occurs, and the equalization of marginal products across sectors is restored. This, in turn, leads to higher productivity and output. Thus, the first term is positive, in this case.

The second term in equation 13 is also positive (because $ln\left(\frac{1-\tau_i^1}{1-\tau_i^0}\right) > 0$ when $\tau_i^0 > \tau_i^1$), and it captures the change in output produced by the change in the supply of intermediate inputs. Given that the provision of intermediate inputs in the economy is not fixed –as opposed to, for example, the case of aggregate labor–, the introduction of taxes affects the supply of this factor of production. Therefore, when taxes decrease, the supply of intermediate inputs in the economy increases, which has a positive effect on aggregate output.

Finally, the last term in equation 13, corresponds to the effect of removing distortions on the allocation of gross output between final and intermediate uses. The reduction in distortions, leads to an increase in the use of intermediate inputs in the economy, which is done –in part– at the expense of final consumption. To see this, recall that the Dommar weights ($\tilde{m}_i$) were reduced under the presence of distortions and that the fraction of gross output that is used as final consumption depends inversely on these weights:

$$\frac{c_i}{Q_i} = \frac{\beta_i}{\tilde{m}_i}.$$

Thus, for a given level of gross output, lower distortions lead to less consumption. Therefore, the effect of removing distortions –through this margin– is negative (note that $ln\left(\frac{\tilde{m}_i^0}{\tilde{m}_i^1}\right) < 0$ in the third term of equation 13).[19]

Note that equation 13 also applies to the markup wedges because these are isomorphic to the output taxes. In the case of the labor wedges, the only margin affected is the one related to labor misallocation, because the supply of this factor of production is fixed. Thus, equation 13 can still be used to study the effect on aggregate output of the labor wedges, but only the first term should be present in the analysis. Furthermore, equation 13 can also be used

[19]We also noted before that the presence of distortions increases the importance of value added in gross output: $\frac{N\tilde{V}A_i}{\tilde{p}_i\tilde{Q}_i} = (1-(1-\tau_i)\sigma_i)$, which is also consistent with this intuition.

to study many different changes in distortions. In particular, I am interested in the effect of eliminating distortions one by one, and in specific subsets of sectors. This is presented in section 5.2.3.

4 Calibration

This section presents the calibration strategy. The goal is to obtain calibrated values for three sets of parameters: 1) the parameters of the technology, 2) the sector-specific distortions, and 3) the productivity gaps. Regarding the first two sets, there is a fundamental identification problem in their calibration that consists on the following. I observe factor shares for the intermediate goods and for labor, which are a function of technological parameters (the Cobb-Douglas exponents) and of distortions. The identification problem is how to separate these two. I address this problem by focusing on the differences between Mexico and the U.S.

I proceed by making two assumptions:

1. The U.S. has no distortions.
2. The labor exponent (α_i) and the total intermediate goods exponents ($\chi_i = \lambda_i + \sigma_i$) are the same in the U.S. and Mexico.

Assumptions 1 and 2 imply that we can read technological parameters for both economies from the U.S. factor shares data.[20] To see this, note that from equations 4, 5, and 6, we obtain:

$$\chi_i = \sigma_i^{MX} + \lambda_i^{MX} = \sigma_i^{US} + \lambda_i^{US} = \frac{\sum_{j=1}^{N} p_j^{US} x_{ij}^{US}}{p_i^{US} Q_i^{US}} + \frac{p_{M,i}^{US} M_i^{US}}{p_i^{US} Q_i^{US}},$$

$$\alpha_i = \alpha_i^{MX} = \alpha_i^{US} = \frac{w^{US} H_i^{US}}{(1-\chi_i) p_i^{US} Q_i^{US}}.$$

Given these technological parameters, we can use the factor shares in Mexico to obtain the value of the distortions. Using again equations 4, 5, and 6, and data for Mexico, we obtain:

$$\psi_i = \psi_i^{MX} = \frac{\chi_i}{\frac{\sum_{j=1}^{N} p_j^{MX} x_{ij}^{MX}}{p_i^{MX} Q_i^{MX}} + \frac{p_{M,i}^{MX} M_i^{MX}}{p_i^{MX} Q_i^{MX}}},$$

[20] The data used for calibration is available in the input-output tables of Mexico and the U.S. published by the World Input-Output Database (WIOD).

Table 3: Calibrated parameters (averages)

α	β	σ	λ	γ	ψ	ϕ	τ	m
0.521	0.037	0.388	0.134	0.053	1.30	1.42	0.003	0.072

$$\phi_i = \phi_i^{MX} = \frac{\psi_i}{\alpha_i}\left(\frac{w^{MX}H_i^{MX}}{(1-\chi_i)p_i^{MX}Q_i^{MX}}\right).$$

The procedure could be interpreted as using the deviations from the 45 degree lines in Figure 4 as the size of the markup and labor wedges in Mexico. Notice also that, the calibrated labor wedge depends on the value of the markup wedge. Put it differently, the observed labor income share in Mexico, at a given industry, is affected by both: the markup wedge and the labor wedge. Thus, part of the explanation of the low labor income shares in Mexico relies on the existence of the markup wedges.[21]

In addition to assumptions 1 and 2 above, note that, since the set-up of the model I have also made an assumption regarding the nature of the distortions. In particular, note that, I don't allow for differential distortions across different intermediate goods, which implies that differences in factor shares of individual intermediate inputs are picked-up by differences in technology parameters (i.e. $\sigma_{ij}^{US} \neq \sigma_{ij}^{MX}$ and $\lambda_i^{US} \neq \lambda_i^{MX}$).[22] It is emphasized that thanks to this calibration strategy, all parameters of the technology (for a given industry) are country-specific, except for two: α_i and χ_i. Thus, one advantage of this strategy is that a significant amount of heterogeneity in the technologies of the countries is still allowed. To calibrate β_i, I use equation 3 and data on final consumption by industry.[23] Note that the output tax rates can be calibrated using tax revenue data. Table 3 shows the simple average across industries of the calibrated parameters.

The assumptions above are not uncontroversial ones. Certainly, the fact that Mexico and the U.S. are in different stages of development might indicate the presence of different technologies, which in turn would be reflected in factor shares. Similarly, distortions might be present in a variety of ways leading to differences in factor shares of individual intermediate inputs. Nonetheless, these assumptions provide a simple way to deal with the identification problem above. Moreover, I think these are reasonable, despite the controversy. Note that the assumption of equal coefficients of labor across countries is a standard one in the

[21] This is the intuition used by Hall (1988), when he uses the ratio of labor compensation to total revenue to study imperfect competition in US industries.

[22] Given the value of ψ_i, I can use equations 5, 6, and data of factor shares to obtain the calibrated values of $\{\sigma_{ij}\}$, and λ_i.

[23] Consumption is defined as in the model: the difference between gross output of sector i and the value of purchases of sector's i output made by the rest of the sectors.

development literature. Similarly, the assumption of equal coefficients of total intermediate goods is consistent with the fact that the factor shares of total intermediate goods in the two countries are highly correlated (see Figure 4).[24] Furthermore, the way distortions are modeled, allows me to focus on one possible interpretation: the presence of market power. Finally, since I have focused on Mexico, I can assess whether the calibrated values of these distortions are consistent with the facts about Mexico's market structure (see section 5).

The last calibration task is to have an assessment of the gaps in the "fundamental" productivity parameters in each sector: $\left(\frac{A_1^{US}}{A_1^{MX}}, \frac{A_2^{US}}{A_2^{MX}}, ..., \frac{A_N^{US}}{A_N^{MX}}\right)$. I proceed by first computing a measure of labor productivity in each sector and country. For this purpose, I use data on value added and hours worked by sector from the WIOD. Then, I take the ratio of these productivity measures sector by sector. To appropriately compare the data from different countries, I use the relative prices at the industry level reported by Inklaar and Timmer (2013).[25] The precise calculation of measure productivity is presented in the appendix. Note that, the *measured* labor productivity gap in a given sector has a counterpart in the model, which is a function of both: fundamental productivity gaps and relative sector-specific distortions across countries (remember that I have assumed that the US has no distortions). Thus, the calibration strategy for the fundamental productivity gaps takes this feature into account. It consists on solving the model numerically and looking for the change in the set of fundamental productivity parameters that, along with the appropriate change in distortions, matches the measured labor productivity gaps observed in the data.

5 Results

In this section, I present the main features of the calibrated economy, and perform counterfactual exercises to asses the importance of productivity gaps and sector-specific distortions on aggregate output.

[24]The assumption implies that, in the absence of distortions, the share of value-added in gross output for a given industry, should be the same in both countries. As showed in Figure 4 of Section 2, there is a strong correlation in the shares of value added in gross output between the two countries.

[25]They implemented a methodology that includes the use of input-output tables to go from final good prices to industry output prices. To my knowledge, this is the only publicly available data set on gross output prices at the industry level that includes the two countries in my analysis.

Table 4: Average productivity gaps

Broad Sectors	Degree of influence μ_i	Markup ψ_i	Labor wedge ϕ_i	*Measured* labor productivity gap	Fundamental productivity gap $\frac{A_i^{US}}{A_i^{MX}}$
Manufactures	0.047	1.01	1.78	6.1	1.83
Other goods	0.092	1.44	1.23	4.9	1.92
Services	0.063	1.54	1.40	5.0	2.84
All	0.059	1.31	1.54	5.33	2.19

5.1 The calibrated economy

The results of the calibration exercise for the vector of influence, the sector-specific distortions, and the productivity gaps, are presented in this section. For illustrative purposes, I group the 33 industries into three broad sectors: Manufactures, Other goods (Agriculture, Mining, Utilities, and Construction), and Services. Table 4 contains the simple average among the industries that pertain to each of the three broad sectors for the variables above. In addition, I also present these calibrated values for each of the 33 industries using Figures 5 to 7, as explained below.

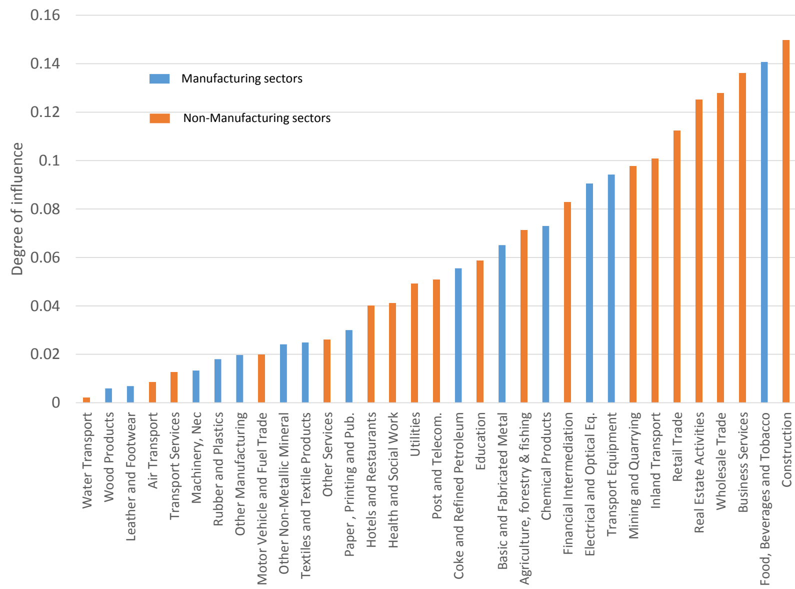
5.1.1 Calibrated vector of influence.

Regarding the vector of influence, Table 4 shows that, in general, Manufactures are industries that have degrees of influence below average, and that, in contrast, Services, and Other goods have degrees of influence above average. In Figure 5, it is observed that three out of the ten sectors with the highest degrees of influence are Manufactures, five out of those ten are Services, and the remaining two sectors are Construction and Mining (pertaining to Other goods). Also note that the sector with the highest degree of influence is Construction, and that the Service industry with the highest influence is Business services, while the corresponding one for the Manufacturing sector is Food products, beverages and tobacco.

5.1.2 Sector-specific distortions.

Table 4 contains a summary of the calibrated values of markup and labor wedges. Regarding the markup wedges, the Table shows that these are specially large in Services and Other goods, while these are relatively small in Manufactures. Figure 6 reports the value of ψ_i for

Figure 5: Calibrated vector of influence



each of the 33 sectors included in the analysis. A number of values are close to 1, which implies the presence of no distortions. However, for a large majority of the sectors, markups are larger than one (ψ_i>1). The unconditional average of industrial markups is 1.3, while if we only take the industries with markups above 1, the average is 1.6. In regards to the case of the labor wedges, Table 4 indicates that their calibrated value is more similar across the three broad industrial categories. The estimates for each industry are presented in Figure 7. An overwhelming majority of the wedges are above 1. On average, the value of the labor wedge is 1.54.[26]

One advantage of focusing on Mexico is that we can relate the measures of distortions to specific policies that are known to be present in this country. The presence of markups larger than one is consistent with the fact that Mexico is a very concentrated economy as documented in section 2.[27] Moreover, the Mexican Federal antitrust commission (COFECE by its Spanish acronym) has signaled interest in performing market investigations and inquiries

[26]Labor wedges are significantly above 1 for Other Services, Utilities, Transport Equipment, Retail Trade, Post and Telecom, Leather and Footwear, Wholesale Trade, Construction, Air Transport, Motor Vehicle and Fuel Trade, Basic and Fabricated Metal, Transport Services, and Electrical and Optical Eq.

[27]Nonetheless, some sectors do show markups less than one. To accurately interpret this case it is important to emphasize that, given the calibration strategy followed in the paper, distortions in Mexico are measured relative to the ones in the US. Thus, a markup less than 1 implies that the distortions faced in Mexico are smaller than the ones in the US.

Figure 6: Calibrated markup wedges

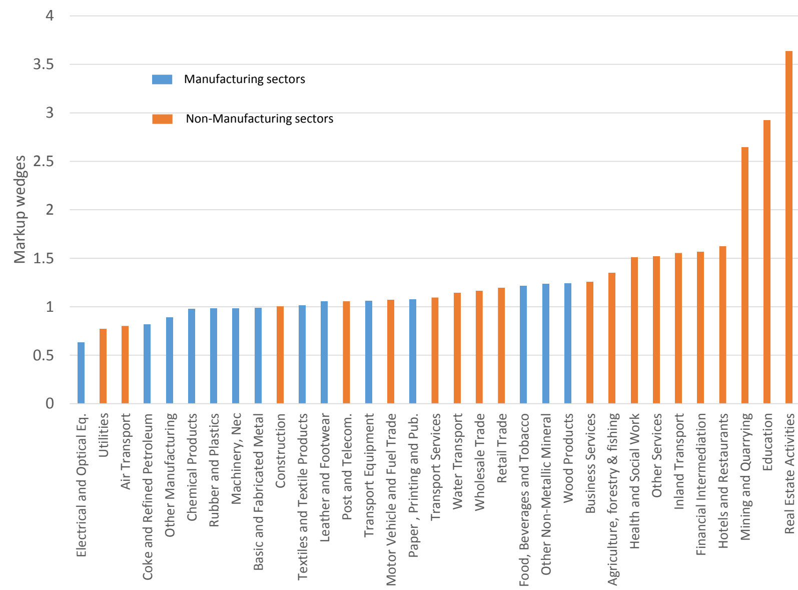
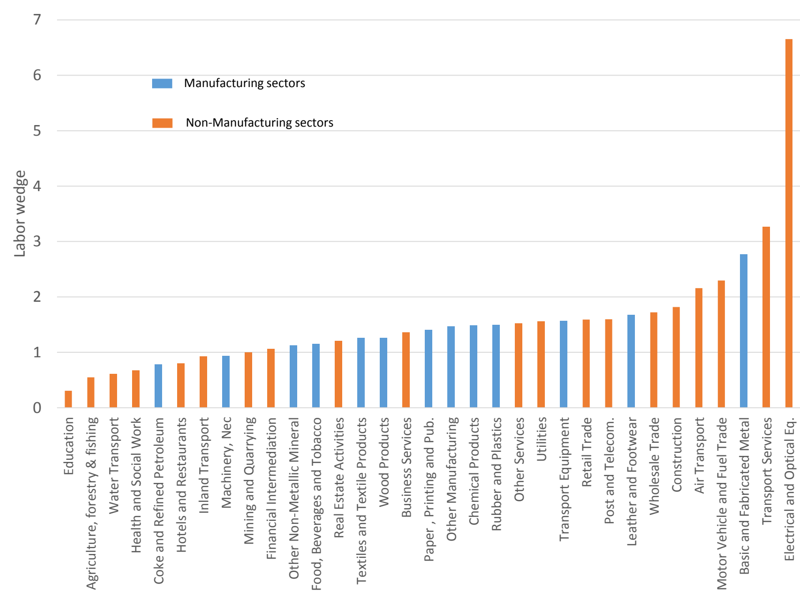


Figure 7: Calibrated labor wedges



in a set of industries which intersects with the set where I find a calibrated markup greater than one.[28]

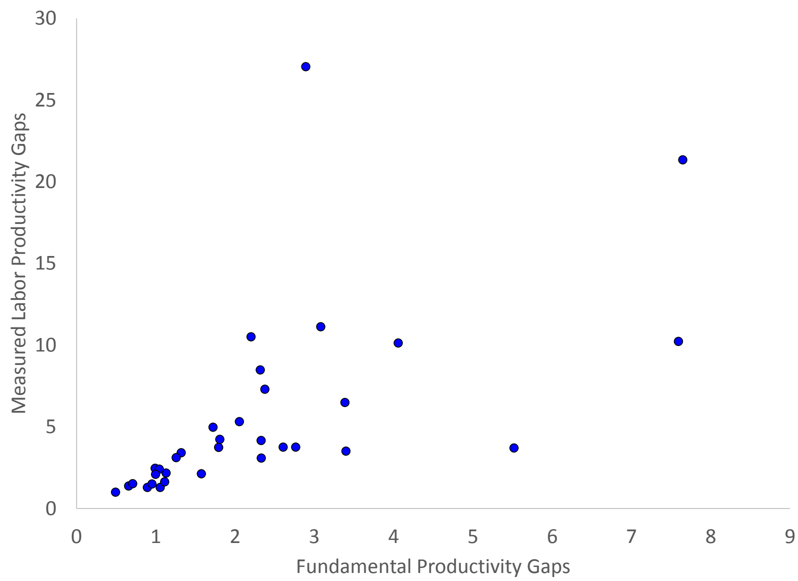
5.1.3 Fundamental productivity gaps

Table 4 presents simple averages of measured and fundamental productivity gaps for the three broadly defined sectors. Note that the units between these two indicators are not directly comparable: measured productivity refers to value added productivity, while the fundamental productivity refers to gross output productivity. Nonetheless, we can compare the rankings of the sectors that emerges using each alternative indicator. While the gap in Manufactures is higher than the gap in Services when *measured* labor productivity is used, the opposite happens when the fundamental productivity is used. This important feature, is a result of the fact that large sector-specific distortions are more concentrated in Services. In general, sectors with large distortions tend to exhibit an "artificially" large *measured* labor productivity (and, therefore, a low *measured* gap with respect to the US). The reason for this is two-fold. On the one hand, a large markup depresses the use of intermediate inputs, and increases the fraction of value-added in gross output. On the other hand, both wedges, the markup and the labor wedge, reduce the allocation of labor into those sectors with large distortions. These two forces artificially increase measured productivity in Services: the first force increases the numerator, and the second one reduces the denominator of measured labor productivity in Mexico.

As Figure 8 shows, the correlation between the *fundamental* productivity gaps that resulted from the calibration procedure, and the *measured* labor productivity gaps, is far from perfect. This result, highlights the relevance of using an input-output model with distortions, instead of a simple value-added economy, to address the questions at hand (see also the arguments below).

[28]Currently the authority is performing research regarding possible monopoly practice in high-impact sectors, including: finance, agro-food industry, transportation, and health. It has also signaled interest in: beverage production, medicines, education, personal care, and pension managers (see Urzúa, 2008, p. 22). Additionally, specific regulatory institutions have been created to deal with the telecommunication and the energy industries. Markups significantly above 1 are obtained in Water Transport, Wholesale Trade, Retail Trade, Food, Beverages and Tobacco, Other Non-Metalic Mineral, Wood Products, Business Services, Agriculture, Forestry & Fishing, Health and Social Work, Other Services, Inland Transport, Financial Intermediation, Hotels and Restaurants, Mining and Quarrying, Education, and Real Estate Activities.

Figure 8: Measured labor productivity gaps vs. Fundamental productivity gaps



5.2 Counterfactuals

In this section I present the result of the counterfactual exercises of interest. I perform three counterfactual exercises regarding the removal of productivity gaps and sector-specific distortions. The object of interest in these exercises is aggregate output, which in the case of the open economy is equal to: $C = Y - (\sum_{i=1}^{N} p_{Mi} M_i)$. The first relevant counter-factual exercise consists on eliminating both types of wedges: productivity gaps and sector specific distortions, and compute its effect on aggregate output. The results are reported in Table 5. I find that simultaneously closing all wedges in all sectors[29] would increase aggregate output by a factor of 4.02. This is roughly consistent with the gap in GDP per capita between Mexico and the US calculated by Inklaar and Timmer (2013) and the gap in the Penn World Tables. Not surprisingly, most of the gains would be given by the removal of productivity gaps: the removal of these gaps –while keeping sector-specific distortions in place– would increase aggregate output by a factor of 3.55. In turn, the removal of the sector-specific distortions –while keeping the productivity gaps constant– would increase output by a factor

[29]Note that some sectors have a negative productivity gap, thus, I did not modified their productivity for this exercise.

Table 5: Effect of removing wedges

Effect of removing:	Aggregate output
Baseline	1
All wedges	4.02
Productivity gaps	3.55
Sector-specific distortions	1.13

of 1.13. However, note that complementarity between these two kinds of wedges plays an important role. In particular, the effect of removing both kinds, simultaneously, is bigger than the sum of their individual effects.[30]

5.2.1 Effect of closing gaps

Next, by the analysis in section 3.1.1, we know that the effect on aggregate output of closing the productivity gap in a single sector i would be given by the interaction of the fundamental productivity gap (x_i), and the degree of influence (μ_i). Figure 9 presents a scatter plot of the fundamental productivity gaps and the degrees of influence of Mexican sectors. The location of the x and the y axis, correspond to the simple average across sectors of degrees of influence and productivity gaps, respectively. Sectors located northeast of the intersection between the two axis are those with relatively high degrees of influence and high productivity gaps. The elimination of productivity gaps in these sectors is expected to have a large impact on aggregate productivity.

Figure 10 ranks the sectors according to their effect on aggregate output when gaps are closed one by one (i.e, according to the factor $x_i^{\mu_i}$).[31] The picture shows that Agriculture, and three Manufacturing sectors are among the top ten with the highest effect on output. The Table also shows, nevertheless, that Services and Construction are highly important for economic development.

Why is it that Services turned out to have a more important role in aggregate productivity than previously considered? There are two main reasons. The first one is that the relatively small measured productivity gap in Services turned out to be just a mirage, due to the fact

[30] Note that the percentage increase in output when both kinds of wedges are reduced simultaneously is 302%. Removing only productivity gaps increases output by 255%, while removing only spector-specific distortions increases output by 13%. The sum of these two effects is less than 269% $<$ 302%.

[31] Notice that the Figure shows some sectors that have a negative impact on aggregate output. These sectors have negative gaps in their fundamental productivity parameters, thus "closing the gap" in these sectors implies a decrease in their corresponding productivity parameters, which reduces aggregate output.

Figure 9: Productivity gaps and degrees of influence

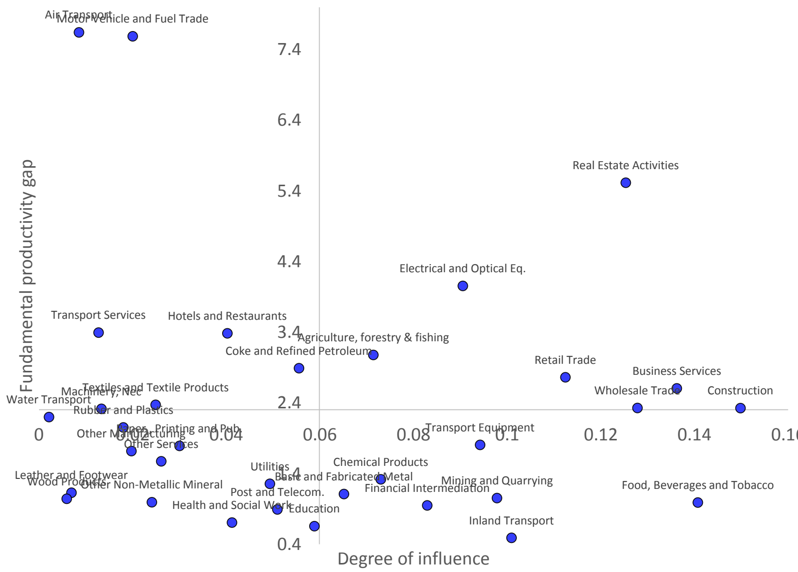


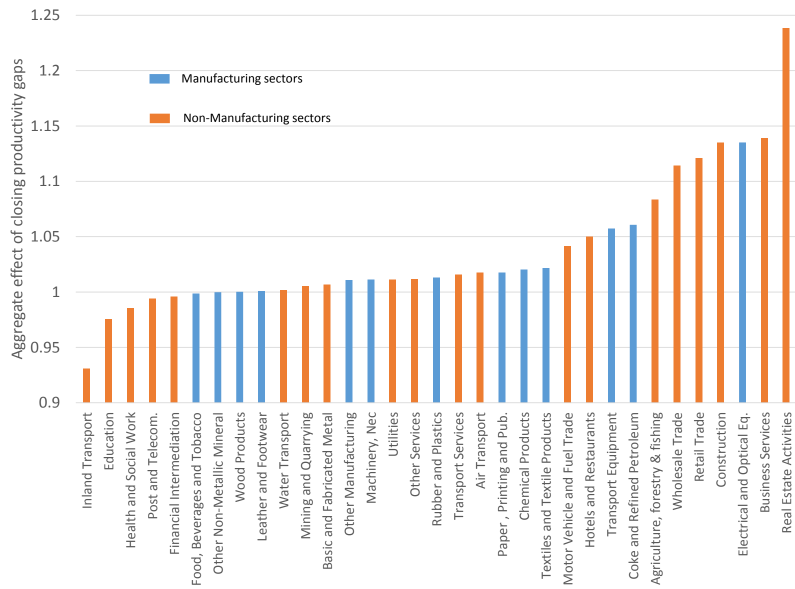
Table 6: Effect of closing productivity gaps

	Mexico
Baseline	1.0
Closing all gaps simultaneously	3.55
in 10 sectors with *highest* $x_i^{\mu_i}$, simultaneously	2.89
in 10 sectors with *lowest* $x_i^{\mu_i}$, simultaneously	1.08

that these sectors face the largest distortions in Mexico. The second one is that a number of Service sectors typically have high degrees of influence. Therefore, this finding could not have been obtained by simply comparing the size of *measured* productivity gaps across sectors.

Now, consider the result of eliminating productivity gaps only in these top ten sectors. Table 6 shows that the result of this exercise would increase aggregate output by a factor of 2.89. Roughly speaking, 80% of the total gains that would be obtained by closing all gaps simultaneously, could be achieved by closing the gaps on these top ten sectors. Instead, closing the gaps in the ten sectors with the lowest contributions ($x_i^{\mu_i}$), would increase output by a factor of only 1.08. This means that by focusing on fixing a few key sectors, the country could experience large aggregate gains. As I explain next, the use of an IO economy with distortions is crucial for this important result.

Figure 10: Effect in Y of closing the productivity gap



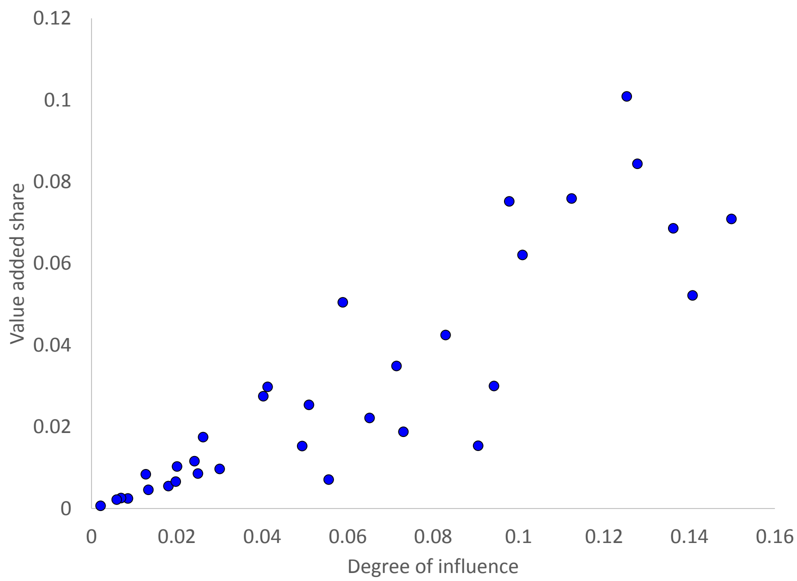
5.2.2 Input-output economy vs. Value-added economy

Why is important to use an input-output (IO) economy instead of a more simple multi-sector value-added economy to study the aggregate impact of closing productivity gaps? The underlying general reason is that the IO economy allows for the study of distortions which have an impact on margins that –by definition– do not exist in a value-added economy. As a result, the productivity gaps, the weights applied to those gaps, and the effect of closing them, differ in the two cases, despite the fact that the same data is used to calibrate their corresponding parameters.

To further illustrate this point, let me consider the value-added economy in the first place. In this case, the fundamental productivity gaps are calibrated by equating them to the measured productivity gaps.[32] In turn, the weights are given by the value added shares of the sectors, which only depend on fundamental technological parameters.

Consider next the IO economy with distortions, and how productivity gaps and weights are defined. Regarding the gaps, I showed in section 5.1.3, that the fundamental productivity

[32]Here, I am referring to the case of a Cobb-Douglas technology, which is the relevant one since my IO economy also assumes Cobb-Douglas.

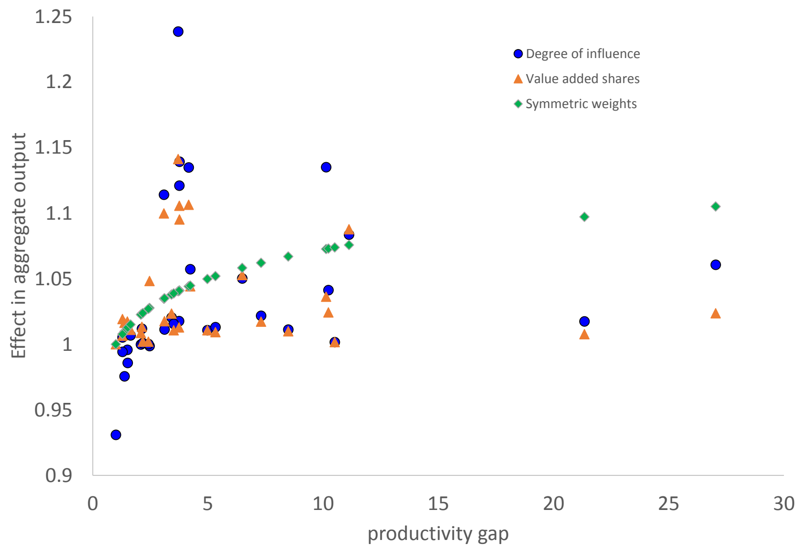


gaps in this economy differ from the measured gaps. The reason for this is that, in the IO model, measured productivity is a function of both, fundamental productivity and distortions, while in the value-added economy this distinction is not possible, because crucial margins are missing. Regarding the weights, I showed in section 3 that the value-added share of a sector and its degree of influence are closely related to each other in the case of the IO economy without distortions (see equation 11), but that this relationship breaks apart under the presence of distortions (see equation 12). The reason for this is that the value added shares in the IO economy are affected by distortions, while the degrees of influence depend only on fundamentals.

Given the above discussion, one could ask whether the value added shares are, in practice, substantially different form the degrees of influence. Figure 11 shows that the correlation between these two alternative weights is, indeed, far from perfect. In particular, there are substantial differences among the top influential sectors.

A related important question is whether the contribution of the sectors to aggregate output changes substantially when value added shares are used as alternative weights, and measured productivity gaps as alternative gaps. I perform this exercise and re-compute the contribution to aggregate output of each sector. I also perform this exercise assuming that the value added shares are symmetric across sectors. In such a framework –which is a special case of the value-added economy– the only differences across sectors are given by the differences in the size of their productivity gaps. Figure 12 shows that when these symmetric weights are used, the effect of closing productivity gaps on aggregate output is simply an increasing function of the size of the gap. It also shows that this correlation is broken when the actual value added shares are used as weights. Furthermore, it shows that the correlation is worsened

Figure 12: Importance of using degrees of influence and fundamental productivity gaps



furthermore when the IO economy is used to compute these effects.

Another way to highlight the differences between the two economies is by looking at the top ten most influential sectors in each case. Table 7 shows that simply comparing the productivity gaps is highly misleading. To see this, note that the use of symmetric weights (third column) would substantially modify the sectors included in the top-ten list, relative to the case of the IO economy (first column). It also shows that using the actual value added shares (second column) keeps most of the sectors in the list, but it changes their ranking. Furthermore, and more importantly, the Table presents, in the first row, the joint contribution to aggregate output of the top ten sectors for the three alternatives in consideration. The Table shows that using either symmetric weights, or value added shares, reduces the joint importance of the top ten sectors. The reason for this is that the correlation between gaps and weights is higher in the IO economy, which increases the aggregate impact of the top ten sectors.

Finally, Table 8 presents the joint contribution of the sectors that are included in each of the three broad industries defined above. Notice that using the value-added economy leads to underestimate the role of Services in economic development. Notice that, in the case of the IO economy, closing the productivity gaps in Services increases output by a factor of 2.02;

Table 7: Top-ten sectors using alternative economies

	IO economy	Value added economy	Symmetric weights
Joint contribution:	2.90	2.18	2.03
1	Real Estate Activities	Real Estate Activities	Coke and Refined Petroleum
2	Business Services	Construction	Air Transport
3	Electrical and Optical Eq.	Retail Trade	Agriculture, forestry & fishing
4	Construction	Wholesale Trade	Water Transport
5	Retail Trade	Business Services	Motor Vehicle and Fuel Trade
6	Wholesale Trade	Agriculture, forestry & fishing	Electrical and Optical Eq.
7	Agriculture, forestry & fishing	Hotels and Restaurants	Machinery, Nec
8	Coke and Refined Petroleum	Food, Beverages and Tobacco	Textiles and Textile Products
9	Transport Equipment	Transport Equipment	Hotels and Restaurants
10	Hotels and Restaurants	Electrical and Optical Eq.	Rubber and Plastics

Table 8: Gains from closing gaps using alternative economies

	IO economy	Value added economy	Symmetric weights
Manufacturing	1.41	1.30	1.87
Other Goods	1.25	1.25	1.17
Services	2.02	1.78	1.73
Total	3.56	2.87	3.80

while for the case of the value-added economy output increases by a factor of 1.78.

5.2.3 Effects of removing sector-specific distortions

The last set of counterfactual exercises consists on reducing the distortions in the model: the output taxes, the markups, and the labor wedges. As discussed in section 3.1.3, the elimination of sector-specific distortions would have an impact on three margins: 1) the allocation of labor, 2) the supply of intermediate inputs; and 3) the allocation of gross output between final and intermediate uses. In addition, in an open economy, the distortions would also affect the purchases of imported intermediate inputs. Table 9 presents a decomposition of the aggregate effect of the elimination of distortions. I find that, roughly speaking, Mexico's aggregate output would be 13% higher when all distortions are removed in all sectors, simultaneously. The largest fraction of that gain would be driven by a positive effect on the supply of intermediate inputs, through which aggregate output would be multiplied by a factor of 1.24 due to this margin. The improvement in the allocation of labor would also contribute to the increase in aggregate output by multiplying GDP by a factor of 1.046. However, the

Table 9: Decomposition of the effect of the removal of distortions

Factor Decomposition	Effect on Aggregate output
Total effect on output (C)	1.130
Misallocation of labor	1.046
Supply effect	1.241
Split btw intermediate/final uses	0.892
Purchases of imports	0.976

remaining two margins would contribute negatively to the change in GDP. In particular, the removal of distortions would increase the use of gross output as an intermediate input, at the expense of its use as final consumption. This margin would multiply aggregate output by a factor of 0.892, reducing it by around 10%. Similarly, there would be a larger use of imported intermediate inputs, which would multiply GDP by a factor of 0.976, causing a relatively small reduction.

Table 10 presents the aggregate effect of the removal of sector-specific distortions in a given subset of the sectors. In particular, for the case when (all kinds of) distortions are removed for the subset of the 10 sectors with the highest degrees of influence, aggregate output increases 8%, which corresponds to roughly 60% of the increase that would have been achieved if distortions were simultaneously removed in all sectors.

The table also shows the case when only one kind of distortion is removed. Note that values of the calibrated output taxes –reported in Table 3– are extremely low and, thus, its effect on output turned out to be negligible. So, for this exercise, I focused only on removing, alternatively, markups or labor wedges. The main takeaway is that the removal of only one kind of these wedges might not result in output gains. The reason for this is that this strategy might exacerbate the misallocation of labor, as the negative effects of the remaining wedges would persist, and might even be enhanced. For example, for the case when all markup wedges are removed –while all labor wedges are kept in place– the effect on output is negligible. This occurs despite a large positive effect on the supply of intermediate inputs, which increases GDP by a factor of 1.23! Nevertheless, the removal of the markup wedges creates more labor misallocation as the dispersion of the remaining labor wedges is bigger than the dispersion of the total labor wedge, which includes the markups.[33] The effect of labor misallocation is to decrease output by a factor of 0.93. In addition to this, the remaining margins regarding the allocation of gross output between final and intermediate uses, and the imports of intermediate inputs also reduce output, with corresponding factors of 0.90, and

[33]The total labor wedge in the first order condition for hours worked is given by $\frac{\psi_i \phi_i}{(1-\tau_i)}$

Table 10: Effects of the removal of distortions

Case	Effect on Aggregate output
All kind of distortions	
All sectors	1.13
Top 5 most influential sectors	1.03
Top 10 most influential sectors	1.08
Markup wedge only	
All sectors	1.00
Top 5 most influential sectors	1.036
Top 10 most influential sectors	1.053
Labor wedge only	
All sectors	1.00
Top 5 most influential sectors	0.99
Top 10 most influential sectors	1.00

0.98, respectively. At the end, all these effects combined end up erasing the original positive effect of the reduction of markups:$(1.23)(0.93)(0.90)(0.98) \approx 1$.

It remains to report the effects of removing sector-specific distortions sector by sector, while keeping the rest of the distortions in place. The effect of doing this for the case of the markup wedges is shown in Figure 13, while for the case of labor wedges is shown in Figure 14. Note the important role of the degree of influence in determining the aggregate effect of removing individual wedges. For example, despite the fact that the markup in Wholesale Trade is smaller than the markup in "Other Services", eliminating the markup in Wholesale Trade gives bigger gains, because it has a higher degree of influence. Note also that the effect of removing individual wedges might be negative in some cases, due to the fact that the removal of a single wedge might end-up exacerbating the problem of labor misallocation given that the rest of the distortions are still in place.

6 Discussion

In the paper, I abstract from capital accumulation. The reason for this is that I believe that this way I can focus the analysis on the basic mechanisms present in the model. This is not to say that capital is unimportant and unrelated to the features studied here. In fact, the presence of sector specific distortions undermines capital accumulation by affecting the first order condition of the firm with respect to capital. Consider a production function such as:

Figure 13: Effect in Y of reducing markups under Case 1: when rents are given back to the household.

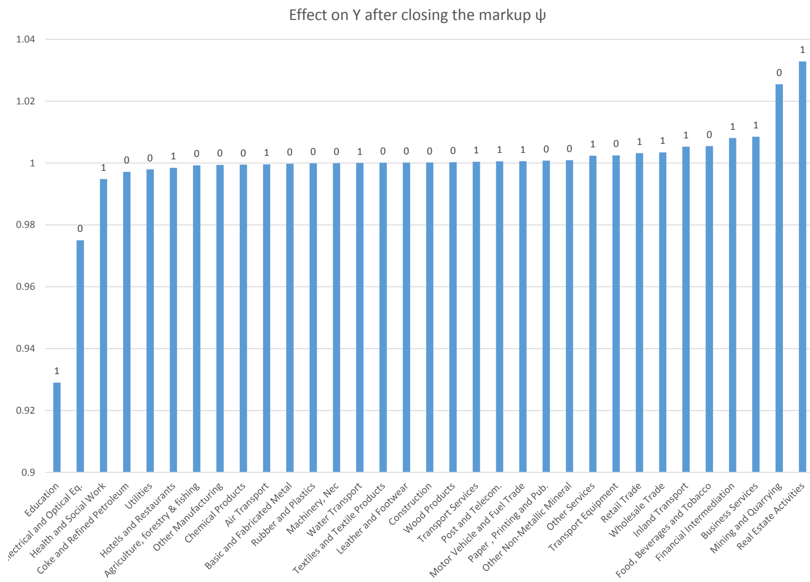
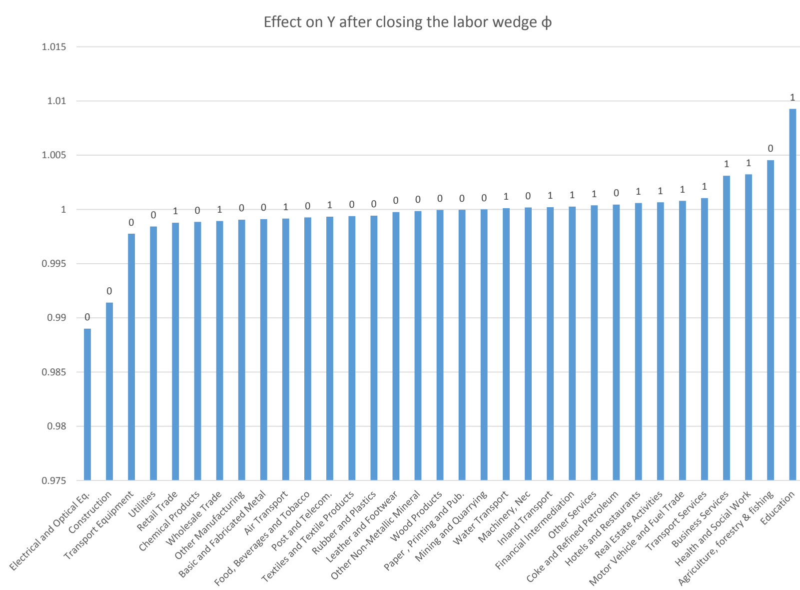


Figure 14: Effect in Y of reducing the labor wedges.



$$Q_i = A_i \left(K_i^{1-\alpha_i} H_i^{\alpha_i}\right)^{(1-\sigma_i)} \prod_{j=1}^{N} x_{ij}^{\sigma_{ij}}, \tag{14}$$

and, for simplicity, assume that we face only output taxes. In this case the first order condition with respect to capital is given by:

$$(1-\tau_i)(1-\alpha_i)(1-\sigma_i)p_i Q_i / K_i = r$$

As we can see, the presence of sector-specific distortions affects the capital-output ratio at the sector level and also at the aggregate level. This mechanism could also be quantitatively important. I let the quantitative assessment of the importance of this channel for future research.

Note, also, the connection of my paper with the structural transformation literature. First, since services turned out to have a larger productivity gap than previously considered, it means that the process of structural transformation could hamper economic development (as more resources are allocated to services). Nevertheless, since these two economic processes occur simultaneously, and, perhaps, as a result of common underlying forces, it would be of interest to study the implications of my results in a model of structural transformation. This work is left for future research. In addition, my paper is connected to the discussion on the mechanisms behind structural transformation. Herrendorf et al. (2012) compare the importance of two standard mechanisms to explain this phenomenon: non-homothetic preferences vs. relative prices. They argue that the answer depends on whether the analysis is done using value-added data or final expenditure data. The input-output structure is the piece that reconciles these two perspectives. My paper incorporates this input-output structure explicitly and, thus, I am able to show the way in which the IO economy is connected to a value-added economy (see section 3.1.2), contributing to this line of research. [34] Furthermore, I show that the presence of sector-specific distortions modifies this equivalence, and, by looking at the case of Mexico, I show that this could occur in a quantitatively meaningful way.

[34] In fact, in my companion paper Leal (2015a), I show that the aggregate effect of sectoral productivity shocks in an IO economy can be equivalent to the effect of shocks in a value-added economy (under certain standard conditions on preferences and technology).

7 Conclusion

For a typical developing country, I have shown that once inter-sectoral linkages and sector-specific distortions are taken into account, closing the productivity gaps in a small subset of key sectors leads to substantial gains in aggregate productivity. Moreover, the role of a number of services turns out to be more important than previously considered by the literature.

This conclusion would not have been possible using a pure value-added economy. The reason for this is that the presence of sector-specific distortions in the IO economy, affects margins that do not exist in the value-added economy. In particular, these distortions affect the use of gross output as an intermediate input, and the value-added shares of the sectors. Crucially, the presence of distortions affects measured productivity at the sector level, thus, some sectors with large distortions, exhibit an "artificially" large measured productivity. When the presence of distortions is taken into account, the fundamental productivity gap of these sectors turns out to be larger than what measured productivity indicates. This issue is specially prevalent in services, where large distortions are present.

I provided a quantitative assessment of the importance of removing these sector-specific distortions on aggregate productivity. These distortions affect several margins in the economy, including labor misallocation, the supply of intermediate goods and the allocation of gross output between final and intermediate uses. I decomposed the effect of removing these distortions by showing the quantitative importance of each of these margins. A key insight from this exercise is that if distortions are removed one by one or in subsets, it is possible to exacerbate the negative effects of the remaining distortions. In particular, labor misallocation can be exacerbated if the dispersion of the remaining distortions is higher.

Regarding future areas of research, the results suggest that analyzing policies and regulations that lead to low productivity in services is a promising one. The analysis in the paper also suggest that, for the case of Mexico, one source of sector-specific distortions is the presence of market power. Thus, anti-trust reforms that aim to increase competition in product markets have the potential to increase aggregate productivity in a significant way.

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Appendix

Data description

The data used in the paper is obtained from two main sources: the World Input-Output Database (WIOD) and Inklaar and Timmer (2013). Next, I list each variable used in the paper and include its source in parenthesis. I also define some additional nomenclature for value added, hours, and prices, to use it in the definition of measured productivity gaps (below). In these definitions, super-script c corresponds to country.

1. Input-output tables at current prices in dollars (WIOD, 2005).
2. Value added at current prices in dollars (WIOD, 2005): $VA_i^{c,wiod}$

3. Consumption expenditures at current prices in dollars (WIOD, 2005).

4. Hours worked by persons engaged (Socioeconomic Accounts form the WIOD, 2005): $H_i^{c,wiod}$

5. PPP prices at the industry level (Inklaar and Timmer (2013)): $p_i^{c,inktim}$

Measured labor productivity gaps ($MLP_i^{US/MX}$-1) takes relative prices into account and are obtained as follows:

$$MLP_i^{US/MX} = \frac{VA_i^{US,wiod}/(p_i^{US,inktim} H_i^{US,wiod})}{VA_i^{MX,wiod}/(p_i^{MX,inktim} H_i^{MX,wiod})}.$$

Table 11: Industry codes

1	Agriculture, Hunting, Forestry and Fishing
2	Mining and Quarrying
3	Food, Beverages and Tobacco
4	Textiles and Textile Products
5	Leather, Leather and Footwear
6	Wood and Products of Wood and Cork
7	Pulp, Paper, Paper , Printing and Publishing
8	Coke, Refined Petroleum and Nuclear Fuel
9	Chemicals and Chemical Products
10	Rubber and Plastics
11	Other Non-Metallic Mineral
12	Basic Metals and Fabricated Metal
13	Machinery, Nec
14	Electrical and Optical Equipment
15	Transport Equipment
16	Manufacturing, Nec; Recycling
17	Electricity, Gas and Water Supply
18	Construction
19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
22	Hotels and Restaurants
23	Inland Transport
24	Water Transport
25	Air Transport
26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
27	Post and Telecommunications
28	Financial Intermediation
29	Real Estate Activities
30	Renting of M&Eq and Other Business Activities
31	Education
32	Health and Social Work
33	Other Community, Social and Personal Services