An unfinished business: Economic liberalization and structural change in Mexico

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Abstract

Mexico, as other Latin American countries, undertook far-reaching economic reforms in the 1980s and 1990s in a wide array of areas: trade and industrial policy, foreign investment and capital account, privatization of public enterprises and deregulation of economic activities, among others. As a result of the new economic model, the Mexican economy experienced outstanding export growth, successful insertion into international dynamic markets and shift towards medium and high-technology industries. Yet productivity growth has been insufficient, leading to low and volatile economic growth. This paper examines the dynamics of productivity growth and in particular analyzes whether inter- and intra-industry dynamics can account for sluggish productivity growth. It makes use of a shift-share analysis, taking advantage of a recently published industry-level database developed by the Mexican National Statistics Office as part of the LA-KLEMS project. The paper shows that Mexico has experienced an unfinished structural change, where productivity growth within sectors has been insufficient to close the gap with its main trading partner, the United States. Moreover, despite a significant reallocation of hours worked across industries, its aggregate impact has been hampered by the fact that flows have been from industrial sectors with high labor productivity growth towards sectors with lower, or contracting, productivity growth.

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Introduction

There is a wide acknowledgement that structural change is needed for long-term economic development (ECLAC, 2012; Lin, 2012; McMillan and Rodrik, 2011; UNIDO, 2009; Haussman and Rodrik, 2003). Since the industrial revolution, the rise of new economic powers has generally been driven by the structural transformation of their economies, characterized by the shift from primary production to manufacturing, or from manufacturing to services, and within manufacturing from natural-resource-based goods to medium and high-technology products (Lin, 2012; Memedovic and Iapadre, 2009).

Structural change involves transforming the composition of output, international trade and employment (ECLAC, 2012). Through increasing productivity in existing activities, and moving towards more complex and technology-intensive sectors and processes, structural change is expected to lead to long-term economic growth, export competitiveness and well-paid jobs.

Mexico is an interesting case among emerging economies to study structural change over the last three decades. Since the mid-1980s, Mexico's economic policies and overall development orientation underwent extensive changes. The underlying premise was to use exports (instead of the domestic market) as the engine of growth and the private sector (instead of the State) as the driver of the new machine (Cordero et al., 2009).

As a result, the export and production structure were transformed significantly: in 1986, exports of primary goods represented 45.6% of total exports, and by 2012 they had decreased to 17.4%. In contrast, exports of medium and high-technology products increased from 33.0% to 61.8% of total exports in the same period (ECLAC, 2014a). This concentration on medium and high-technology products is higher than in any of the so-called BRICS countries[4]; in China those products accounted for 56.9% of total exports in 2012 (ECLAC, 2014a). Mexico has also gone through a successful insertion into high-growth global markets and has shown remarkable export competitiveness. Its market share in total US imports, which is the largest import market in the world, rose from 6.1% in 1990 to 12.2% in 2012, in spite of increasing Asian competition (ECLAC, 2014b).

Yet Mexico has experienced low and volatile economic growth. Between 1990 and 2012, Mexico's economy grew only at 2.2% annually on average. In addition, the percentage of population living in poverty conditions in 2012 was similar to that observed in 1992 (52%).

Various authors have examined this weak association in Mexico between economic reforms and export growth, on the one hand, and economic growth, on the other. There is wide acknowledgement that it is closely associated with slow productivity growth (McKinsey Global Institute, 2014; OECD, 2013; Kehoe and Ruhl, 2010; López-Córdova, 2003) and low domestic value added of manufacturing exports (De la Cruz, 2011; Padilla-Pérez and Hernández, 2010; Fujii, 2005).

[4] Brazil, the Russian Federation, India, China and South Africa.

This paper aims to analyze the first factor: the dynamics of productivity growth by sector and assess whether the structural transformation observed over the last two decades can account for sluggish productivity growth. The analysis decomposes labor productivity growth through the use of a standard shift-share analysis, taking advantage of a recently published industry-level database developed by the Mexican National Statistics Office (INEGI) as part of the LA-KLEMS project[5] (INEGI, 2013; Aravena and Hofman 2014). The database consists of annual industry-level time-series of output, as well as labor, capital and intermediate inputs over the period 1990-2011. The level of disaggregation available in the database allows a detailed analysis of the dynamics of resource allocation across industries. To the best of our knowledge this study is the first to apply this methodology to analyze the Mexican case.

The main contribution of this paper is to show that Mexico has experienced an incomplete or unfinished structural growth over the last three decades. Although it has succeeded in diversifying its production matrix and shifting towards more technologically complex industries, productivity growth has been unsatisfactory and quite below that of its main trading partner, the United States. On the one hand, productivity growth within sectors has been sluggish in general, on the other, sectoral shifts have been characterized by the relocation from industries with high productivity expansion to those with low or negative rates of growth.

The paper is divided into four further sections. The first section presents the main concepts used in this paper, in particular a detailed definition of structural change. It also gives further details of the database used to estimate productivity. The second section describes the main features of the Mexican economy under the economic model implemented in the previous three decades. The third section offers an in depth analysis of productivity growth by sector in Mexico and its comparison with US performance. The fourth section concludes.

1. Conceptual framework and methodology

Economic theory, since its origin, has given significant attention to structural change. For Adam Smith (1776) and David Ricardo (1817) the structural composition of the economy was strongly related to economic development and growth. By the same token, for economic development theory pioneers - such as Allan Fisher (1939), Hollis Chenery (1960), Arthur Lewis (1954), Luigi Pasinetti (1981) and Nicholas Kaldor (1957) - structural change is a key element for robust and sustainable growth. More recently, after the international 2008-2009 crisis, there has been a renewed interest in the quest for long-term economic growth and structural change has been brought to the fore again (e.g. ECLAC, 2012; Lin, 2012; McMillan and Rodrik, 2011).

[5] The LA-KLEMS Project is based on the EU-KLEMS Project developed by the Groningen Growth and Development Centre for the European Union (Ref needed). The KLEMS growth and productivity accounts include measures of output growth, productivity, employment and skill creation, capital formation and technological change at the industry level. The input measures include various categories of capital (K), labour (L), energy (E), materials (M) and services (S).

Yet structural change has been understood in many different ways. Three main complementary definitions are here adopted. First, structural change results from innovations and increasing productivity in existing sectors, which may come from product, process and functional upgrading. Product upgrading is the development and commercialization of new or improved products with improved performance characteristics. Process upgrading involves the development and implementation of new or significantly improved production or delivery methods. Functional upgrading, in turn, means engaging in new and superior activities in the value chain, for instance, when a firm moves from components manufacturing to product design.

Second, structural change has been commonly associated with long-term and persistent shifts in sectoral composition of economic systems. It entails modifications in the relative importance of different sectors over time, measured by their share in employment, output and trade (Memedovic and Iapadre, 2009). But more important for long-term economic growth, it is characterized by an increase in the contribution of knowledge-intensive sectors or activities to output and trade and a denser and more diversified production matrix (ECLAC, 2012).

Third, structural change is also associated to insertion into high-growth global markets, leading to growing aggregate demand, production and job creation (ECLAC, 2012). Therefore, it entails a transformation towards sectors and activities that are increasingly demanded in global markets. Growing market share of international markets is a result of this transformation.

Economic catching-up theories assert that to open an economy to international trade creates the conditions to develop local technological capabilities and increase productivity, therefore engaging in a structural change process. This is based on the expected positive effects that opening up to international trade has on technological capabilities through exports of goods, imports of intermediate and capital goods and foreign direct investment (FDI).

The catching-up theory in its simple form asserts that being backward in productivity level carries a potential for rapid advance. The catching-up theory can be traced back to Veblen's (1915) and Gerschenkron's (1962) analyses of the process by which England was overtaken by other countries such as Germany and Russia in the nineteenth and early twentieth centuries. In comparisons across countries, growth rates of productivity over any long period tend to be inversely related to the initial level of productivity. The central idea has to do with the level of technology embodied in a country's capital stock. The larger the technological gap, and therefore the productivity gap between leader and follower, the stronger the follower's potential for growth in productivity.

Yet, according to Abramovitz (1986), "a country's potential for rapid growth is strong not when it is backward without qualification, but rather when it is technologically backward but socially advanced" (p. 388). Thus the catching up process is conditioned on what Abramovitz called "social capabilities", which are related to education, institutions, and policies. Based partly on the results of Easterly and Levine (2001), which highlight the importance of differences in productivity in explaining cross-country income heterogeneity,

endogenous growth theory has further elaborated on the role of international trade and integration in the diffusion and absorption of technology (Keller, 2004).

At its most abstract level, productivity refers to the volume of outputs that can be produced from a given bundle of inputs. Its relevance stems from the fact that sustained differences in the rate of growth of productivity explain a substantial portion of the heterogeneity observed in income levels across countries (IADB, 2010; Crespi, 2010; Easterly and Levine, 2001). Thus the analysis of its dynamics and its determinants is of the utmost importance from the perspective of development.

The particular definition of productivity depends on the objective of measurement, as well as to the availability of data. Considering the close association between labor productivity and income per capita, this paper focuses on this measure which is defined as the quotient between value-added, expressed in constant terms, and the number of hours worked.

The methodology used is a shift-share analysis of labor productivity (Fabricant, 1942). It allows the decomposition of changes in labor productivity into two components: pure-productivity gains within industries (intra-sectoral or within change), and the effect due to the reallocation of resources across industries (inter-sectoral or between change). Following the work of Maudos et al. (2008), inter-sectoral changes in productivity are further decomposed into those which are due to the reallocation of resources to industries with higher productivity levels (static sectoral effect), and those due to the reallocation towards industries with higher rates of productivity growth (dynamic sectoral effect):

$$\frac{Y_T}{H_T} - \frac{Y_0}{H_0} = \underbrace{\sum_{i=1}^{n} \theta_{i,0} \left(\frac{Y_{i,T}}{H_{i,T}} - \frac{Y_{i,0}}{H_{i,0}} \right)}_{Intrasectoral\ change} + \underbrace{\underbrace{\sum_{i=1}^{n} \frac{Y_{i,0}}{H_{i,0}} (\theta_{i,T} - \theta_{i,0})}_{Static\ effect} + \underbrace{\sum_{i=1}^{n} (\theta_{i,T} - \theta_{i,0}) \left(\frac{Y_{i,T}}{H_{i,T}} - \frac{Y_{i,0}}{H_{i,0}} \right)}_{Dynamic\ effect}}_{Intersectoral\ change}$$

where $Y_T/H_T - Y_0/H_0$ denotes aggregate labour productivity growth between periods T and 0, and $\theta_{i,T}$ represent the share of hours worked in industry i as a proportion of total hours worked during period T: $\theta_{i,T} \equiv H_{i,T}/\sum_i H_{i,T} = H_{i,T}/H_T$.

The decomposition afforded by the shift-share analysis isolates the different sources of productivity growth. The first term on the right hand side measures the change in productivity that would have occurred solely due to improvements in efficiency within industries. Thus, it reflects changes in productivity that result from supply-side driven innovations within industries (Schumpeter, 1939), along the lines of the first definition of structural change presented above. The second term measures productivity changes that would have occurred only due to the flow of labor across industries. That is, it measures the demand-side induced reallocation of resources between sectors (Pasinetti, 1981). This second term correspond to both the second and the third definitions of structural change. Finally the third term measures the interaction between labor flows across industries, and the productivity gains within industries, in line with the first and second definitions of structural change. Positive values of this term reflect what Baumol (1967) called the structural bonus that results from labor shifts from low to high productivity industries.

2. Export competitiveness and industrial recomposition in Mexico over the last three decades

In the 1980s and 1990s, Mexico, as other Latin American countries, undertook a far reaching program of economic reforms in different areas: trade and industrial policy, foreign investment and capital account liberalization, privatization of public enterprises, and deregulation of domestic economic activities.

Trade policy reform began with unilateral liberalization of international commerce in 1984. In 1986, Mexico joined the General Agreement on Tariffs and Trade (GATT) and the government committed itself to maximum tariff rates and pledged to continue the replacement of import controls by tariffs. By the end of the 1980s, radical changes in the country's trade policy had transformed Mexico from an almost closed economy to one of the most open in the world (Moreno-Brid and Ros, 2009). Similarly, administrative regulations and restrictions for FDI in most sectors were abolished.

In the 1980s, 1990s and the first decade of the 2000, Mexico was very active in negotiating and signing free trade agreements (FTAs) with various countries and regions. The North American Free Trade Agreement (NAFTA), with the United States and Canada, went into effect in January 1994. By 2013, FTAs had been signed with more than 40 countries, including the European Union, the European Free Trade Association, the five Central American countries (Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua), Chile, Bolivia, Uruguay, Venezuela, Colombia and Israel.

As a result of this new economic model, Mexico's exports have experienced an outstanding growth in the last two decades: between 1993 and 2013, they grew at an annual average rate of 10.5%. Mexico is by far the largest exporter in Latin America, contributing with one-third of total regional exports. In 2013, its exports amounted to US$ 380.2 billion, over and above Brazil's US $242.2 billion.

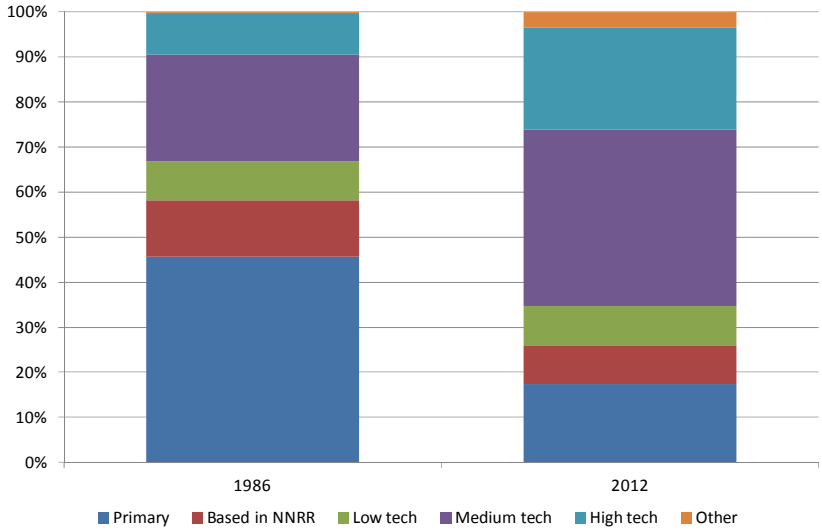
Export competitiveness, understood as an increasing market share, has been also noteworthy. In 2012, Mexico possessed 12.2% of total US imports market, in comparison with 6.9% in 1993, in spite of increasing Asian competition. Mexico is the third largest exporter to the US, just behind China and Canada.

The export structure has undergone a significant transformation. Figure 1 shows exports by technology intensity. In 1986, when Mexico signed the GATT, primary products represented 45.6% of total exports, whereas high and medium-technology exports accounted for 33%. In 2012, the share of primary goods had reduced to 17.4%, while the latter reached 61.8%.[6] This proportion of high and medium-technology goods is similar to

[6] This taxonomy is based on Lall (2000). It classifies industries according to their average expenditure on research and development. Primary products comprise fresh fruit, meat, rice, timber, petroleum and coffee, among others. Natural resource-based manufactures include prepared meals/fruits, beverages, vegetable oils, cement and glass, among others. Low-technology manufactures comprise textile fabrics, clothing, footwear, toys and furniture, among others. Medium-technology manufactures include passenger vehicles, synthetic fibres, plastics, and chemicals and paints, among others. And high-technology manufactures comprise data

that of Germany, and higher than that of countries with large research and development expenditures, such as Sweden and Finland. TV sets, mobile phones, computers and cars are among the most important exported products by Mexico.

Figure 1
Mexico: exports by technology intensity



Source: ECLAC (Software SIGCI).

Another indicator of the diversification of production structure is the total number of products exported. In 1986, Mexico exported 631 different goods (at four digits of the Standard International Trade Classification), while by 2012 the number had increased to 745 (ECLAC, 2014a).

Export growth was particularly robust in sectors that experienced a significant growth in global trade. In 2012, 53.7% of Mexico's exports took place in sectors whose global trade grew above the average between 1990 and 2012 (COMTRADE, 2014). Indeed, its exports observed a significant increase not only in high-growth manufacturing goods, such as electronics and medical devices, but also in dynamic primary products such as oil, silver and flowers.

Notwithstanding this positive export performance and a significant structural transformation, economic growth has been low and volatile. Between 1990 and 2012, Mexico's economy grew only at 2.2% annually on average. In 2013, real GDP increased only 1.1%. Mexico has 45.5% of its population living in poverty conditions; that is 53.3 millions. This ratio came down after 1995, but has climbed again in the last six years. In Chiapas and Guerrero, among the most backward states, nearly seven of every ten residents are poor. Income inequality has remained high over the last three decades. In 2012, the

processing and telecommunications equipment, pharmaceuticals, aerospace and optical instruments, among others.

GINI index was 0.5, similar to that observed in 1980, placing Mexico close to the average figure of Latin America, the most unequal region in the world.

Over the last three decades Mexico's economy has gone successfully through two out of three factors of structural change: composition of exports and positive insertion into global markets. However, this has not been enough to boost economic growth and improve overall social conditions. The following section studies in detail the third factor needed for a complete of structural change: productivity growth.

3. Productivity growth and structural change

The LA-KLEMS data for Mexico contain series for 62 industries over the period 1990-2011. In order to benchmark the performance of labor productivity, the results are compared to those of the United States, using the dataset developed by Jorgenson et al. (2012) [7] [8], which contains data for the period 1947-2010. Aside from the United States being the standard choice to benchmark the evolution of productivity growth, it is Mexico's largest trading partner: in 2013, 78.8% of Mexico's exports were sent to the US market. Moreover through NAFTA, the integration of certain sectors of the two countries' economies, particularly manufacturing, over the period studied has been substantial.

The top panel of figure 2 plots the annual GDP growth rates for Mexico and the United States. The first feature to note is that both series exhibit significant co-movement across the period studied, which reflects the extent of the linkages between both economies. The second aspect to remark is that economic growth in Mexico has been markedly more volatile, which in turn reflects the still elevated vulnerability of the Mexican economy to internal and external shocks.

The bottom panel of figure 2 shows the evolution of labor productivity in both countries, where for comparison purposes the value for 1990 has been normalized to 100. The evolution of labor productivity in Mexico clearly reflects the volatility of aggregate growth. Moreover, while economic growth has been relatively similar over the 1990-2011 period labor productivity growth in Mexico has been lagging behind that of the United States, thus increasing the already sizeable productivity gap.

The average annual growth rate of labor productivity in Mexico over the period 1990-2011 was 1,0%, which is significantly slower than the rate of 1,7% of the United States.

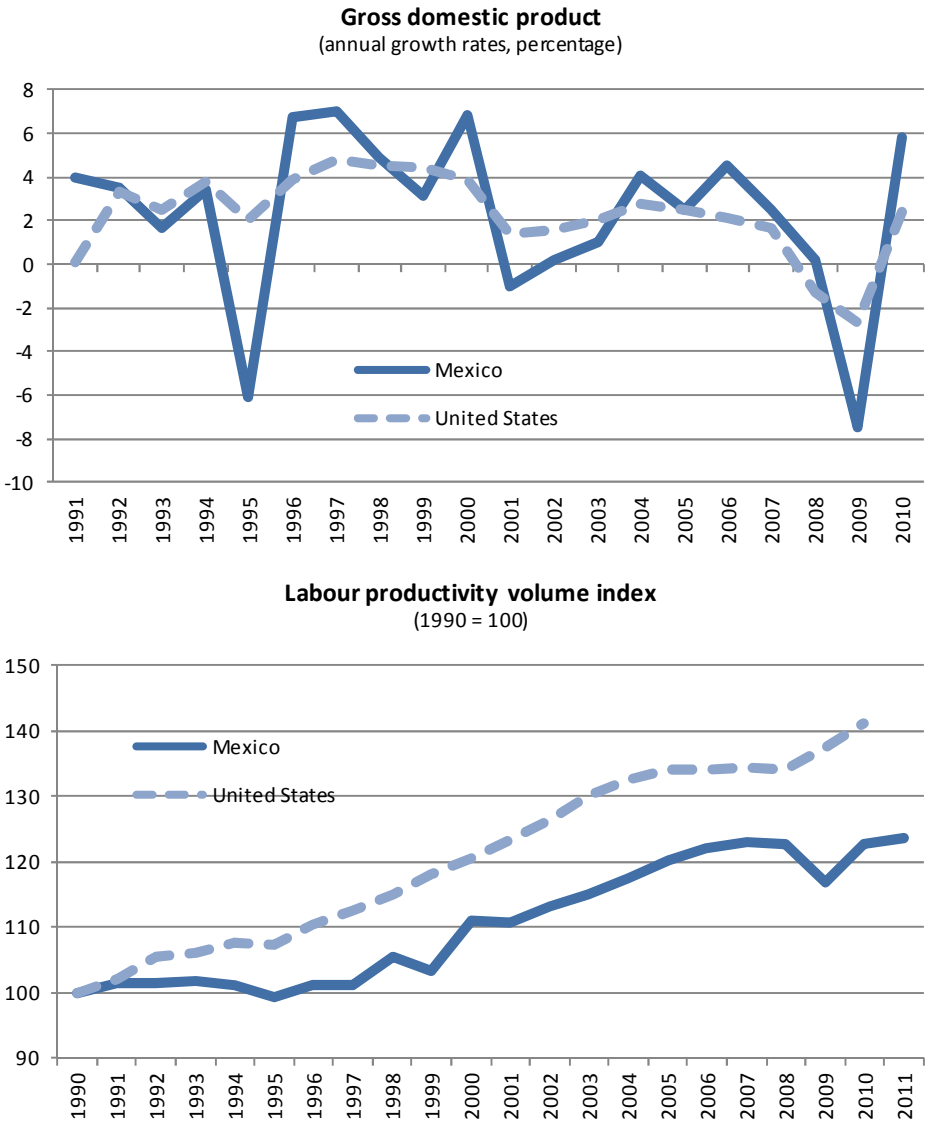
With respect to other middle income Latin American countries, Hofman et al. (2004) found that over the period 1995-207 labor productivity growth in Mexico doubled the rate found for Brazil (0,63%), but lagged behind those of Argentina (1,68%), Chile (2.56%) and the

[7] KLEMS data for both countries is built from official statistics, which use the North American Classification System (NACE). However, in order to maintain comparability with other analyses based on KLEMS data, we use the International Standard Industry Classification (Rev. 3)

[8] Since price and volume data for the United States are chain-weighted, aggregation of industry-level volume data is carried out by constructing appropriate Thornqvist price indices to deflate current value series.

United States (2,02%). To put these growth rates into perspective they imply that whereas it would take 28 and 35 years for productivity levels in Chile and the United States, respectively, to double, it would take 43 years for Argentina, 60 years for the case of Mexico and over 100 years for Brazil!

Figure 2
Mexico and the United States 1990-2011: Growth and labour productivity



Source: Own elaboration based on KLEMS data.

The evolution of productivity highlights two main facts about the Mexican economy. First, shifts in sectoral composition and insertion into high-growth global markets have not been accompanied by rapid productivity growth. Therefore, it is here argued that Mexico has experienced an incomplete or unfinished structural change. Second, economic theory predicts that growing integration between two economies should result in convergence of

labor productivity, however the gap between US' and Mexico's productivity has widened over the last two decades.

As is well known, countries in general go through phases of growth, stagnation and decline. Taking this into consideration, the shift-share decomposition for the growth periods identified within the sample for Mexico is computed, in addition to the results for the whole sample. The growth periods are bracketed by the occurrence of three crises, which resulted in recessions of varying magnitude in Mexico. The first occurred in 1995 associated to severe mismatches in the Mexican balance of payments. The second took place in 2001, as a consequence of the piercing of the so-called dot-com bubble in the United States. The final crisis spilled over from the United States to the global financial system in 2009.

Table 1 summarizes the shift-share decomposition for both countries for the four identified growth periods, as well as for the whole sample. The figures in the top panel correspond to the annual average growth rates of each component, while those in the bottom panel are the contributions of each component to total change[9].

As previously noted, commencing with the full sample (column 5), the growth rate of labor productivity in Mexico is significantly smaller than the one observed for the United States. This reflects differences in both the relative importance of the components and in their respective growth rates.

As for the relative importance of the components, inspection of the bottom panel of table 1 shows that reflecting the differing level of development between the two countries, in the United States the totality of productivity growth originated in improvement within industries, while in Mexico 22% percent of productivity growth is accounted for by the flow of labor between industries.

Hofman et al. (2014) find similar results when comparing develop and emerging economies: on average the contribution of the inter-industry effect on aggregate labour productivity change for Germany, Austria, Belgium, Denmark, Finland, France, Italy, the Netherlands and the United Kingdom over the period 1995-2007 is less than one percent; whereas its contribution for Argentina and Chile are 16% and 11% respectively.

Regarding the growth rate of the components, the expansion of the intra-industry effect in Mexico (0.8%) has been less than a half of the rate of the United States (1.8%). Although the growth rate of the inter-industry component in the United States is negative, its weight is negligible, whereas for Mexico its growth rate has averaged only 0.2%. On the one hand, both productivity and productivity growth diverge significantly between the United States and Mexico. Following catching-up theories, this gap should have given plenty of space to Mexico to increase its productivity growth rate. On the other, the United States, given its economic development level, seems to have depleted the space to increase productivity through inter-industry shifts, whereas Mexico still has some room.

[9] Note that for the case of Mexico, the incidence of the individual components for the period 1990-1994 is severely distorted. This reflects the relative magnitude of the components, with respect to the very small increase in productivity observed during the period.

Table 1

Shift-share decomposition of labour productivity growth

	1990-1994	1995-2000	2003-2007	2010-2011	1990-2011
	Annual average growth rates				
Mexico					
Labour productivity change	0.3%	2.2%	1.7%	2.8%	1.0%
Intraindustry effect	1.9%	2.3%	0.8%	2.0%	0.8%
Interindustry effect	-1.7%	-0.1%	1.0%	0.8%	0.2%
Static effect	-1.2%	0.0%	1.3%	0.9%	0.5%
Dynamic Effect	-0.5%	-0.1%	-0.3%	0.0%	-0.2%
United States [a]					
Labour productivity change	1.9%	2.3%	0.8%	2.7%	1.7%
Intraindustry effect	2.1%	2.6%	0.8%	2.9%	1.8%
Interindustry effect	-2.7%	-2.0%	-3.4%	-1.8%	-2.5%
Static effect	-2.7%	-2.0%	-3.4%	-1.8%	-2.5%
Dynamic Effect	-2.5%	-1.7%	-3.5%	-1.6%	-2.3%
	Contribution to aggregate labour productivity change				
Mexico					
Labour productivity change	100.0%	100.0%	100.0%	100.0%	100.0%
Intraindustry effect	654.7%	105.8%	44.1%	69.9%	77.1%
Interindustry effect	-554.7%	-5.8%	55.9%	30.1%	22.5%
Static effect	-382.7%	-0.7%	73.9%	31.3%	44.0%
Dynamic Effect	-171.9%	-5.1%	-18.0%	-1.2%	-21.5%
United States [b]					
Labour productivity change	100.0%	100.0%	100.0%	100.0%	100.0%
Intraindustry effect	105.0%	108.1%	99.4%	104.8%	102.8%
Interindustry effect	-5.0%	-8.1%	0.6%	-4.8%	-2.8%
Static effect	-4.4%	-7.6%	0.9%	-4.9%	-2.5%
Dynamic Effect	-0.7%	-0.6%	-0.4%	0.1%	-0.3%

Notes: a\ Since the series for the United States are chain-weighted, annual average volume growth rates are computed by first calculating the nominal growth rate, and then deflating by the corresponding Thornqvist index approximation to the Fisher ideal index (see Whelan 2000 for details)
b\ For the case of the United States the contribution of each component to aggregate labour productivity changes is approximated using nominal shares.

Source: Own elaboration based on KLEMS data

The decomposition of the contribution of inter-industry change in Mexico sheds light into the effect of the reallocation of resources across industries. The top panel shows that while the static effect has experienced an average annual rate of 0.5%, the dynamic effect has actually contracted by 0.2% on average.

Examining the contributions of each of the components to total change, the bottom panel clearly indicates that the shifts in the relative weights of each industry with respect to total hours worked, i.e. the static effect, explains over 40% of total productivity growth. However, the negative sign on the contribution of the dynamic effects, which halves the

aggregate structural change effect, implies that on average the flows have been from industries with higher productivity growth towards industries with slower or contracting productivity growth. The labor market in both countries is highly dynamic, allowing for significant shifts among sectors. In the United States such shifts have been towards more productive sectors, while in Mexico towards industries with lower productivity.

The decomposition by growth spells reveal that except for the first period, aggregate productivity in Mexico during expansion episodes has grown at rates that are comparable to those of the United States, and substantially higher during the period 2003-2007. This means that part of the lower productivity growth observed in Mexico for the full sample is explained by the losses that occur during crises.

Indeed the data indicate that in the 1995 labor productivity contracted by 1.7% in Mexico and only 0.2% in the United States. Similarly, whereas labor productivity in Mexico fell by an average of 0.1% and 2.5% respectively during 2001 and the period 2008-2009, in the United States labor productivity grew by 2.3% and 1.1% respectively during the same periods. That is despite exhibiting comparable growth rates during growth spells, labor productivity in Mexico is markedly pro-cyclical during downturns, whereas it exhibits countercyclical behavior in the United States.

In contrast to the prominent role of the intra-industry effect across growth phases for the United States, the main driver of productivity in Mexico has alternated from intra-industry improvements during the 1990s, to inter-industry changes over the period 2003-2007, and a smaller but still significant contribution of the change between industries in the most recent period. In fact the contribution of the aggregate inter-industry effect was negative during the first two periods, and only turned positive in the two most recent growth episodes.

Analyzing the contribution of the components of the inter-industry effect, the data indicate that over the 1990s those industries with both the higher productivity levels and growth rates, evidenced respectively by the static and dynamic effects, saw their share in total hours worked diminished (see table 1). Whereas during the most recent decade, the static effect turned positive indicating that the labor share of industries with high productivity levels started increasing, the dynamic effect remained negative indicating that on average labor flowed away from the industries with the highest productivity growth rates and towards sectors with declining productivity levels.

Taking advantage of the level of detail available in the data set, the analysis is further disaggregated with the purpose of identifying which groups of industries, if any, are driving the growth of aggregate labor productivity, and to identify the direction of labor flows across industries. In order to keep the analysis tractable, the industries are classified according to the taxonomy proposed by Castaldi (2009), which combines the taxonomies of Pavitt (1984) and of Miozzo and Soete (2001). The central idea behind the taxonomies is to classify industries according to both the sources and dynamics of innovation within industries.

Manufacturing industries are classified into three categories: i) Scale intensive industries, whose efficiencies are to be found in the scale of their operations and whose innovations

are to be found mostly in the improvement of processes[10]; ii) Supplier dominated industries, which are characterized by the fact that they derive the majority of their innovations from improvements embodied in the capital and intermediate goods provided by specialized suppliers[11]; and finally iii) Science-based and specialized suppliers which rely mainly on formal research activities to produce their own innovations.[12]

Service industries are classified into analogous categories, with the exception that scale intensive services are further broken down into industries involved in the development and management of physical and information networks. In addition, within the classification of physical networks industries two subcategories are identified, the first contained industries related to trade activities and the second those involved in storage and distribution. This is done because despite the existence of large firms, trade in Mexico is characterized by the existence of a large number of small and mostly informal firms.

In order to capture the flows of resources for the whole economy, three additional categories are also considered. The first includes producers of primary products; the second, labeled other production, includes construction and the provision of basic services, and finally a category for non-market services, which are services mainly provided by the state, is included. The details of the mapping of individual industries into the aforementioned categories are shown in table A in the appendix.

Table 2 provides details of the contributions of the different industrial categories over the period 1990-2011[13]. As before, the top panel presents the results for Mexico and the bottom panel those for the United States. The first row of each panel of table 2 replicates the magnitudes presented on the last column of the bottom panel of table 1. The rest of the rows show the contribution of each industrial category to the total aggregate.

The Mexican economy is characterized by a dual structure: both primary products and manufacturing experienced positive productivity growth between 1990 and 2011, while almost all service categories showed a negative performance. In contrast, in the United States the increase in aggregate intra-industry productivity change is the result of a generalized increase across industrial categories.

Manufacturing productivity growth in Mexico (2.4%) was much lower than in the same industry in the United States (4.6%), in spite of the close integration between those countries, in particular in this industry. The higher growth rate in the US was boosted by an impressive dynamism of science-based and specialized services manufacture (14.9%). In contrast, in Mexico this category, which in 2013 accounted for 38.4% of total exports,

[10] Of particular interest for the case of Mexico, this category includes the manufacture of transport equipment, chemical products, and food products and beverages.
[11] This category includes textiles, apparel and paper products.
[12] It comprises pharmaceuticals, electronic goods and components, scientific instruments and electrical machinery and equipment. Pavitt's original taxonomy distinguishes between science-based and specialized suppliers. Yet this paper groups them together because in Mexico they present similar features regarding innovation sources and dynamics.
[13] In the interest of brevity the results for the growth episodes are omitted. However they are available from the authors upon request.

showed a meager performance (0.7%). This fact illustrates that although industries such as electronics, aeronautics and scientific instruments are considered knowledge industries in developed economies, in Mexico they are dominated by labor and scale-intensive process with much lower productivity growth (Padilla-Pérez and Hérnandez, 2010).

Table 2

Incidence on the change in aggregate labour productivity

	Average aggregate growth rate 1990-2011	Intraindustry effect	Interindustry effect		
			Static	Dynamic	Total
			Mexico		
Total industries	1.0%	77.1%	44.0%	-21.5%	22.5%
Primary products	0.8%	20.3%	-20.4%	-7.2%	-27.6%
Manufacturing	2.4%	50.2%	-29.8%	-4.9%	-34.7%
Scale intensive	3.1%	46.0%	-25.5%	-4.0%	-29.4%
Supplier dominated	0.6%	1.4%	-4.5%	-0.6%	-5.1%
Science-based and specialised suppliers	0.7%	2.8%	0.1%	-0.3%	-0.2%
Other production	-0.9%	-1.8%	6.0%	-1.1%	5.0%
Market services	0.7%	14.4%	89.7%	-7.0%	82.7%
Supplier dominated services	-0.6%	-1.7%	1.5%	-0.4%	1.1%
Scale intensive services: Physical networks	-0.3%	-5.8%	32.9%	-1.2%	31.8%
Trade	-0.3%	-4.7%	26.9%	-1.1%	25.9%
Transport and Storage	-0.3%	-1.1%	6.0%	-0.1%	5.9%
Scale intensive services: Information networks	3.1%	27.7%	45.8%	-4.9%	40.9%
Knowledge intensive business services	-1.3%	-5.8%	9.5%	-0.5%	8.9%
Non-market services	-0.7%	-6.0%	-1.5%	-1.3%	-2.8%
			United States		
Total industries	1.7%	102.8%	-2.5%	-0.3%	-2.8%
Primary products	1.1%	2.3%	-0.1%	0.1%	-0.1%
Manufacturing	4.6%	17.6%	-8.6%	-0.4%	-9.0%
Scale intensive	1.4%	8.9%	-3.8%	-0.2%	-4.0%
Supplier dominated	3.0%	3.7%	-2.5%	-0.1%	-2.6%
Science-based and specialised suppliers	14.9%	5.0%	-2.2%	-0.2%	-2.4%
Other production	-1.1%	5.3%	-1.2%	0.0%	-1.2%
Market services	2.1%	57.6%	3.0%	0.0%	3.0%
Supplier dominated services	0.0%	5.7%	1.2%	0.0%	1.2%
Scale intensive services: Physical networks	3.2%	11.8%	-0.5%	0.0%	-0.5%
Trade	3.8%	9.5%	-0.7%	0.0%	-0.8%
Transport and Storage	2.1%	2.3%	0.3%	0.0%	0.3%
Scale intensive services: Information networks	2.9%	25.5%	-0.9%	-0.1%	-1.0%
Knowledge intensive business services	1.7%	14.6%	3.3%	0.1%	3.4%
Non-market services	-0.1%	20.0%	4.3%	0.1%	4.5%

Source: Own elaboration based on KLEMS data

Productivity growth in the United States was also higher in supplier-dominated manufactures (3% versus 0.6% in Mexico), but not in scale-intensive manufactures (1.4% versus 3.1%). The latter, which accounted for 35.6% of total exports of goods in Mexico in 2013 and comprises industries such as transport equipment, food products and beverages, has experienced significant productivity growth based mainly on process innovations and acquisition of machinery and equipment (Padilla-Pérez and Hernández, 2010; Abdel-Musik, 2004).

In addition, substantial differences regarding the relative importance of the different categories are observed. In Mexico the main driver of intra-industry productivity growth

has been manufacturing, with the scale intensive products category explaining almost 60% of aggregate within industry change, followed by information networks and primary products. Information networks comprise telecommunications and banking, which have been characterized by the introduction of new technologies over the past two decades.[14] In contrast, intra-industry productivity growth in science-based and specialized suppliers and supplier-dominated manufactures was meager.

For its part, in the United States information networks is the most dynamic sector, whereas taken together manufacturing and primary products account for less than 20% of aggregate intra-industry productivity growth. It is interesting to note that despite the differences in industrial composition between the two countries, the incidence of information networks is very similar.

Since in general the contribution of inter-industry changes to productivity in the United States is relatively small and thus not comparable to Mexico, in the remainder of this section the analysis focuses on the sources of aggregate inter-industry change for Mexico.

The second column of table 2 shows the contribution of the static inter-industry effect, which as discussed above is positive (negative) for those categories whose share in total hours worked increased (decreased) during the period studied. Consistent with the traditional story of structural change, there has been a diminution of hours worked in the primary products sector. Yet instead of observing a flow into manufacturing, a massive flow into market services is experienced.

Although the aggregate effect of this recomposition of hours worked across sectors is positive, the results in the third column show that the reallocation has been less than efficient, since the generalized negative sign signifies that either industrial categories with high intra-industry productivity growth rates, such as scale intensive activities, are reducing their share in total hours worked, or labor is flowing towards sectors whose within industry productivity is falling, such as trade.

Within the scale intensive sector, the main determinant of the decrease of the dynamic effect is the food and beverages industry, which despite substantial productivity gains has dramatically reduced its share of total hours worked. For its part auto manufacturing, which posted similar productivity gains, has mostly maintained its labor share. In contrast the negative dynamic effect observed for trade is explained by the general decline of productivity within the sector, which as already mentioned is characterized by a large number of small informal enterprises.

Finally an interesting case is provided by information networks which despite having increased its overall share of hours worked, as evidenced by its positive static effect, and its important gains in productivity growth, shows a negative dynamic effect. This result is driven by the flow of hours worked into real estate activities whose productivity fell over the study period. The effect was only partially offset by the increase in labor share of financial intermediation, whose productivity grew over the period.

[14] See, for instance, OECD (2000).

4. Conclusions

Over the last two decades, Mexico has gone through an incomplete or unfinished structural change process. There has been a shift towards more knowledge-intensive industries, the production matrix has been diversified and exports have oriented successfully towards dynamic markets. Yet productivity growth has been insufficient and way below that of its main trade partner, the United States. Furthermore, structural change has resulted in shifts of labor force from sectors with high productivity growth to those with low productivity expansion.

The analysis shows that labor productivity growth in Mexico was significantly lower than that of the United States between 1990 and 2011. Consequently, productivity gap between those countries widened, in spite of their increasing trade integration. When the analysis is decomposed by economic cycles, during economic expansion periods in Mexico, its labor productivity has grown at a similar rate than US'. However, economic downturns have been both more frequent and deeper in the former, impacting negatively the annual average growth rate.

Intra-industry productivity growth in Mexico was positive between 1990 and 2011, but it had a limited impact in total productivity growth, although it is still an emerging country and, theoretically, it should have more room for structural change arising from shifts between sectors. As for inter-industry productivity growth, scale-intensive manufactures and information network services exhibited the highest annual growth rates. Yet manufacturing released workers to less productive sectors, such as market services. In effect, the inter-industry component had a positive contribution to total productivity growth, but its contribution was hindered by the shift towards less dynamic sectors.

The new economic model achieved has successfully achieved some of its main goals: export competitiveness, production diversification, closer integration with the United States economy and a shift towards more complex industries. However, these achievements have not been accompanied by robust productivity growth, having negative effects on economic growth and social development.

This paper analyzed the role of the reallocation of hours worked across industries over the period 1990-2011 in the determination of labor productivity growth, disaggregating sectoral dynamics. The shift-share exercise shows a clear dual structure: primary products, manufacturing and information network services experienced productivity growth in 1990-2011. Scale-intensive manufactures and information network services observed higher growth than in the United States. In contrast, labor productivity decreased in all other services in the same period.

The empirical analysis also shows that the participation of manufacturing in total labor force decreased over the last two decades in Mexico. Developed countries have gone through similar processes of deindustrialization. However, in Mexico this process has taken place under low aggregate productivity growth, mainly due to shifts from dynamic sectors (manufacturing) to declining sectors (market services).

As mentioned, there is a second factor behind the weak association between export dynamism and economic growth: feeble linkages between the export sector and the rest of the economy, therefore generating limited domestic value added. Exports are highly concentrated in a few large export-oriented manufacturing firms whose backward linkages are scant. This second factor has been increasingly studied by domestic and international organizations, such as the Economic Commission for Latin America and the Caribbean and the Organization for Economic Co-operation and Development, based on input-output matrices.

Three final remarks emerge from the analysis. First, active public policies are needed to foster productivity growth in all sectors. The gigantic difference in productivity growth between science-based and specialized suppliers manufactures in the United States and Mexico illustrates that the shift towards more complex industries in the former country has not been accompanied by increasing innovation capabilities. Policies to support human capital formation, research and development activities and infrastructure, among others, are needed to strengthen productivity growth. Following Abramovitz (1986), a country has strong potential for productivity growth, as a result of economic integration with a technologically-advanced nation, if it has previously developed social capabilities.

Second, low productivity growth in market services is closely associated with a large informal sector. Micro and small-sized firms that do not have access to credit and new sources of knowledge and technologies, struggle hard to increase productivity. Since market services are attracting a significant amount to labor force released by more productive sectors, public policies are urgently needed to support the informal sector.

Third, economic crises over the last two decades have hindered significantly long-term productivity growth in Mexico. During economic growth periods between 1995 and 2011, the productivity gap between the United States and Mexico has been reduced. Economic crises as a result of both domestic and external shocks have had a disruptive effect on productivity growth in Mexico. Counter-cyclical economic policies, which pay more attention to real stability rather than to nominal, are also needed.

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Appendix

Table A

Industry	ISIC rev. 3	Category
Agriculture, hunting and related service activities	1	Primary products
Forestry, logging and related service activities	2	Primary products
Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	5	Primary products
Mining of coal and lignite; extraction of peat	10	Primary products
Extraction of crude petroleum, natural gas and incidental service activities	11	Primary products
Mining of uranium and thorium ores	12	Primary products
Mining of metal ores	13	Primary products
Other mining and quarrying	14	Primary products
Food products and beverages	15	Scale intensive
Tobacco products	16	Scale intensive
Textiles	17	Supplier dominated
Wearing apparel; dressing and dyeing of fur	18	Supplier dominated
Leather and footwear	19	Supplier dominated
Wood and of products of wood and cork	20	Supplier dominated
Paper and paper products	21	Supplier dominated
Publishing, printing and reproduction of recorded media	22	Supplier dominated
Coke, refined petroleum products and nuclear fuel	23	Scale intensive
Pharmaceuticals	244	Science-based and specialized suppliers
Chemicals excluding pharmaceuticals	24x	Scale intensive
Rubber and plastics products	25	Scale intensive
Other non-metallic mineral products	26	Scale intensive
Basic metals	27	Scale intensive
Fabricated metal products, except machinery and equipment	28	Scale intensive
Machinery and equipment n.e.c.	29	Science based and specialized suppliers
Office, accounting and computing machinery	30	Science based and specialized suppliers
Insulated wire and cable	313	Supplier dominated
Other electrical machinery and apparatus n.e.c.	31x	Science based and specialized suppliers
Radio, television and communication equipment and apparatus	32	Science based and specialized suppliers
Scientific instruments	331t3	Science based and specialized suppliers
Other instruments	334t5	Scale intensive
Motor vehicles, trailers and semi-trailers	34	Scale intensive
Other transport equipment	35	Scale intensive
Furniture; manufacturing n.e.c.	36	Supplier dominated
Recycling	37	Supplier dominated

Electricity, gas, steam and hot water supply	40	Other Production
Collection, purification and distribution of water	41	Other Production
Construction	45	Other Production
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50	Physical networks (Trade)
Wholesale trade and commission trade, except of motor vehicles and motorcycles	51	Physical networks (Trade)
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	52	Physical networks (Trade)
Hotels and restaurants	55	Supplier dominated services
Land transport; transport via pipelines	60	Physical networks (Storage and Distribution)
Water transport	61	Physical networks (Storage and Distribution)
Air transport	62	Physical networks (Storage and Distribution)
Supporting and auxiliary transport activities; activities of travel agencies	63	Physical networks (Storage and Distribution)
Post and telecommunications	64	Information networks
Financial intermediation, except insurance and pension funding	65	Information networks
Insurance and pension funding, except compulsory social security	66	Information networks
Activities auxiliary to financial intermediation	67	Information networks
Real estate activities	70	Information networks
Renting of machinery and equipment without operator and of personal and household goods	71	Supplier dominated services
Computer and related activities	72	Knowledge intensive business services
Research and development	73	Knowledge intensive business services
Other business activities	74	Knowledge intensive business services
Public administration and defense; compulsory social security	75	Non market services
Education	80	Non market services
Health and social work	85	Non market services
Sewage and refuse disposal, sanitation and similar activities	90	Supplier dominated services
Activities of membership organizations n.e.c.	91	Supplier dominated services
Recreational, cultural and sporting activities	92	Supplier dominated services
Other service activities	93	Supplier dominated services
Private households with employed persons	95	Supplier dominated services