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MULTI-REGIONAL INPUT-OUTPUT MODEL TO ANALYZE THE ECONOMIC IMPACTS OF THE NORTH AMERICAN FREE TRADE AGREEMENT

ABSTRACT

The North American Free Trade Agreement (NAFTA) was renegotiated starting in 2017 under pressure from the US administration, which argued that the trade agreement had been unfair to the US economy and favorable to Mexico. The purpose of this paper is to evaluate which country—Mexico, Canada, or the United States—benefited the most from NAFTA, using economic indicators estimated through the Input-Output model. Specifically, the Multi-Regional Input-Output (MRIO) analysis technique and data from the World Input-Output Database (WIOD) were employed. Our main finding is that US benefited relatively more from NAFTA's trade and rules than Mexico or Canada did.

Keywords: Free Trade Agreement; Input-Output; Exports; Employment; Value-Added
JEL Classification: C67; F13; F53

RIASSUNTO

Modello input-output multiregionale per l'analisi dell'impatto economico dell'accordo NAFTA

Il NAFTA (North American Free Trade Agreement) è stato rinegoziato a partire dal 2017 su pressione dell'amministrazione USA secondo cui tale accordo nella sua versione originale aveva avuto effetti sfavorevoli per l'economia USA e favorevoli per quella messicana. Lo scopo di questo studio è valutare quale paese – Messico, Canada o Stati Uniti – abbia tratto il maggior beneficio dall'applicazione dell'accordo NAFTA, tramite l'utilizzo di indicatori economici stimati con il modello Input-Output. In particolare, sono stati impiegati la tecnica MRIO (Multi-Regional Input-Output) e i dati del World Input-Output Database (WIOD). L'evidenza principale è che gli USA hanno beneficiato relativamente di più dall'applicazione dell'accordo NAFTA del Messico o Canada.

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1. Introduction

The North American Free Trade Agreement (NAFTA) was renegotiated starting in July 2017 under pressure from the US administration, which argued that the trade agreement was unfair to the US economy and overly favorable to Mexico. The objectives of the US government for a new treaty were essentially threefold: (1) equalize wages and labor benefits between countries, (2) apply stricter rules of origin to bilateral exports, especially concerning the automotive industry, and (3) prevent the use of Mexican currency depreciation as a trade policy (US Trade Representative, 2017).

There were three issues that then-President Trump and his administration found problematic about NAFTA with regard to Mexico: the US trade deficit with Mexico, the loss of local jobs to workers hired by US companies in Mexico, and the influx of Mexican migrants across the southern US border. These were, in fact, the same complaints that the US government had since the inception of NAFTA (Lustig, 1997).

At the start of the treaty negotiations, President Trump complained that some US plants had relocated to Mexico due to both the extremely low wages prevailing there and NAFTA rules that favored such moves (Autor *et al.*, 2016; Blecker *et al.*, 2017; Monroy-Gómez-Franco, 2024). President Trump also pointed to the enormous and growing US trade deficit with Mexico since the treaty's implementation. He mistakenly attributed this to alleged Mexican tariffs on certain US exports. Although this tariff issue was clarified, the Trump administration imposed retaliatory tariffs for a time on all US imports of steel and aluminum products from many countries, including Mexico (Fiorentini, 2020).

Now that NAFTA has ended and has been replaced by the United States-Mexico-Canada Agreement (USMCA), it is imperative to evaluate the economic outcomes of NAFTA during its effective period. This includes analyzing, on the one hand, the original purposes for which it was signed and, on the other, the actual performance of its member countries through their trade relationships. Given the complaints from the US government, we emphasize the Mexico-US relationship to determine which country benefited more from NAFTA in terms of value-added generated and job creation.

NAFTA has been studied from various angles and for different purposes throughout its 25-year

history. Many studies have addressed some of the aforementioned issues with a variety of results. Our study tackles these issues using input-output analysis with a multi-regional focus. There have been several input-output studies of NAFTA related to economic issues prior to ours, and we have reviewed them. This work differs from all of them in several respects: the study period, multi-regional input-output analysis techniques, and the dataset used. Despite all this, we reached similar conclusions on several issues.

We used the Multi-Regional Input-Output analysis to examine the extent to which NAFTA-driven export growth generated significant increases in production and employment growth in member countries. These issues are fundamental to NAFTA, given its first three objectives:

"Contribute to harmonious development and expansion of world trade and provide a catalyst for broader international cooperation; Create new employment opportunities and improve working conditions and living standards; Promote sustainable development" (NAFTA, 1993, Preamble).

We measured NAFTA's results for Mexico and the US by estimating the amount of labor and value-added produced directly and indirectly by their exports, both bilateral and with the rest of the world, since NAFTA's inception. We also analyzed the content and factorial distribution of the Value-added of exports.

We found that NAFTA helped Mexico significantly increase its exports, but it did not produce a substantial trend of economic growth as expected, nor did it prevent the migration of Mexican labor to the US. On the other hand, US companies benefited from NAFTA through low labor costs and consequently higher profits from their investments in export plants in Mexico. The migration of Mexican workers to the US provided companies in that country direct access to a low-cost workforce that could not be protected by US labor regulations, as most workers were undocumented.

This paper is divided into seven sections, including this introduction. The second section is dedicated to a brief history of NAFTA. In the third section, we present the most relevant arguments in the discussion of NAFTA's key issues. The scope of the research and the data are presented in the fourth section. We introduce the methodology used in the fifth section. The analysis of results belongs to the sixth section, and the seventh section is reserved for conclusions.

2. The geopolitics of NAFTA

There is always a political reason behind any economic policy, especially when it comes to foreign trade policy. The United States has been considered a champion of free trade since the end of World War II (Dam, 1970), although it is well known that it developed its manufacturing industry by applying strict protectionist rules starting in 1820 (Chang, 2002). It was under the Ronald Reagan administration in the 1980s that the United States successfully promoted a global free trade campaign. In this sense, NAFTA could be interpreted as a geopolitical strategy by the US to face globalization by securing a free trade zone. In North America, things started moving in 1988 with the Canada-United States Free Trade Agreement (CUSFTA). With the addition of Mexico, the CUSFTA was replaced in 1994 by NAFTA.

In Mexico, after the economic crisis of 1982, the government initiated a trade liberalization process as part of a set of neoliberal policies aimed at reducing state intervention in the economy. The process, which began slowly, accelerated when Mexico joined the GATT (now the WTO) in 1986 and peaked when it became part of NAFTA in 1994. This package of neoliberal measures was promoted in Mexico and other developing countries by the US government, the World Bank, and the International Monetary Fund (Sachs, 1987). These strategic policies focused on exports both for recovery and growth. Protectionism was abandoned under the belief that it was biased against exports (Lustig *et al.*, 1992). It was expected that the growing aggregate demand, driven by export increases, would further stimulate domestic production and, consequently, employment.

However, Mexico's economic performance from 1983 to 1993 did not respond to neoliberal policies (Ruiz-Nápoles, 2001). Political leaders believed that an adjustment to Mexican legislation regarding foreign investment was necessary. Thus, the Mexican president in the early 1990s campaigned for NAFTA, promising new laws that would allow US companies to invest in many previously restricted sectors of the Mexican economy, as well as allowing Mexican and foreign investors to import goods from any part of the world. Access to cheap imports would, in turn, increase competitiveness and consequently boost exports. This eventually made the treaty possible (NAFTA, 1993).

The unending flow of migrants across the Mexico-US border, on the other hand, was unacceptable to the United States. Both Mexican and US authorities assumed that investment in

Mexico (attracted by low wages) would trigger a labor boom that would reduce, if not stop, migration. In summary, NAFTA meant free trade and free mobility of capital, but not labor. Unlike other free trade agreements, such as that of the European Union, NAFTA did not include rules to regulate migration.

From its inception, NAFTA raised considerable expectations.

"It is one of the largest free trade zones in the world, both in terms of population and GDP," and "it is an archetype of an agreement that resulted in the creation of cross-border production chains" (Caliendo and Parro, 2015).

3. The NAFTA debate

There is an overwhelming number of references in the economic literature regarding NAFTA. Thus, we conducted a very selective review of it. To begin with, according to neoclassical trade theory, one way to evaluate the benefits of free trade is to estimate its effects on welfare. Several studies using this approach (Chapa, 2004; Romalis, 2007; Caliendo and Parro, 2015; Caliendo *et al.,* 2019) were reviewed but fell outside the scope of this work, given that our theoretical focus is Keynesian.

3.1 US Trade Deficit with Mexico

As mentioned at the start of this paper, a US trade deficit with Mexico was mounting. This worried many US analysts (Hinojosa-Ojeda *et al.,* 2000; Villarreal, 2010, 2015; Scott, 2011; PCTW, 2014; Caliendo and Parro, 2015; Villarreal and Ferguson, 2017). It was expected that tariff reductions between the US and Mexico would only worsen the condition by increasing Mexican exports to the US. And, in fact, these expectations were met. But Hinojosa-Ojeda *et al.* (2000) showed that the tariff reductions did little to raise Mexican exports to the US. Gross trade flows show that Mexico benefited much from NAFTA. But Mexican exports involve several imported inputs. I-O methodology allows distinguishing value-added flows and confirming if Mexican exports create a substantial amount of value-added (and thus, increase GDP). It turned out that the expansion of Mexican exports was largely based on processing imported intermediate inputs (Hinojosa-Ojeda *et al.,* 2000; Dussel, 2000; Palma, 2003; Moreno-Brid *et al.,* 2005; Cardero and Aroche, 2008; De la Cruz *et al.,* 2011). Moreover, US demand for Mexican products likely

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increased due to a trade diversion effect (Romalis, 2007). Indeed, the apparent massive foreign direct investment (FDI) in Mexico concentrated in just a handful of exporting activities (Pacheco-López, 2005; Villarreal, 2010; Scott, 2011; CRS, 2019; Pineda Albarrán, 2024).

Meanwhile, US exports to Mexico grew but languished in comparison, enhancing the trade deficit. Scholars seem to agree that the strong depreciation of the Mexican Peso following the Mexican crisis of 1994-1995 was the prime cause (Hinojosa-Ojeda *et al.*, 2000; Villarreal, 2010; Scott, 2011). This enabled Mexico's enhanced connections to the US economy. That is, Mexico became more integral to US Global Value Chains (GVCs) (Lavin *et al.*, 2018; Scott, 2011). In any case, while the US trade deficit with Mexico exists, it is undoubtedly overemphasized; it is insignificant compared to the US trade deficit with China (Lavin *et al.*, 2018).

3.2 Growth and Convergence

According to most studies, NAFTA failed to produce economic growth in Mexico (Palma, 2003; Ruiz-Nápoles, 2004; Tornell *et al.*, 2004; Moreno-Brid *et al.*, 2005; Cardero and Aroche, 2008; Blecker and Esquivel, 2010; Aroche-Reyes and Márquez Mendoza, 2012a; CRS, 2019). Export growth with little job growth was attributed to the delinking of Mexican manufacturing exports from the rest of the domestic economy (Palma, 2003; Ruiz-Nápoles, 2004; Chapa, 2005) – an effect of neoliberal policies. While some manufacturing exports were far more strongly tied to foreign economies than Mexico's (Cardero and Aroche, 2008; Aroche-Reyes and Márquez Mendoza, 2012b). On wage convergence, Blecker and Esquivel (2010) concluded bluntly:

"the data show that there has been no economic convergence whatsoever between Mexico and the United States since NAFTA's enactment" (p. 20).

As an effect of the breakdown of local production chains, the expansion of Mexican exports was largely based on the processing of imported intermediate inputs (Hinojosa-Ojeda *et al.*, 2000; Dussel, 2000; Palma, 2003; Moreno-Brid *et al.*, 2005; Cardero and Aroche, 2008; De la Cruz *et al.*, 2011). Moreover, it is likely that US demand for Mexican products increased due to a trade diversion effect (Romalis, 2007). In fact, apparent foreign direct investment (FDI) in Mexico concentrated on only a handful of export activities (Pacheco-López, 2005; Villarreal, 2010; Scott, 2011; CRS, 2019).

3.3 *NAFTA and Employment*

Concerns in the United States about job losses due to NAFTA trade were widespread even before its implementation. And after its implementation, statistics seemed to confirm them. The logic seemed simple: a growing US trade deficit with Mexico suggests that imports from Mexico were growing faster than US exports to Mexico. This, in turn, implies that US jobs were being "exported". However, Lustig (1997) argued that such criticisms were mistaken and stemmed from miscalculations of net effects.

Hinojosa-Ojeda *et al.,* (2000) estimated that, on net, the United States lost an average of 37,000 potential jobs annually through US imports from Mexico between 1990 and 1997. Nonetheless, they admit that this impact was relatively small. McLaren and Hakobyan (2010) reached similar conclusions.

Scott (2011) found that US trade with Mexico from 1993 to 2010 displaced 682,900 jobs, 415,000 of them in manufacturing. This averages out to 40,200 jobs per year. Commenting on Scott's estimates, Blecker (2014) pointed out that these 415,000 manufacturing jobs were less than 10% of the nearly 5 million manufacturing jobs lost by US manufacturing in the past two decades.

In the case of Mexico, Ruiz-Nápoles (2004) showed that the total labor needs for exports increased from 4.7 % of Mexico's labor force observed between 1982 and 1986 to an average of 10.6 % between 1995 and 2000. An apparent labor boost derived from NAFTA. However, the total labor force during the two periods was not significantly affected, suggesting that while there was a major shift in the labor structure from local production sectors to export sectors, there was no change in the total. Ruiz-Nápoles (2004) also showed that liberalization and NAFTA led to a strong increase in imports at the expense of domestic production and, consequently, jobs in these sectors. This process was an integral part of the disconnect between exports and domestic activities (Palma, 2003; Chapa, 2005; Cardero and Aroche, 2008; Aroche-Reyes and Márquez Mendoza, 2012a).

Mexico suffers from a growing gap between trends in its economically active population (EAP) and its employed population, i.e., the unemployment gap. However, since informal employment is part of the employed population group in official statistics (Ruiz-Nápoles and Ordaz-Díaz, 2011), this gap cannot be observed through official unemployment figures. Even so, this gap

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allows migratory flows from southern Mexican states to northern states where maquiladoras are located; and when there are few or no jobs available there, many of these migrants attempt to cross the border into the United States (NBMS, 2013). Many of these emigrants to the United States abandoned their farmlands in the process because they could not compete with agricultural imports from the United States (Wise, 2003, 2010a, 2010b, 2011; Villarreal and Ferguson, 2017). Therefore, it seems that the labor issue was little alleviated by NAFTA and the boom in Mexican exports (Wise and Gallagher, 2002; Delgado-Wise and Márquez-Covarrubias, 2007). In fact, preexisting employment problems seemed to worsen.

3.4 *Wages*

Blecker and Esquivel (2010) analyzed the behavior of manufacturing wages in Mexico and found that average wages and labor benefits in Mexico's manufacturing sectors have not increased since the early 1980s. In contrast, the average wage in the United States increased during the 1980-2008 period. Therefore, far from wage convergence between Mexico and the United States, the wage gap has widened (Blecker and Esquivel, 2010). For example, in the automotive industry, Rodríguez and Sánchez (2017) show that in 1994, US assembly plants paid 5.4 times the wage paid by assembly plants in Mexico, and by 2016, it was 8.4 times higher. Vehicle parts plants in the United States paid 6.6 times the wage paid in Mexico in 1994 for the same work; this gap increased to 11.7 in 2016.

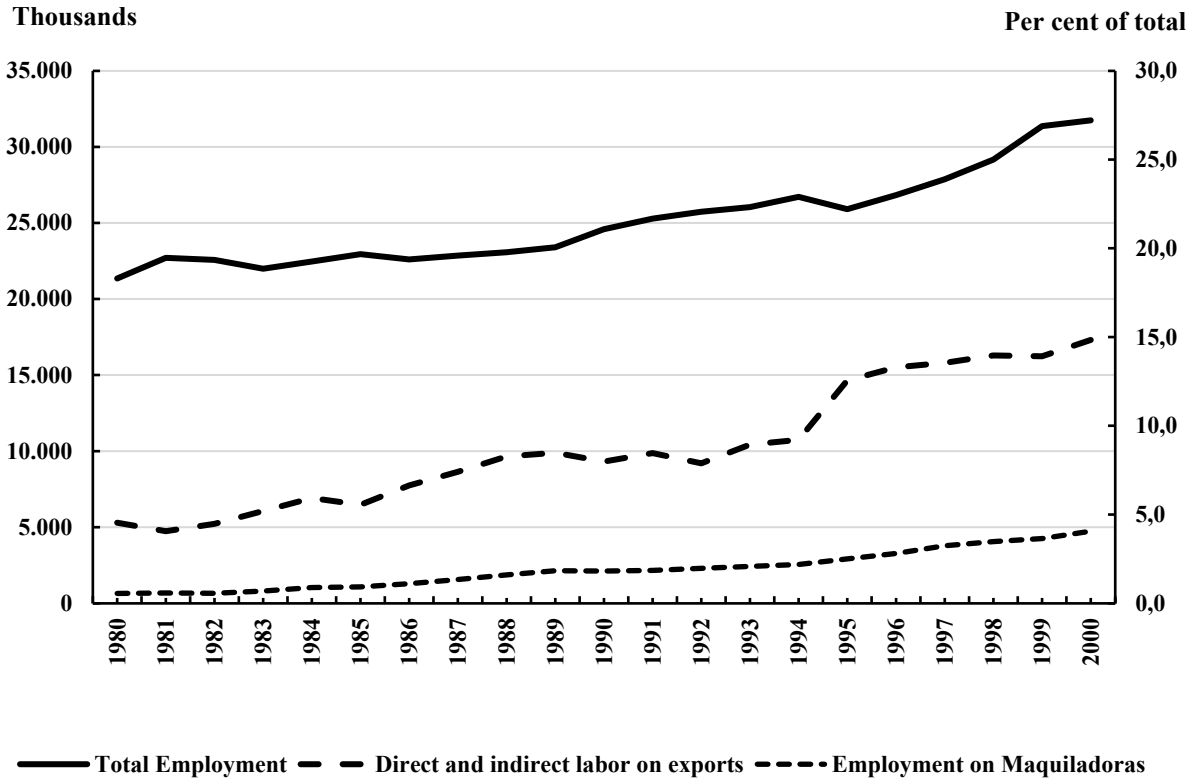
3.5 Maquiladoras

In 1965, a job creation program was established in Mexico consisting of foreign investment assembly plants, mainly US-owned, limited to an area along the northern border. It was called the offshore plants program (maquiladoras). This program evolved over time, but unlike other countries, it never had the expected impact in Mexico.

Using input-output matrices calculated from statistical sources in Mexico, we have been able to estimate the amount of direct and indirect employment generated by annual exports, including activities of the maquiladora industry. From the same sources, we obtained annual data on total compensated employment in Mexico and the number of jobs in the maquiladora industry for those same years. These data are shown in Figure 1. The top line refers to the total employment

trend, measured on the left vertical axis. The second line refers to the trend of direct and indirect employment generated by exports as a percentage of total employment, measured on the right vertical axis, and the third line refers to the trend of employment exclusively in the maquiladora industry, also as a percentage of total employment.

FIGURE 1 – *Employment in Mexico, Total and Generated by Exports 1980-2000*



It is worth noting in the behavior of these three lines that total employment was not affected in its trend during the period when NAFTA came into operation in 1994. However, the effect is evident in the increase in employment generated by exports, which rose from 9% of the total in 1993 to almost 15% in 2000. Employment generated by the maquiladoras maintains a growing but limited trend.

We can infer from these trends that there was little or no net job creation with NAFTA in Mexico; the undeniable increase in the direct and indirect labor effect of exports from 1994 to

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1995 was offset by the rise in unemployed workers due to the closure of local companies caused by the penetration of imported goods.

4. Hypotheses, scope, and data

In this work, we measure the effects of NAFTA on the member countries by estimating the amounts of employment and value added produced, directly, and indirectly, by their respective exports. We also analyze for the United States and Mexico the content of value added (local or foreign) and the factorial distribution (remunerations to labor and capital) of the value added from exports.

With the results of these estimates, we demonstrate that NAFTA helped Mexico significantly increase its exports and, to a lesser extent, employment. However, this did not lead to a sustainable growth path for Mexico as intended. We also show that US companies established in Mexico benefited from the treaty due to lower labor costs and consequently higher profits obtained through their exporters linked to global value chains.

We constructed a multiregional input-output (MRIO) model using data from the World Input-Output Database (WIOD) (Tukker and Dietzenbacher, 2013). This model was an adaptation, for NAFTA, of the model applied to the European Union (Arto *et al.*, 2015). Additionally, equations were added to the model to analyze the value-added content in trade as in Stehrer (2012, 2013) and Foster-McGregor and Stehrer (2013).

Ideally, our analysis would end in 2019, the year when negotiations that led to a new treaty (USMCA) concluded. The idea was to compare that year with one before NAFTA, say 1993. Homogeneous and consistent trade information with input-output matrices was required, so WIOD seemed the best for these purposes as it was in the cited European Union study. The problem is that WIOD Version 2016, the latest available version, includes international MRIO tables for each year only from 2000 to 2014 and for only 56 sectors, although for 43 countries, including one that is “the rest of the world”. Therefore, it lacks the first seven and last five years of the original NAFTA implementation. We are aware of this limitation and the potential problems that could arise from using more aggregated sectors in the case of WIOD. It may also seem like a limitation that we are using data measured in millions of current US dollars instead of constant prices in PPP units. The main reason is that, in addition to I-O data, we are using

foreign trade data, i.e., exports and imports, which are generally more conveniently expressed in current prices.

Even so, we maintain that the model and analysis are robust enough to provide viable answers to our research questions and to evaluate our hypotheses.

5. Methodology

5.1 *Basic Structure of a MRIO Model*

We start with the basic structure of a two-region interregional input-output model[1]. First, we have the general interindustry-interregional flows of goods matrix $\mathbf{Z}$.

$$\mathbf{Z} = \begin{bmatrix} \mathbf{Z}^{rr} & \mathbf{Z}^{rs} \\ \mathbf{Z}^{sr} & \mathbf{Z}^{ss} \end{bmatrix}$$

This matrix is made of four submatrices: two interindustry matrices $\mathbf{Z^{rr}}$ and $\mathbf{Z^{ss}}$, one for each region *r* and *s* in the main diagonal, and two interregional flows matrices $\mathbf{Z^{rs}}$ and $\mathbf{Z^{sr}}$, in the other. The first superscript indicating the selling region and the second superscript indicating the buying region.

In the same way we define the two-regional product vector $\mathbf{x} = \begin{bmatrix} \mathbf{x}^r \\ \mathbf{x}^s \end{bmatrix}$. Consequently, we can obtain the corresponding two-region input coefficient matrix:

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}^{rr} & \mathbf{A}^{rs} \\ \mathbf{A}^{sr} & \mathbf{A}^{ss} \end{bmatrix}$$

Also, the two-region final demand $\mathbf{f} = \begin{bmatrix} \mathbf{f}^r \\ \mathbf{f}^s \end{bmatrix}$

We define $\mathbf{I} = \begin{bmatrix} \mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{I} \end{bmatrix}$ within which, each $\mathbf{I}$ = unitary matrix made of ones in the diagonal, and zeros elsewhere, of order according to the number of sectors in each one of the two regions considered *r* and *s*.

$$\left\{ \begin{bmatrix} \mathbf{I} & \mathbf{0} \\ \mathbf{0} & \mathbf{I} \end{bmatrix} - \begin{bmatrix} \mathbf{A}^{rr} & \mathbf{A}^{rs} \\ \mathbf{A}^{sr} & \mathbf{A}^{ss} \end{bmatrix} \right\} \begin{bmatrix} \mathbf{x}^r \\ \mathbf{x}^s \end{bmatrix} = \begin{bmatrix} \mathbf{f}^r \\ \mathbf{f}^s \end{bmatrix}$$

[1] This detailed description of a MRIO model is taken from Miller and Blair (2009, pp. 77-83).

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Or in a compact expression: $(\mathbf{I} - \mathbf{A})\mathbf{x} = \mathbf{f}$. So, we finally get the Leontief solution equation for a two-region model $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}$.

5.2 *Multiregional Input Output Model*

For building a NAFTA MRIO model, we used the data set from WIOD Release 2016 (Timmer *et al.,* 2015) that includes 43 countries plus a 44th set for the Rest of the World. All I-O data have 56 sectors, at current prices in millions of US dollars, from 2000 to 2014. The details about WIOD construction and characteristics appear in Dietzenbacher *et al.* (2013) and Timmer *et al.* (2015).

We aggregated the 43 countries data into six submatrices (see Appendix). The submatrices are:

- Mexico
- United States
- Canada
- Europe (30): the 28 countries that belong to the EU plus Switzerland and Norway.
- Asia (6): China, India, Japan, Indonesia, Korea, and Taiwan.
- Rest of the World: Row in WIOD plus Australia, Brazil, Russia, and Turkey.

The set of equations is adapted from the model that appears in the European Union Report (Arto *et al.,* 2015).

We define first $\mathbf{Z}$ inter-industry transactions and interregional flows of goods Multi Regional Matrix (including 36 submatrices of $\mathbf{Z}$'s) as follows:

$$\mathbf{Z} = \begin{bmatrix} \mathbf{Z}^{mx,mx} & \mathbf{Z}^{mx,usa} & \mathbf{Z}^{mx,ca} & \mathbf{Z}^{mx,eu} & \mathbf{Z}^{mx,as} & \mathbf{Z}^{mx,rw} \\ \mathbf{Z}^{us,mx} & \mathbf{Z}^{us,us} & \mathbf{Z}^{us,ca} & \mathbf{Z}^{us,eu} & \mathbf{Z}^{us,as} & \mathbf{Z}^{us,rw} \\ \mathbf{Z}^{ca,mx} & \mathbf{Z}^{ca,us} & \mathbf{Z}^{ca,ca} & \mathbf{Z}^{ca,eu} & \mathbf{Z}^{ca,as} & \mathbf{Z}^{ca,rw} \\ \mathbf{Z}^{eu.mx} & \mathbf{Z}^{eu,us} & \mathbf{Z}^{eu,ca} & \mathbf{Z}^{eu,eu} & \mathbf{Z}^{eu,as} & \mathbf{Z}^{eu,rw} \\ \mathbf{Z}^{as,mx} & \mathbf{Z}^{as,us} & \mathbf{Z}^{as,ca} & \mathbf{Z}^{as,eu} & \mathbf{Z}^{as,as} & \mathbf{Z}^{as,rw} \\ \mathbf{Z}^{rw,mx} & \mathbf{Z}^{rw,us} & \mathbf{Z}^{rw,ca} & \mathbf{Z}^{rw,eu} & \mathbf{Z}^{rw,as} & \mathbf{Z}^{rw,rw} \end{bmatrix}$$

The Multi Regional $\mathbf{f}$ (final demand) matrix:

$$\mathbf{f} = \begin{bmatrix} \mathbf{f}^{mx,mx} & \mathbf{f}^{mx,us} & \mathbf{f}^{mx,cnd} & \mathbf{f}^{mx,eu} & \mathbf{f}^{mx,as} & \mathbf{f}^{mx,rw} \\ \mathbf{f}^{us,mx} & \mathbf{f}^{us,usa} & \mathbf{f}^{us,ca} & \mathbf{f}^{us,eu} & \mathbf{f}^{us,as} & \mathbf{f}^{us,rw} \\ \mathbf{f}^{ca,mx} & \mathbf{f}^{ca,us} & \mathbf{f}^{ca,ca} & \mathbf{f}^{ca,eu} & \mathbf{f}^{ca,as} & \mathbf{f}^{ca,rw} \\ \mathbf{f}^{eu.mx} & \mathbf{f}^{eu,us} & \mathbf{f}^{eu,ca} & \mathbf{f}^{eu,eu} & \mathbf{f}^{eu,as} & \mathbf{f}^{eu,rw} \\ \mathbf{f}^{as,mx} & \mathbf{f}^{as,us} & \mathbf{f}^{as,ca} & \mathbf{f}^{as,eu} & \mathbf{f}^{as,as} & \mathbf{f}^{as,rw} \\ \mathbf{f}^{rw,mx} & \mathbf{f}^{rw,us} & \mathbf{f}^{rw,ca} & \mathbf{f}^{rw,eu} & \mathbf{f}^{rw,as} & \mathbf{f}^{rw,rw} \end{bmatrix}$$

and the Multi Regional **x** gross output, **v** value added and ***l*** labor vectors:

$$\mathbf{x} = \begin{bmatrix} \mathbf{x}^{mx} \\ \mathbf{x}^{us} \\ \mathbf{x}^{ca} \\ \mathbf{x}^{eu} \\ \mathbf{x}^{as} \\ \mathbf{x}^{rw} \end{bmatrix} \qquad \mathbf{va} = \begin{bmatrix} \mathbf{va}^{mx} \\ \mathbf{va}^{us} \\ \mathbf{va}^{ca} \\ \mathbf{va}^{eu} \\ \mathbf{va}^{as} \\ \mathbf{va}^{rw} \end{bmatrix} \qquad \boldsymbol{l} = \begin{bmatrix} \boldsymbol{l}^{mx} \\ \boldsymbol{l}^{us} \\ \boldsymbol{l}^{ca} \\ \boldsymbol{l}^{eu} \\ \boldsymbol{l}^{as} \\ \boldsymbol{l}^{rw} \end{bmatrix}$$

where:

Z = multiregional matrix of inter-industrial flows; $\mathbf{Z}^{r,s}$ = submatrices showing the sales of intermediate inputs from country *r* to country *s*; superscripts, *mx* = Mexico, *ca* = Canada, *us* = United States, *eu* = Europe; *as* = Asia, and *rw* = Rest of the world.

f = multiregional matrix of final demands; $\mathbf{f}^{r,s}$ = vectors of final demand from country to country *r*.

x = column vector of multiregional gross outputs; $\mathbf{x}^{r}$ = gross output of country *r*.

va = column vector of multiregional of value added vectors; $\mathbf{va}^{r}$ = vector of value added of country *r*.

l = column vector of multiregional labor, $\boldsymbol{l}^{r}$ = labor vector of country *r*.

Then we have the well-known identity equation:

$$\mathbf{Zi} + \mathbf{f} = \mathbf{x}$$

where: **Z**, **f** and **x** are the matrix and vectors defined above and **i** is the unitary vector or summation vector made of one.

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Then we define a Regional Matrix for the North American Free Trade Agreement (NAFTA) zone, with the superscript ***NA***:

$$\mathbf{Z}^{NA} = \begin{bmatrix} \mathbf{Z}^{mx,mx} & \mathbf{Z}^{mx,us} & \mathbf{Z}^{mx,ca} \\ \mathbf{Z}^{us,mx} & \mathbf{Z}^{us,us} & \mathbf{Z}^{us,ca} \\ \mathbf{Z}^{ca,mx} & \mathbf{Z}^{ca,us} & \mathbf{Z}^{ca,ca} \end{bmatrix}$$

and NAFTA final demand matrix is:

$$\mathbf{f}^{NA} = \begin{bmatrix} \mathbf{f}^{mx,mx} & \mathbf{f}^{mx,us} & \mathbf{f}^{mx,ca} & \mathbf{e}^{mx,eu} & \mathbf{e}^{mx,as} & \mathbf{e}^{mx,rm} \\ \mathbf{f}^{us,mx} & \mathbf{f}^{us,us} & \mathbf{f}^{us,ca} & \mathbf{e}^{us,eu} & \mathbf{e}^{us,as} & \mathbf{e}^{us,rm} \\ \mathbf{f}^{ca,mx} & \mathbf{f}^{ca,us} & \mathbf{f}^{ca,ca} & \mathbf{e}^{ca,eu} & \mathbf{e}^{ca,as} & \mathbf{e}^{ca,rm} \end{bmatrix}$$

where: $\mathbf{e}^{ij} = \mathbf{f}^{ij} + \mathbf{Z}^{ij}\mathbf{i}$, represents total exports from country *i* to country *j*, it includes intermediate and final exports.

Gross Output, Value added and Labor vectors:

$$\mathbf{x}^{NA} = \begin{bmatrix} \mathbf{x}^{mx} \\ \mathbf{x}^{us} \\ \mathbf{x}^{ca} \end{bmatrix} \quad \mathbf{va}^{NA} = \begin{bmatrix} \mathbf{va}^{mx} \\ \mathbf{va}^{us} \\ \mathbf{va}^{ca} \end{bmatrix} \quad \boldsymbol{l}^{NA} = \begin{bmatrix} \boldsymbol{l}^{mx} \\ \boldsymbol{l}^{us} \\ \boldsymbol{l}^{ca} \end{bmatrix}$$

The technical coefficient matrix **A** for the NAFTA region is:

$$\mathbf{A}^{NA} = \mathbf{Z}^{NA} \, (\hat{\mathbf{x}}^{NA})^{-1} \tag{1}$$

where $\hat{\mathbf{x}}^{NA}$ is a diagonal matrix with industry outputs, placed along the main diagonal, and zeros elsewhere.

The Leontief's inverse is defined as:

$$\mathbf{L}^{NA} = (\mathbf{I} - \mathbf{A}^{NA})^{-1} \tag{2}$$

The gross output equation is:

$$\mathbf{x}^{NA} = \mathbf{L}^{NA} \, \mathbf{f}^{NA} \tag{3}$$

Value added coefficients:

$$\mathbf{v}^{NA} = (\hat{\mathbf{x}}^{NA^{-1}}\mathbf{va}^{NA}) \tag{4}$$

For the gross output generated by exports to other regions, we have the equation:

$$\mathbf{x}_{exNA}^{NA} = \mathbf{L}^{NA}\ \mathbf{e}^{NA} \tag{5}$$

Value added generated by exports from the NAFTA region to other regions:

$$\mathbf{va}_{exNA}^{NA} = (\mathbf{v}^{NA})'\ \mathbf{L}^{NA}\ \mathbf{e}^{NA} \tag{6}$$

where: $(\mathbf{v}^{i})'\ \mathbf{L}^{ij}\ \mathbf{e}^{jk}$ is the value added generated in country *i* of NAFTA due to the extra exports of member country *j* to non-NAFTA member country *k*.

The matrix of import coefficients of inputs, from non-NAFTA region countries to the NAFTA region as:

$$\mathbf{A}^{noNA,NA} = \mathbf{Z}^{noNA,NA}\ (\hat{\mathbf{x}}^{NA})^{-1} \tag{7}$$

where: $\mathbf{Z}^{noNA,NA}$ is the matrix of imported inputs from outside NAFTA to the NAFTA region countries.

$$\mathbf{Z}^{noNA,NA} = \{\mathbf{z}^{rs}\}\ \forall\ r\ \neq mx\ , us, ca,\ s\ \neq eu, as, rm.$$

The value of imports from outside NAFTA required for NAFTA countries to export outside NAFTA is given by the expression:

$$\mathbf{A}^{noNA,NA}\ \mathbf{L}^{NA}\ \mathbf{e}^{NA} \tag{8}$$

Value-added generated outside NAFTA by the exports of NAFTA to other regions:

$$\mathbf{va}_{exNAFTA}^{noNA} = (\mathbf{v}^{noNA})'\ \mathbf{L}^{noNA}\ \mathbf{A}^{noNA,NA}\ \mathbf{L}^{NA}\ \mathbf{e}^{NA} \tag{9}$$

For labor, we get first the equation for labor coefficients.

$$\boldsymbol{lc^{NA}} = (\hat{\mathbf{x}}^{\boldsymbol{NA}})^{-1}\boldsymbol{l^{NA}} \tag{10}$$

Then we have:

$$\boldsymbol{lc^{NA}_{exNA}} = (\boldsymbol{lc^{NA}})' \ \mathbf{L}^{\boldsymbol{NA}} \ \mathbf{e}^{\boldsymbol{NA}} \tag{11}$$

where: $\boldsymbol{lc}^{i\prime}\,\mathbf{L}^{rs}\,\mathbf{e}^{sk}$ is the amount of labor generated in country *i* of the NAFTA region due to the exports of intermediate inputs of that country to country *s* of that region, and the exports of that country to non-NAFTA member country *k*.

5.3 Value Added in Exports Equations

Following Stehrer (2013) we can formulate the equations for domestic and foreign Value added in country *r*'s exports.

$DVAiE^r = \mathbf{v}^r\,\mathbf{L}\,\mathbf{e}^r$ Domestic Value added content in Exports of country *r*

$FVAiE^r = \mathbf{v}^s\,\mathbf{L}\,\mathbf{e}^r$ Foreign Value added content in Exports of country *r*

The specifications of these two equations are:

$DVAiE^{mx} = \mathbf{v}^{mx}\,\mathbf{L}\,\mathbf{e}^{mx}$ Domestic Value added content in Mexican Exports (19.a)

$DVAiE^{usa} = \mathbf{v}^{usa}\,\mathbf{L}\,\mathbf{e}^{usa}$ Domestic Value added content in US Exports (19.b)

$FVAiE^{mx} = \mathbf{v}^{s}\,\mathbf{L}\,\mathbf{e}^{mx}$ Foreign Value added content in Exports of Mexico (20.a)

$FVAiE^{usa} = \mathbf{v}^{s}\,\mathbf{L}\,\mathbf{e}^{usa}$ Foreign Value added content in Exports of the US (20.b)

where the superscript *mx* stands for Mexico as a region, *us* stands for United States as a region and *s* for each of the five other regions as defined in our WIOD model above.

6. Analysis of results

6.1 *Final Demand and Value Added*

Table 1 shows estimated Value added generated via exports and domestic final demand for 2000 and 2014 for each of the three NAFTA member countries. An important result from this analysis

is that in 2014 US Value added (GDP) depends much more on domestic activities (90.8%) than on exports (8.2%). Other NAFTA countries are a tertiary market for US production (1.6%) while US exports to non-NAFTA nations were second (7.6%). Canada, in turn, generates 75%, of its Value added via its own final demand and the rest, 25%, via exports, about half (13.6%) of which are exports to NAFTA partners. About 81% of Mexico's Value added is generated via domestic activities and the rest from exports, the lion's share (13.5%) is via exports to NAFTA partners. For both Canada and Mexico, the US shadows other regions as a marketplace.

TABLE 1 - *Value Added Generated by Final Demand in the United States, Canada and Mexico*

Millions of Dollars					
	2000	2014	% Share	2014-2000	% Var.
United States					
Value Added Total	10.284.778,0	17.348.070,0	100,0	7.063.292,0	68,7
Domestic Demand	9.523.408,1	15.757.643,6	90,8	6.234.235,5	65,5
Exports to Canada	81.897,9	179.820,9	1,0	97.923,0	119,6
Exports to Mexico	59.905,3	95.666,3	0,6	35.761,0	59,7
Exp. to non-NAFTA	619.566,7	1.314.939,2	7,6	695.372,5	112,2
Canada					
Value Added Total	698.250,3	1.675.520,8	100,0	977.270,5	140,0
Domestic Demand	492.186,0	1.260.946,9	75,3	768.760,9	156,2
Exports to USA	137.839,2	219.533,9	13,1	81.694,7	59,3
Exports to Mexico	2.817,5	7.876,2	0,5	5.058,7	179,5
Exp. to non-NAFTA	65.407,6	187.163,8	11,2	121.756,1	186,1
Mexico					
Value Added Total	614.135,9	1.227.752,1	100,0	613.616,2	99,9
Domestic Demand	506.005,9	990.888,9	80,7	484.883,1	95,8
Exports to USA	80.418,1	155.276,8	12,6	74.858,8	93,1
Exports to Canada	3.762,0	11.510,3	0,9	7.748,3	206,0
Exp. to non-NAFTA	23.949,9	70.076,0	5,7	46.126,1	192,6

Source: WIOD Release 2016 and estimations from the model.

6.2 *Final Demand and Labor*

Table 2 shows the estimated results for labor generated by exports and by domestic final demand, in 2000 and 2014, for NAFTA country members. Again, the US domestic final demand

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generates nearly all the jobs in 2014 (92.8 %). Exports produced only 7.2% (1.2% exports to NAFTA). From 2000 to 2014, Canada reduced labor generated by exports to the US by a significative amount, 667,000 workers, while the US reduced its labor generated via exports to Mexico by 119,000 workers.

Canada generated more labor via its domestic demand too (79% in 2014). Labor generated by exports to non-NAFTA countries increased by 546,000 workers or 40% from 2000 to 2014.

In Mexico, labor generated by domestic final demand in 2014 was 84% of all Mexican jobs. Exports generated the remaining 16% and exports to the US were 11% of the total (69% of the 16%). From 2000 to 2014, the amount of labor generated in the Mexican economy via exports to the US increased by 806,000 workers or by 22%. Overall labor generated by exports to non-NAFTA countries over the study period was about 694,000 workers, a 90% increase.

TABLE 2 - *Labor Generated by Final Demand in the United States, Canada and Mexico*

Number of workers

	2000	2014	% Share	2014-2000	% Var.
United States					
Total Labor	150.433.351	155.770.460	100,0	5.337.109	3,5
Domestic Demand	140.960.969	144.565.800	92,8	3.604.831	2,6
Exports to Canada	1.027.421	1.258.537	0,8	231.116	22,5
Exports to Mexico	742.982	623.874	0,4	-119.108	-16,0
Exp. to non-NAFTA	7.701.979	9.322.250	6,0	1.620.271	21,0
Canada					
Total Labor	15.143.131	18.449.875	100,0	3.306.744	21,8
Domestic Demand	11.117.595	14.525.645	78,7	3.408.049	30,7
Exports to USA	2.604.467	1.936.649	10,5	-667.819	-25,6
Exports to Mexico	57.036	77.355	0,4	20.320	35,6
Exp. to non-NAFTA	1.364.032	1.910.226	10,4	546.194	40,0
Mexico					
Total Labor	31.748.215	38.996.763	100,0	7.248.548	22,8
Domestic Demand	27.230.832	32.843.898	84,2	5.613.065	20,6
Exports to USA	3.594.505	4.401.314	11,3	806.809	22,4
Exports to Canada	151.141	285.040	0,7	133.899	88,6
Exp. to non-NAFTA	771.737	1.466.511	3,8	694.774	90,0

Source: *WIOD Release 2016* and estimations from the model.

6.3 Trade, Value Added, and Labor Effects Produced by NAFTA

Table 3 refers to Trade Balances among NAFTA members. Note that the US economy registered a trade deficit with both Canada and Mexico. But the number of US exports to NAFTA countries remains larger than that of the other two. Basically, the US economy had a significant trade deficit with its closest trading partners despite dominating them in terms of the value of exports within the region.

TABLE 3 - *Trade among NAFTA members in 2014*

Millions of Dollars			
	Exports	Imports	Balance
US -NAFTA	470.516,9	617.847,6	-147.330,7
US- Canada	291.929,8	350.482,1	-58.552,3
US- Mexico	178.587,1	267.365,5	-88.778,4
Canada-NAFTA	358.719,2	311.687,0	47.032,2
Canada-US	350.482,1	291.929,8	58.552,3
Canada- Mexico	8.237,1	19.757,2	-11.520,1
Mexico- NAFTA	287.122,7	186.824,2	100.298,5
Mexico- US	267.365,5	178.587,1	88.778,4
Mexico-Canada	19.757,2	8.237,1	11.520,1

Source: WIOD Release 2016.

Table 4 shows that the amount of Value added generated by exports to NAFTA in 2014 was greater in the US (275 billion USD) than in Canada (227 billion USD) and in Mexico (167 billion USD). From the start to the end of the study period, the US Value added generated via exports to NAFTA was the greatest (41% of the total in 2014).

These results suggest that through this period the US benefited more than the two other country members from Value added generated by exports. It can be observed in Figure 2.

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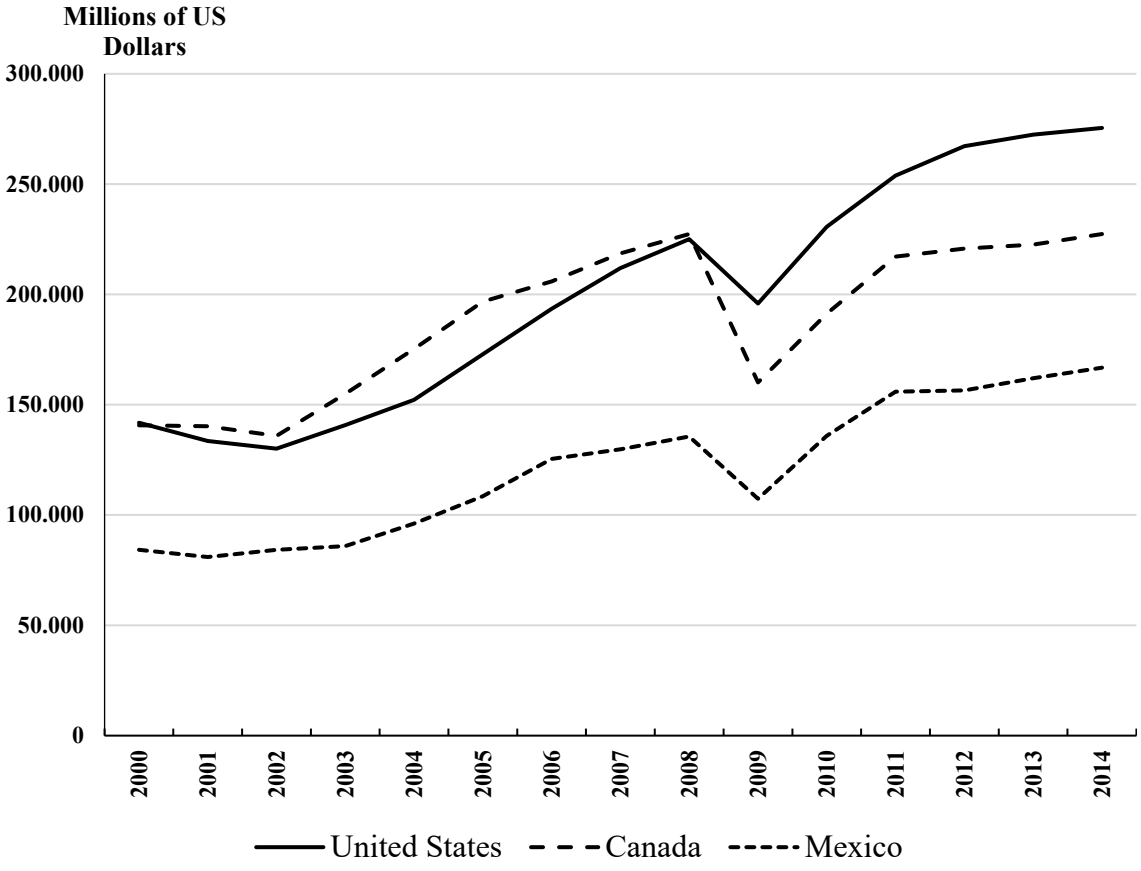
TABLE 4 - *Value Added Generated by NAFTA Trade*

Millions of Dollars

	2000	2014	% share	2000-2014
Total Value Added	366.639,9	669.684,4	100,0	303.044,5
Exports US-NAFTA	141.803,1	275.487,2	41,1	133.684,0
Exports to Canada	81.897,9	179.820,9	65,3	97.923,0
Exports to Mexico	59.905,3	95.666,3	34,7	35.761,0
Exports Can-NAFTA	140.656,7	227.410,1	34,0	86.753,4
Exports to USA	137.839,2	219.533,9	96,5	81.694,7
Exports to Mexico	2.817,5	7.876,2	3,5	5.058,7
Exports Mex-NAFTA	84.180,0	166.787,1	24,9	82.607,1
Exports to USA	80.418,1	155.276,8	93,1	74.858,8
Exports to Canada	3.762,0	11.510,3	6,9	7.748,3

Source: Elaborated with data from the model.

FIGURE 2 – *Value Added Generated by Exports to NAFTA by Country Members*



Paradoxically, if we look at these figures, country by country, in 2014 there was more Value added generated by exports from Mexico to the US (155.3 billion USD) than Value added generated by US exports to Mexico (95.6 billion USD). And the opposite happened in the case of the US with Canada. Exports to the US in 2014 generated more value added (219 billion USD) than the exports from the US to Canada (179 billion USD). These results are consistent with what we just observe in Table 3 regarding trade, the differences in value added produced by exports match the trade differences between the US and NAFTA partners. In Table 3 imports are included.

The fact that US exports to NAFTA were more Value added-intensive than are those exported by the other two countries combined, is largely due to the magnitude of the US exports. In terms of US trade balances, NAFTA is ought not to be blamed nor should Mexico be singled out as a problematic NAFTA partner. Exports cannot be more value-added intensive just because they are larger. There have to be other factors (type of goods, R&D embedded, monopoly).

In Table 5 we can see results for labor, which were much more favorable to Mexico than for the other two countries. Mexico garnered 4.6 million workers 55% of all jobs generated by exports within NAFTA in 2014. Canada was second with 2 million, and the US trailed with 1.9 million. There were significant changes from 2000 to 2014, the US generated fewer jobs via exports to Mexico, just 119,000; and Canada lost 668,000 jobs via its exports to the US. On balance, the US gained more jobs in its trade with Canada than it lost with Mexico. The true net loser in terms of job was Canada.

Table 5 also shows that more jobs were generated by exports from Mexico to the US (4.4 million workers) than by exports from the US to Mexico (0.62 million workers). Job creation through exports in Mexico during NAFTA has been studied before. We confirm it with more recent data. We found that 623,700 jobs were generated by US exports to Mexico in 2014.

In sum, there is no doubt that the Mexican economy created more jobs through its trade in NAFTA, than did the two other country members. Nonetheless, this was precisely the rationale for signing NAFTA in the first place, i.e., that US and Canadian firms would move some plants to exploit Mexico's lower wages, thereby reducing costs and easing northward migration.

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TABLE 5 - *Labor Generated by NAFTA Trade*

Number of workers				
	2000	2014	% share	2000-2014
Total Labor	8.177.552	8.582.768	100,0	405.216
Exports US-NAFTA	1.770.403	1.882.410	21,9	112.007
Exports to Canada	1.027.421	1.258.537	66,9	231.116
Exports to Mexico	742.982	623.874	33,1	-119.108
Exports Can-NAFTA	2.661.503	2.014.004	23,5	-647.499
Exports to USA	2.604.467	1.936.649	96,2	-667.819
Exports to Mexico	57.036	77.355	3,8	20.320
Exports Mex-NAFTA	3.745.646	4.686.354	54,6	940.708
Exports to USA	3.594.505	4.401.314	93,9	806.809
Exports to Canada	151.141	285.040	6,1	133.899

Source: Elaborated with data from the model.

6.4 *Further Analysis on Value Added and Labor Generated by Exports*

We have selected 8 important sectors, out of the total 56, in the three NAFTA economies to present the results of the MRIO model developed relating Value Added and Employment generated by total exports of these countries to NAFTA and to non-NAFTA countries according to WIOD Release 16 data.

We must recall that both Value Added and Labor are the variables we have chosen in this work to measure the magnitude of the impact produced by NAFTA. This measure of exports corresponds to both final and intermediate demand in each sector from each NAFTA country to the rest of the countries (43) considered in the WIOD (see Appendix). The I-O methodology makes it possible to estimate the total value added or labor, which is generated by the economy through all its sectors by the value of its exports in a period. We have selected eight among the main value added generating sectors in 2014 which are common to the US, Canada, and Mexico.

The results for value added are shown in Table 6. The eight selected sectors represent 35.7% of total value added generated by exports in the US, 48.8 in Canada and 56.4 in Mexico.

TABLE 6 - *Value Added Generated by Exports in US, Canada and Mexico*

Millions of Dollars

	United States		Canada		Mexico	
	2014	% Share	2014	% Share	2014	% Share
Total Value Added generated by Exports	1.590.426,4	100,0	414.573,9	100,0	236.863,1	100,0
Selected sectors	567.013,1	35,7	202.141,8	48,8	133.655,9	56,4
Crop and animal production, hunting and related service activities	37.744,3	2,4	12.690,8	3,1	11.006,4	4,6
Mining and quarrying	85.386,4	5,4	100.847,1	24,3	52.641,5	22,2
Manufacture of chemicals and chemical products	70.914,2	4,5	6.991,9	1,7	6.674,7	2,8
Manufacture of basic metals	18.765,7	1,2	18.791,7	4,5	9.257,7	3,9
Manufacture of computer, electronic and optical products	86.961,8	5,5	6.934,0	1,7	9.326,5	3,9
Manufacture of motor vehicles, trailers and semi-trailers	27.056,6	1,7	10.617,1	2,6	21.613,0	9,1
Wholesale trade, except for motor vehicles and motorcycles	199.303,7	12,5	26.894,5	6,5	16.564,7	7,0
Land transport and transport via pipelines	40.880,4	2,6	18.374,7	4,4	6.571,4	2,8

Sources: WIOD Release 16 and estimations from the model.

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For obvious reasons, the Wholesale trade sector is in the three countries is important in value added generation by exports, throughout their respective economies. Other important sector in the three economies for value added generation by exports is Mining and Quarrying, which includes oil extraction. They can be considered Tertiary and Primary activities, respectively. With respect to Secondary activities, four manufacturing sectors are important: Chemical products, Computer and electronics, Basic Metals and Motor vehicles, with different degree for each country.

Motor Vehicles and Computer and electronics can be considered high tech manufacturing exports, which are important in the three countries, suggesting the existence of an integrated production process between plants among them or regional value added chains.

Table 7 shows the results for Labor generated by exports of the same eight sectors selected in the three NAFTA countries. They represent 25.3% of labor generated by exports in the US, 30.6 in Canada and 59.6 in Mexico. Again, the Whole Trade sector is common to the three countries as important labor generating sector. Manufacture of computer electronics is important for both Mexico and the US. Land transport is important for the US and Canada and Crop and animal production is important but for Mexico. It is also important to notice that during this year 2014, the United States generated through its total exports 11 million jobs, while Mexico was second with 6 million and Canada was third with almost 4 million jobs. If we compare these figures with those of Table 2 above, we clearly see that for the US jobs generation are more important the exports to Non NAFTA countries than those to NAFTA countries.

TABLE 7 - *Employment Generated by Exports in US, Canada and Mexico*

Number of people

	United States		Canada		Mexico	
	2014	% Share	2014	% Share	2014	% Share
Total Employment generated by Exports	11.204.660	100,0	3.924.230	100,0	6.152.865	100,0
Selected sectors	2.837.032	25,3	1.199.395	30,6	3.642.610	59,2
Crop and animal production, hunting and related service activities	336.792	3,0	152.158	3,9	1.961.727	31,9
Mining and quarrying	151.951	1,4	197.199	5,0	188.430	3,1
Manufacture of chemicals and chemical products	157.933	1,4	30.661	0,8	69.947	1,1
Manufacture of basic metals	129.054	1,2	157.279	4,0	62.281	1,0
Manufacture of computer, electronic and optical products	343.863	3,1	84.077	2,1	324.978	5,3
Manufacture of motor vehicles, trailers and semi-trailers	164.668	1,5	90.761	2,3	321.791	5,2
Wholesale trade, except of motor vehicles and motorcycles	1.140.780	10,2	274.458	7,0	526.885	8,6
Land transport and transport via pipelines	411.990	3,7	212.802	5,4	186.571	3,0

Sources: WIOD Release 16 and estimations from the model.

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6.6 *Value Added Content in Exports*

Drilling down into the question of value added generated by exports, we now present the results of the equations developed by Stehrer (2012, 2013) derived mainly from Koopman *et al.* (2008). We use these equations to measure both domestic and foreign value added in exports for both Mexico and the US from 2000 to 2014, using the same model and data as throughout this paper. Table 8 indicates that the content of value added of Mexican exports has been two thirds domestic and one third foreign throughout the period.

TABLE 8 - *Domestic and Foreign Value Added in Mexican Exports*

Value Added in Mexican Exports	2000		2014	
	Mill.Dls	% Share	Mill.Dls	% Share
Total Value Added	163.351,7	100,0	358.906,0	100,0
Domestic Value Added	109.060,4	66,8	239.552,3	66,7
Foreign Value Added	54.291,3	33,2	119.353,7	33,3
Foreign VA by origin	54.291,3	100,0	119.353,7	100,0
VA from USA	32.871,2	60,5	52.957,2	44,4
VA from Canada	1.153,5	2,1	3.340,4	2,8
VA from Europe	6.654,7	12,3	14.607,8	12,2
VA from Asia	8.196,1	15,1	29.629,3	24,8
VA from RoW	5.415,9	10,0	18.819,1	15,8

Source: *WIOD Release 2016* and estimations from the model.

While the foreign value added of Mexican exports was originally mainly US, over the period the US share has diminished in its importance from 60% in 2000 to 44% in 2014. Meanwhile the share of value added from Asia (mainly China) rose from 15% to 25%.

Table 9 shows that the percentage of domestic value added in US Exports was higher than that of foreign value added, nearly maintaining slightly from 90 in 2000 to 88 % in 2014. There seems to be slight variation in the share of foreign value added to US exports over the period either.

TABLE 9 - *Domestic and Foreign Value Added in US Exports*

Value Added in US Exports	2000		2014	
	Mill.Dls	% Share	Mill.Dls	% Share
Total Value Added	917.750,4	100,0	1.905.321,4	100,0
Domestic Value Added	830.166,4	90,5	1.678.022,5	88,1
Foreign Value Added	87.584,1	9,5	227.298,8	11,9
Foreign VA by origin	87.584,1	100,0	227.298,8	100,0
VA from Mexico	5.528,0	6,3	18.480,0	8,1
VA from Canada	12.795,0	14,6	36.944,0	16,3
VA from Europe	22.042,4	25,2	47.540,2	20,9
VA from Asia	20.649,0	23,6	52.243,5	23,0
VA from RoW	26.569,7	30,3	72.091,2	31,7

Source: *WIOD Release 2016* and estimations from the model.

Stehrer's (2013) equations helped us to analyze Global Value Chains. The domestic Value added content has been higher for the US exports than for their Mexican equivalents. Foreign Value added content was established in Mexico right from the beginning of NAFTA. This has been widely recognized previously (Dussel, 2000; Palma, 2003; Moreno-Brid *et al.*, 2005; Cardero and Aroche, 2008; De la Cruz *et al.* 2011). The Mexican authorities changed FDI rules prior to NAFTA for exactly this reason. So, our expanded model confirms these findings using WIOD data. Note that the US maintained a large share of the foreign Value added content in Mexican exports during NAFTA, but its share has diminished and has been largely substituted by content from Asia. With respect to US exports, rather than Mexico as a destination, as might have been hoped, Asia rose to exploit the opportunity from 2000 to 2014.

Thus, Mexico has been generating more value added in its exports to the US than has the US in its exports to Mexico. Still, if we consider all Mexican exports, we observe that only two thirds of their Value added content have a domestic origin and most of the foreign Value added content comes from the US.

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7. Conclusions

We measured the economic benefits of NAFTA to determine which member country benefited the most. Therefore, if a country's exports produced more added value in its exports to a given market than the others, it benefits more in terms of added value. We found that the United States generated more added value in its exports to NAFTA than the other two countries combined from 2000 to 2014.

When it comes to job creation, the situation is quite different. It is not the case with classical theory where trade is free, and factors are relatively immobile. In the case of NAFTA, while trade is free with respect to most goods and services, production factors present restrictions. In the case of capital, its mobility was almost completely expanded from NAFTA in the case of Mexico. But also, in the case of Mexico, labor mobility to the north has been heavily restricted by US laws. Thanks to NAFTA, capital could move freely between Mexico and the United States so that exporting companies in Mexico, now being foreign owned, could benefit from NAFTA.

Since all companies act rationally in terms of location and trade, they seek to reduce total logistics costs by selling to nearby markets. This logic is quite feasible in the context of globalization (Storper, 2000), given unrestricted trade and free capital mobility, as in North America. The current scenario is US companies, which always have better technology than their Mexican counterparts, leave their country to produce in Mexico, where wages and transportation costs are lower. This allows them to offer the demanded goods more cheaply to their existing markets, whether final or intermediate. Since the US market is larger than Mexico's, a substantial amount of foreign investment into Mexico has flowed into the Mexican export sectors. Additionally, US investors in Mexico not only supply their national market but also sell the same goods to other regions of the world, a phenomenon Mexico shares with India, China, and other Asian countries. Viewed this way, by moving operations to Mexico, US companies reduce their costs, thus improving their productive efficiency often through greater economies of scale. This undoubtedly generates greater profitability. Clear examples of this are the automotive industry, the electronics components industry, and mining.

On the other hand, we see that the United States did not generate more jobs than Mexico from exports to NAFTA during the study period. From the perspective of the so-called "national interest" of the United States, the Trump administration's complaints about NAFTA and its

pressure to renegotiate seem correct. But from a purely capitalist point of view, it is clear that US companies, whether located within the United States or abroad, were the net beneficiaries of free trade and NAFTA. Within the NAFTA area, these companies are the leaders of global value chains, exploiting low wages and transportation costs to reduce total costs. The US parent companies of these plants are the ones that obtain the benefits and royalties as part of the added value. We observe that these amounts are greater in total added value than those corresponding to labor remuneration.

In the case of Mexico, the change in FDI rules and pre-NAFTA liberalization made it possible for foreign companies to displace local companies and basically transform Mexico's economy into a giant maquiladora. But the technological change that occurred in the Mexican economy through modernization made it possible to export capital-intensive goods, instead of labor-intensive goods that were needed to cover the employment deficit through exports. In turn, the lack of legal labor mobility between countries facilitated that wages in Mexico's export sectors remained lower than US and Canadian wages in the same sectors.

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APPENDIX

WIOD COUNTRIES (44) REGIONS (6)

	Acronym	Country	Region		Acronym	Country	Region
1	USA	United States	United States	23	NDL	Netherlands	Europe
2	CAN	Canada	Canada	24	NOR	Norway	Europe
3	MEX	Mexico	Mexico	25	POL	Poland	Europe
4	AUT	Austria	Europe	26	PRT	Portugal	Europe
5	BEL	Belgium	Europe	27	ROU	Romania	Europe
6	BGR	Bulgaria	Europe	28	SVK	Slovakia	Europe
7	HRV	Croatia	Europe	29	SVN	Slovenia	Europe
8	CYP	Cyprus	Europe	30	ESP	Spain	Europe
9	CZE	Czech Republic	Europe	31	SWE	Sweden	Europe
10	DNK	Denmark	Europe	32	CHE	Switzerland	Europe
11	EST	Estonia	Europe	33	GBR	United Kingdom	Europe
12	FIN	Finland	Europe	34	CHN	China	Asia
13	FRA	France	Europe	35	IND	India	Asia
14	DEU	Germany	Europe	36	IDN	Indonesia	Asia
15	GRG	Greece	Europe	37	JPN	Japan	Asia
16	HUN	Hungary	Europe	38	KOR	Korea	Asia
17	IRL	Ireland	Europe	39	TWN	Taiwan	Asia
18	ITA	Italy	Europe	40	AUS	Australia	Rest of the world
19	LVA	Latvia	Europe	41	BRA	Brazil	Rest of the world
20	LTU	Lithuania	Europe	42	RUS	Russia	Rest of the world
21	LUX	Luxembourg	Europe	43	TUR	Turkey	Rest of the world
22	MLT	Malta	Europe	44	ROW	Rest of the world	Rest of the world

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