2014 International Input Output Conference 14th-18th July 2014 in Lisbon, Portugal

CHANGES IN INDIRECT DOMESTIC VALUE ADDED IN MEXICO'S MANUFACTURING EXPORTS BY SECTORS AND COUNTRIES OF ORIGIN AND DESTINATION, 1995-2011[1]

Rosario Cervantes[2]

Gerardo Fujii[3]

Abstract:

In previous works (G. Fujii and R. Cervantes, 2013a and 2013b) we found that, in 2003, domestic value added contained in Mexico's manufacturing exports was relatively low, about 42%. Most of this value added was direct, about 53% of domestic value added, and most of the domestic indirect value added generated by manufacturing exports was non-manufacturing, 78.3% of indirect domestic value added. The aim of this presentation, based on the WIOD database, is to trace the changes of total indirect value added content in Mexico's manufacturing exports by sectors and countries of origin and destination, in order to show more evidence of how the internal disarticulation of the Mexican economy, especially in the production of intermediate manufacturing inputs, helps to explain the low correlation between the growth of Mexico's exports and economic growth. The method of analysis is based on classical techniques of input-output research.

I. Introduction

Usually, export-led growth is conceived as the opposite of domestic demand-led growth. Industrialization through import substitution, implemented by Latin American countries between the forties and the eighties of the 20th century is presented as an example of this antithesis. Indeed, during those years, domestic demand was the most dynamic part of global demand. [This point of view, which posits these two opposing components of global demand, appears now to be of the opinion that China must begin favoring domestic markets if its economic growth is to be sustained.]

During the eighties, several countries switched to manufacturing export-led growth. These exports grew quickly; however, their effects on growth have varied. In some countries, such as China, exports have been accompanied by dynamic growth; in other cases (Mexico) this has not happened.

[1] Study sponsored by National Council of Sciences and Technology of Mexico (CONACyT), grant 10017, project 152740

[2] University Center for Economic and Administrative Sciences, University of Guadalajara, Mexico, mariac@cucea.udg.mx

[3] College of Economics, National Autonomous University of Mexico (UNAM), fujii@unam.mx

One way to achieve export-led economic growth is through persistent and growing trade surpluses. In this case, net exports can account for some economic growth. This is the path followed by the German and Chinese economies. But this same path cannot be traveled by all countries simultaneously, because if some countries have trade surpluses, other countries must have trade deficits. In this case, net exports have a negative effect on economic growth. For this reason, this variant of export-led growth causes tensions between both groups of countries.

The objective of this paper is to explore the changes in indirect domestic value added associated with Mexican manufacturing exports, their supply and demand by sector, by country of origin and country of destination. This may help to explain the gap between the dynamics of the export sector and the country's economic performance. In this sense, it is possible to posit that the correlation between export growth rates and product depends as much on the structure of exports as on the coefficients of domestic value added, both direct and indirect.

We believe, therefore, that Mexico's slow growth is due not only to the low domestic value-added content in its manufacturing exports, but also to the fact that the process of disarticulating Mexico's economy has led the low share of indirect domestic value added to be concentrated in non-manufacturing sectors. Thus, while we find that just under one-half of the value of Mexican manufacturing exports is being used to finance imported components of those same exports, at the same time most domestic value added is being used to pay the factors of production directly involved, and most indirect value added is derived mainly from complementary activities such as service provision (mostly related to distribution and trade), or, in the best scenario, from intermediate products from the primary sector.

In the logic of export-led growth models, we need to consider the following aspects: 1) total exports should be a source of domestic income, since, in a simple Keynesian model, these exports contribute to economic growth, both by the multiplier effect of household consumption, and by the increase of net savings that can encourage investment; 2) further, if exports are from the manufacturing sector, they will have greater impact on economic performance due to indirect effects, given the size of industrial production chains; and 3) we can further deduce that the manufacturing exports that will have the greatest impact in economic growth will be precisely those that include intermediate inputs from the manufacturing sector.

In the case of the Mexican economy, we posit that only the second condition holds: Mexican exports are from the manufacturing sector. Yet, as previously mentioned, with regards to the first condition, almost half of the value of manufacturing exports comes from imported inputs. The third condition associated with a successful export model, as we have previously shown, holds that most imported inputs incorporated in the production of exported goods are from the manufacturing sector; this is particularly true of the maquiladora textile industry, the electric-electronics industry, and the manufacture of transportation equipment. Further, with regards to

aggregate savings that presumably would increase, not as a function of export value, but rather of domestic value added generated by exports, we should consider that when exports are undertaken by foreign companies, the gross operating surplus can be remitted, to a greater or lesser extent, to the country of origin from which the foreign investment originated (OECD-WTO, 2012:3).

Thus, according to Hicks (1950), Thirlwall (1979), and Kaldor (1989), generally, in export-led growth models, product-expansion phases associated with the foreign sector will have lower economic growth rates. This is because, while exports are increasing, so are imports of intermediate goods that are incorporated into exported goods.

Defending the importance of articulating domestic manufacturing, Amsden (2004) presents a study that accounts for the industrialization of the Southeast Asian economies as a result of a development strategy based on the substitution of high value-added, imported intermediate inputs, i.e., work in progress. Thus, we can summarize the conditions for working models of export-led growth as follows: exports have high domestic value-added within strong production chains, and the internal market is driven by income from exports.

The remainder of this paper is organized as follows: the second section explains the methodology used to calculate value added by Mexican manufacturing exports in 1995, 2000, and 2011, based on information from WIOD [World Input-Output Database], as well as the method used to identify the indirect effects brought about by Mexico's manufacturing exports. Building on the proposed model, in this paper we have assumed that Mexico, like any other country, can better take advantage of global value chains if it begins to incorporate more work in progress, both in its own exports and in the rest of the world's production of finished goods. In the third section, we briefly discuss the characteristics of the Mexican export sector, which, in keeping with the traditional way of measuring international trade, could be characterized as a "high technology" sector. Yet, according to an analysis of locally-generated value added (and due to the fact that demand of intermediate goods and services is concentrated in non-manufacturing sectors), it can be argued that Mexico's export sector has specialized in relatively uncomplicated phases of assembly, distribution, and sales, i.e., "low technology" activities. In the fourth section, we examine our main findings and show that the manufacturing exports that generate the greatest (direct and indirect) domestic value added are also those that are incorporated in other countries' production processes: Transport Equipment industry vs. Electrical and Optical Equipment. The fifth section concludes the paper.

II. Methodology

As input-output analysis has been applied to foreign trade statistics in the past few years, results suggest that, since the beginning of the 21st century, one of the reasons that the growth rate of international trade has greatly surpassed that of world output has to do with double counting. A paper from UNCTAD (2013:123) makes this clear: the problem stems from the fact that a growing share of world trade is accounted for by the flow of raw materials and by work in progress. Likewise, this method has also uncovered a way to estimate real gains from trade in countries participating in what is known as international shared production networks or global value chains. In particular, the Chinese economy has been studied at length by Chen *et al*. (2005), Chen *et al*. (2008), He and Zhang (2010), Koopman, Wang, and Wei (2008), Lau *et al.* (2006), Los, Timmer, and de Vries (2012). The Mexican economy has been analyzed by De la Cruz, Koopman, and Wang (2011), Larudee (2012), and Fujii and Cervantes (2013a and 2013b). Both the Chinese and the Mexican economies have been studied by Shafaeddin and Pizarro (2010).

This section is based on research by Ferrarini (2011), Timmer (2012), Los, Timmer, and de Vries (2013), and Erumban *et al*. (2011), which studies the way in which the input-output analysis model proposed by Leontief in 1936 and 1941 can be widened to understand better the logic of international trade in the late 20th and early 21st centuries. Following these authors, the world becomes a "closed" economy with two destinations for output: intermediate consumption or final consumption. Information is organized in a *world input-output table*, for *S* number of industries and *N* countries, so that, from right to left, we see the distribution of output from sector *i*, of country *p*, as intermediate consumption of each of the industrial sectors within the country in question and those of the rest of the world; similarly we see the destination of final output as household consumption, government expenditure or investment in N possible countries of destination. Further, from top to bottom, we can observe the "origin" of output of sector *j* and of country *q*, in accordance to the content of raw materials that originates in sector *i* and in country *p*, plus domestic value added.

With information from the World Input-Output Database (Timer, 2012), we estimate domestic value added contained in Mexico's manufacturing exports for 1995, 2000, and 2011, and we shall use the expanded Leontief model as an *ex-post* distribution model, as explained in Los *et al.* (2012). We hope to determine the sector and the country in which income (output), associated to the value of final consumer goods, was generated. Thus, by transforming the total (direct and indirect) requirements matrix into a value-added matrix, we can avoid the double counting problem. Further, with regards to international trade, we can make a clear distinction between the exports of intermediate goods and final consumer goods.

The limitations of the proposed study involve ignoring the reasons that lead to changes in the distribution of value added around the world. This is because, on the one hand, value-added coefficients can change in accordance with: specific conditions of supply within each domestic economy: the ways wages for employed labor are determined; processes of accumulation of

human capital; market power; and other factors. On the other hand, in the aggregate, it may be the characteristics of demand that lead to changes in the generation of value[4].

Therefore, in matrix notation, the procedure we used to observe changes in (both direct and indirect) domestic value added associated with the structure of Mexican manufacturing exports involves estimating a matrix of worldwide value-added multipliers:

$$WVA = V(I - B)^{-1} \qquad (1)$$

Where B represents a square matrix of order SN, of technical coefficients, or gross value coefficients, since we are using the input-output model as an ex-post distribution model, whose elements represent the proportional value of inputs of sector i, of country p incorporated in the making of good j of country q. $(I - B)^{-1}$ is the total-requirements matrix that accounts for the necessary amount of intermediate goods to be incorporated during the production process, equal to the traditional inverse of Leontief. V is a square matrix of order NS, whose elements in the main diagonal are equal to the coefficients of domestic value added in each sector j, country q , and zero for the remaining values. With respect to WIOD matrixes, $N = 41$, for 40 domestic economies and the rest of the world, and 35 industries.

By using the input-output model as a technique to observe industrial sectors and countries in which wages were paid to personnel and in which gross operation surpluses were generated, in equation (2), when we subtract the I identity matrix from the matrix of total technical requirements or gross output multipliers, we obtain a matrix of indirect value-added multipliers:

$$WIVA = V[(I - B)^{-1} - I] \qquad (2)$$

Elements of this matrix indicate the income generated in sector i, country p, for supplying a certain quantity of intermediate inputs to industry j in country q. In particular, these allow us to identify both the income generated in other countries by sector of origin of the inputs incorporated in Mexico's manufacturing exports (as finished goods), and the income generated in Mexico through the export of intermediate consumer goods, as per the industry and country of destination.

III. Mexico's "High-Tech" Manufacturing Exports

According to CEPAL (2008), in 2005, 31% and 45% of Mexican manufacturing exports were high and medium-technology products, respectively. If we consider manufacturing exports, not by technological content but rather by the complexity of the production processes involved (i.e., by the number of phases needed to transform raw materials, from their most natural form to a finished product for final consumption), industries such as the making of Electrical and Optical

[4] For a discussion in this regard, please consult Guerra and Sancho (2010), Maresa and Sancho (2012), and Ha and Swales (2010).

Equipment and Transportation Equipment have accounted for more than 70% of the country's manufacturing exports since the mid-1990s. See Table 1.

In particular, during the 90s and the early 21st century, almost half of Mexican manufacturing exports had to do with the Electrical and Optical Equipment industry. However, around 2011, in the Transportation Equipment industry, there was a pronounced increase in export volume, from 9.7 billion dollars in 1995, to 52.8 billion dollars in 2011, accounting for 43.6% of manufacturing exports.

Table 1. Mexico´s Manufacturing Exports, millions of dollars.

	1995		2000		2011	
	Exports as final goods	%	Exports as final goods	%	Exports as final goods	%
Electrical and Optical Equipment	11,292	40.0	30,831	42.3	34,244	28.3
Transport Equipment	9,739	34.5	23,856	32.7	52,858	43.6
Rest of manufacturing exports	7,187	25.5	18,191	25.0	34,054	28.1
Total	28,218	100	72,878	100	121,155	100

Source: Authors' estimate based on the WIOD (2013)

Yet these medium and high-technology exports (or those involving relatively more complex processes), only had on average 50% domestic value added. In Table 2 we see that, between 1995 and 2011, in Mexican exports from the Electrical and Optical industry, the percentage of domestic value added dropped from 39.4% to 33%; this was the most important decrease. In second place, all other manufacturing exports stopped incorporating almost 5 percent points of domestic value added as a function of export value.

In Table 2, we also see that in 2000 exports from the Transportation Equipment industry and the rest of manufacturing exports generated relatively less domestic value added. Our working hypothesis is that irrespectively of whether the changes in the content of domestic value added are induced by supply (for example, changes in labor productivity), or by demand, it is likely that productive disarticulation and the substitution of intermediate manufactured goods can account not only for the low content of domestic value added in exports, but also for the slow growth of the Mexican economy over the past few years.

Table 2. Domestic Value Added on Mexico´s Manufacturing Exports, millions of dollars.

	1995		2000		2011		DVA % Exports		
	Value Added	%	Value Added	%	Value Added	%	1995	2000	2011
Electrical and Optical Equipment	4,450	28.5	12,058	31.4	11,292	17.0	39.4	39.1	33.0
Transport Equipment	5,686	36.4	13,299	34.6	30,770	46.3	58.4	55.7	58.2
Rest of manufacturing exports	5,494	35.2	13,105	34.1	24,425	36.7	76.4	72.0	71.7
Total	15,630	100	38,462	100	66,486	100	55.4	52.8	54.9

Source: Authors' estimate based on the WIOD (2013)

In Table 3, with information from the OCED's Trade in Value Added data base, we can observe the data from domestic and foreign value added as a proportion of the exports of four developed countries and five large-scale, mid-level, developing economies, Mexico among them. We see that the dispersion of the domestic value-added coefficient, as a percent of exports, is rather high, from lows hovering around 69% for Mexico and China, to 91.4% for Brazil. Among developed economies, the figure is about 74% in Germany and France, and up to 80 and 90% in Japan and the United States. Unsurprisingly, the coefficients of direct and indirect domestic value added are significantly different: Mexico's indirect value added is proportionally the lowest (27.8% of exports), reflecting the fact that, among the countries considered, it is the country with the least integration in direct exporting activities, in activities that produce parts and components for goods that are exported and/or produce low-value parts. In France, Germany, and Japan, indirect domestic value added contained in exports is greater than direct value added; in China, whose export profile is, in a certain way, similar to Mexico's, the weight of indirect domestic value added contained in exports is double that of direct value added, which demonstrates that its exports have greater domestic integration than Mexico's, or that it is producing parts whose unit price is above those produced in Mexico.

Table 3. Share of Domestic and Foreign Value Added content in exports (2009).

	Domestic			Foreign
	Total	Direct	Indirect	
Mexico	68.5	40.7	27.8	31.3
France	73.9	34.3	39.6	25.7
Germany	73.8	34.9	38.8	25.4
Japan	84.8	36.9	47.9	14.9
United States	88.1	49.1	39	11.4
Turkey	78.9	41.5	37.4	21.1
Brazil	91.4	41.5	49.9	8.6
China	69.5	21.4	48.1	28.5
Indonesia	85.3	49.3	36	14.6

Source: Authors' estimate based on OECD-WTO, Trade in Value Added (2014)

Once again, with information from WIOD in Table 4, we can see which countries generated the remaining value added associated with the value of Mexico's manufacturing exports. First, it is apparent that in 1995, the largest part of indirect value added associated with Mexico's manufacturing exports was generated in United States (24% of export value). Of the 28.218 billion dollars of value of Mexican manufacturing exports (hereinafter Mexican exports), 15.630 billion dollars were generated in value added (hereinafter VA) in Mexico, and 6.858 billion dollars were generated in United States. As demonstrated by the method used herein, the VA generated in United States associated with Mexican exports assures us that we are accounting for all direct and

indirect effects that occur simultaneously in United States. For Mexico this means that importing intermediate inputs widens the gap between the gross value of exports and the domestic VA that exports generate in two ways: one by way of direct intermediate inputs incorporated in the production of exported goods, and the other by way of indirect inputs. The opposite effect occurs in countries that provide those intermediate inputs, to the extent that the intermediate inputs exported by United States to Mexico to produce export goods simultaneously use inputs produced in the United States; the VA generated in the U.S. includes the direct VA of inputs that it exports, plus the VA of local intermediate inputs utilized therein. If the VA of U.S. content in Mexican manufacturing exports is equal to 24% of their value, this does not mean that the proportion of imported inputs, in terms of quantity or gross value of U.S. intermediate production that are incorporated in production, are equivalent to one-fourth of export value. What we see in Table 4 is the geographic distribution of production in terms of payment to factors of production: these are the true gains of trade. This analysis assures us that, by means of the worldwide value-added multipliers matrix, we can rank, by country and industrial sector, the locations in which the income generated does indeed contribute to gross domestic product.

Thus, systems of international shared production mean that Mexico's exports of finished goods to the United States contain U.S. value added. Something similar occurs in the opposite direction, but, as we shall see below, the VA generated in Mexico by final demand of U.S. production, in both absolute and relative terms, is significantly less.

In 1995, other countries that also generated income associated with Mexican manufacturing exports were Japan (885 million dollars); Germany (494 million dollars); Canada (241 million dollars); South Korea (211 million dollars), and China (131 million dollars). Some 1.843 billion dollars were generated in the rest of the world.

By 2000, the percent of VA paid in the United States, Canada, South Korea, China, and the rest of the world had gone up slightly, in terms of the gross value of Mexican manufacturing exports; Germany's share remained stable, while Japan's fell. This means that the relative increase of profits generated in other regions occurred mainly at the expense of the income generated in Mexico.

It is surprising that, in spite of NAFTA, Canada's share of income generated by Mexican manufactured exports is even lower than Japan and Germany's share, not only because Mexico's first free-trade agreement was signed precisely with Canada and United States, but also because the three countries are relatively closer (geographically) to each other.

In 2011, China's share in income derived from Mexican exports increases significantly. In 1995, China generated only 0.5% of the value of finished products in Mexico; the percent increased to 1% in 2000; by 2011, its share had reached 7.1%. As we can infer from Table 4, almost all of the loss of VA that was generated in United States, equal to almost 10 percent points, can be explained virtually in its entirety by China's increase of 6.6 percent points, in addition to increases posted by South Korea and the rest of the world.

Finally, and still with Table 4, we observe that the share of Mexican VA remained relatively stable. The most important changes have to do with indirect value added contained in Mexican manufactured exports. Nonetheless, in the sections below we shall detail the changes observed in indirect VA as generated by Mexican exports.

Table 4. Value Added on Mexico's Manufacturing Exports by Country of Origin, millions of dollars.

Country		1995		2000		2011	
		Value Added	%	Value Added	%	Value Added	%
Mexico	Total VA	15,630	55.4	38,462	52.8	66,486	54.9
	Direct VA	6,988	24.8	20,160	27.7	32,827	27.1
	Indirect VA	8,642	30.6	18,302	25.1	33,659	27.8
United States		6,858	24.3	18,244	25.0	17,499	14.4
Japan		885	3.1	1,965	2.7	2,922	2.4
Germany		494	1.8	1,313	1.8	2,119	1.7
Canada		241	0.9	934	1.3	1,660	1.4
South Korea		211	0.7	788	1.1	1,954	1.6
China		131	0.5	722	1.0	8,618	7.1
Subtotal		40,079	142	100,891	138	167,745	138
Rest of the World		1,843	6.5	5,510	7.6	12,211	10.1
Total*		26,292	93.2	67,939	93.2	113,469	93.7
Mexico's Manufacturing Exports		28,218	100	72,878	100	121,155	100

*The total Value Added content in Mexican manufacturing exports does not equal the Gross Value of Exports due to net taxes and international margin transports

Source: Authors' estimate based on the WIOD (2013)

IV. Indirect Value Added Content in Mexico's Manufacturing Exports

In this section we present the results of estimating indirect value added associated with Mexican manufacturing exports: both the exports destined for household consumption, the expenditure in investment goods or foreign governments' public spending, as well as the exports of intermediate consumer goods. Thus, the analysis will be undertaken in accordance with the logic of the world input-output matrix, identifying the principal sectors (and countries) that supply intermediate inputs for the export of finished goods. In section IV.1, we describe the changes in indirect domestic value added in Mexican manufacturing exports (as finished goods). In section IV.2, we note the changes in foreign value added contained in those same Mexican exports. In section IV.3, we present the changes in value added generated in Mexico through its exports of intermediate consumer goods.

IV.1 Indirect Domestic Value Added by Sectors of Origin and Destination

Table 5 summarizes the changes in indirect domestic value added contained in Mexican manufacturing exports. As previously mentioned, since 1995 almost three-quarters of the gross value of Mexican manufacturing exports has been concentrated in two industries: Electrical and

Optical Equipment and Transport Equipment. Yet these two sectors have a very low content of intra-industrial domestic value added: less than 10% in 1995 and 2011. More than 60% of indirect value added generated by these industries has a non-manufacturing origin. This corroborates what Shafaeddin and Pizarro (2010) demonstrated in the sense that the low domestic value added in Mexican manufacturing exports is due to the fact that Mexico exports high-technology products, but does not produce high-technology products; it simply assembles them.

Thus, in 1995, the Electrical and Optical Equipment industry generated 1.551 billion dollars of value added in non-manufacturing sectors, significantly more than the 186 million dollars generated within the industry itself, and more than the 32 million generated in the Transport Equipment industry, or the 685 million generated by all the remaining manufacturing activities.

The Transport Equipment industry, which is relatively more integrated with Mexican productive sectors, generates relatively less indirect VA in manufacturing sectors, even though, in absolute values, in 1995 it generated 959 million dollars in these sectors, of which only 36 million can be attributed to the income generated in the Electrical and Optical Equipment sector. As we observed in Fujii and Cervantes (2013b), if the industries that concentrate the largest share of Mexican manufacturing exports demand few domestic inputs, i.e., if they have weak backward productive chains as suppliers of intermediate goods, then their participation in the Mexican economy is even lower.

Around the year 2000, with the estimate of indirect domestic VA, the process of production disarticulation seemed to have been reversed, since within the two industries that export the most, indirect value added generated by their use of domestically-made intermediate goods increased, as did the value added generated by those sectors that supply intermediate inputs. This meant that non-manufacturing indirect VA fell in relative terms from 68.4% to 64.7% of total income generated indirectly through the export of finished goods.

One of the reasons for estimating the amount of indirect VA that is generated by Mexican exports for 1995, 2000, and 2011 was to explore the possibility, before China was formally admitted to the World Trade Organization (WTO) in 2001, that changes had occurred in favor of domestic income contained in Mexican manufacturing exports. Nonetheless, in Table 4, we can see that this did not occur, since, as a percent of the gross value of Mexican manufacturing exports, domestic value added fell from 55.4% to 52.8%. We can gather from indirect domestic VA that, in reality, even before China's formal entry to the WTO, the drop in domestic VA in Mexican exports can be attributed to the lesser relative content of indirect VA. This occurred in spite of the increase in the share of indirect VA of manufacturing origin.

In 2011, the opposite occurred: an increase in indirect VA accompanied the growth of the share of domestic VA in exports while, simultaneously, indirect VA of manufacturing origin had a relative decrease.

Table 5. Mexico's Indirect Domestic Value Added on Manufacturing Exports, millions of dollars.

	Electrical and Optical Equipment		Transport Equipment		Rest of manufacturing		Total IVA	
1995	Value Added	%	Value Added	%	Value Added	%	Value Added	%
Electrical and Optical Equipment	186	7.6	36	1.2	7	0.2	230	2.7
Transport Equipment	32	1.3	261	8.5	17	0.5	310	3.6
Rest of manufacturing	685	27.9	662	21.5	846	27.1	2,192	25.4
Total manufacturing	903	36.8	959	31.2	869	27.9	2,731	31.6
Non-manufacturing	1,551	63.2	2,113	68.8	2,247	72.1	5,911	68.4
Total IVA	2,454	100	3,072	100	3,116	100	8,642	100
2000								
Electrical and Optical Equipment	738	13.2	152	2.5	31	0.5	920	5.0
Transport Equipment	102	1.8	621	10.3	54	0.8	778	4.2
Rest of manufacturing	1,552	27.8	1,258	20.9	1,945	29.1	4,755	26.0
Total manufacturing	2,392	42.8	2,031	33.7	2,030	30.3	6,453	35.3
Non-manufacturing	3,198	57.2	3,987	66.3	4,664	69.7	11,849	64.7
Total IVA	5,590	100	6,019	100	6,694	100	18,302	100
2011								
Electrical and Optical Equipment	263	4.2	144	1.0	30	0.2	437	1.3
Transport Equipment	79	1.3	1,154	7.8	62	0.5	1,295	3.8
Rest of manufacturing	1,562	24.8	2,516	17.0	2,367	18.8	6,445	19.1
Total manufacturing	1,905	30.2	3,814	25.8	2,459	19.6	8,177	24.3
Non-manufacturing	4,402	69.8	10,972	74.2	10,108	80.4	25,482	75.7
Total IVA	6,307	100	14,786	100	12,567	100	33,659	100

Source: Authors' estimate based on the WIOD (2013)

IV.2 Indirect Value Added by Countries of Origin and Sectors of Destination

In Table 6, we have a summary of the results of our estimates, arranged by country of origin and sector of destination of intermediate inputs. Based on information from WIOD, in 1995 and 2000, Mexican exports of the Electrical and Optical Equipment industry generated more indirect VA in the United States than in Mexico. In these two years, the indirect domestic VA associated with exports of the Electrical and Optical Equipment industry was 2.453 billion dollars in 1995 and 5.590 billion dollars in 2000. The corresponding amounts in the United States were 3.880 billion and 10.334 billion dollars; so, between 1995 and 2000, the indirect VA generated in the United States grew to be twice as much as that generated in Mexico. As previously mentioned, China's share changed the situation regarding U.S. VA contained in Mexican exports. This was particularly the case in this industrial sector: if in 1995, 46% of indirect VA was generated in United States, 29% in Mexico, and 1% in China, by 2011 these shares were recorded at 23.2%, 23.8%, and 19.3%, respectively.

Something similar occurred to a lesser degree in the Transport Equipment industry: United States lost a relative share in the income that is indirectly generated by the export of finished goods from this industry, while China's share gained a bit more than 7 percentage points from 1995 to 2011.

The original intent behind this paper was to determine if the changes in indirect VA generated by Mexico could help explain why a gap exists between the growth rates of Mexican exports and the rates of economic growth. Even though no significant changes were found in the income that Mexican manufacturing exports generate indirectly, what has been confirmed, following Shafaeddin and Pizarro (2010), is that the difference between China and Mexico's economic growth rates may be explained by the growth in the production of intermediate inputs that began to accelerate in China: "China's relative success in increasing the value added component in production is attributed to improvement in its RCA [Revealed Comparative Advantage] in the production of capital/technology intensive products, particularly in parts and components. It also has better prospects in export of these products, which are among 'demand dynamic' products in international markets, as they have gained RCA, in relation to almost all labour intensive products." (Shafaeddin and Pizarro, 2010:394). As we saw in Table 3, in 2009 the main difference in the content of domestic VA in China and Mexico's exports is that the former had significantly greater indirect VA compared to direct VA.

Generally, Mexican manufacturing exports did indeed stop generating less indirect domestic VA in relative terms, particularly of manufacturing origin. Nonetheless, WIOD's data show that, by country of origin, the country that has lost the greatest share in indirect VA is the United States.

Table 6. Indirect Value Added content in Mexico´s Manufacturing Exports, by country of origin and sector of destination, millions of dollars.

1995	Electrical and Optical Equipment	%	Transport Equipment	%	Rest of manufacturing	%	Total	%
Mexico	2,453.57	29.1	3,072.08	48.3	3,116.13	69.0	8,641.78	44.8
United States	3,880.14	46.0	2,086.99	32.8	891.30	19.7	6,858.43	35.5
Japan	513.35	6.1	295.65	4.6	75.66	1.7	884.65	4.6
Germany	221.33	2.6	208.42	3.3	64.24	1.4	494.00	2.6
Canada	121.61	1.4	77.36	1.2	42.36	0.9	241.33	1.3
South Korea	127.23	1.5	46.48	0.7	36.98	0.8	210.70	1.1
China	81.28	1.0	35.80	0.6	13.79	0.3	130.87	0.7
Subtotal	7,398.50	87.8	5,822.77	91.6	4,240.47	93.9	17,461.74	90.5
Rest of the World	1,028.66	12.2	537.08	8.4	276.86	6.1	1,842.60	9.5
Total	8,427.17	100	6,359.85	100	4,517.32	100	19,304.34	100
2000								
Mexico	5,589.93	25.4	6,018.62	40.5	6,693.56	61.6	18,302.11	38.3
United States	10,334.51	46.9	5,335.78	35.9	2,573.49	23.7	18,243.77	38.2
Japan	1,135.69	5.2	662.03	4.5	166.87	1.5	1,964.58	4.1
Germany	559.24	2.5	612.49	4.1	141.73	1.3	1,313.46	2.7
Canada	400.68	1.8	370.29	2.5	163.39	1.5	934.36	2.0
South Korea	480.08	2.2	152.69	1.0	155.64	1.4	788.41	1.7
China	409.64	1.9	169.57	1.1	142.70	1.3	721.91	1.5
Subtotal	18,909.77	85.8	13,321.46	89.7	10,037.38	92.3	42,268.61	88.5
Rest of the World 2	3,140.28	14.2	1,533.65	10.3	836.14	7.7	5,510.07	11.5
Total	22,050.05	100	14,855.11	100	10,873.52	100	47,778.67	100
2011								
Mexico	6,306.61	23.8	14,785.90	44.4	12,566.64	60.2	33,659.16	41.7
United States	6,138.56	23.2	7,498.60	22.5	3,861.61	18.5	17,498.77	21.7
Japan	1,229.72	4.6	1,386.21	4.2	305.71	1.5	2,921.64	3.6
Germany	763.54	2.9	1,030.64	3.1	324.76	1.6	2,118.94	2.6
Canada	456.25	1.7	798.20	2.4	405.85	1.9	1,660.29	2.1
South Korea	1,072.29	4.0	702.50	2.1	179.51	0.9	1,954.30	2.4
China	5,119.86	19.3	2,546.64	7.7	951.68	4.6	8,618.18	10.7
Subtotal	21,086.83	79.6	28,748.69	86.4	18,595.76	89.1	68,431.28	84.9
Rest of the World 2	5,412.72	20.4	4,529.86	13.6	2,267.99	10.9	12,210.57	15.1
Total	26,499.55	100	33,278.55	100	20,863.75	100	80,641.85	100

Source: Authors' estimate based on the WIOD (2013)

IV.3 Domestic Value Added Content in the Rest of the World's Exports

Finally, to confirm that we can explain the low correlation between the growth of exports and the growth of product, in this section we review the way the Mexican manufacturing industry participates in the production of the rest of the world's finished goods exports.

In Table 7, we have the domestic value added generated by Mexican manufacturing exports of intermediate goods that are incorporated in the rest of the world's exports. Rows contain the "indirect" value added according to the countries of destination of intermediate goods exports; columns show VA by sector of origin of intermediate goods for 1995, 2000, and 2011. What we first observe in this table is that estimates of VA are much lower. For example, in the Electrical and Optical Equipment sector, in 1995 only 93.84 million dollars of income were generated indirectly associated with the total of U.S. manufacturing exports; yet Mexican exports of finished goods in this sector alone generated 3.880 billion dollars in the United States in wages to personnel and

gross operating surpluses (see Table 6). In addition, by country of destination, in this sector approximately three-quarter of VA that is generated by the exports of other countries can be explained by two destinations of intermediate inputs: United States and Canada.

It is also clear that outside the NAFTA area, Mexico's non-manufacturing VA contained in exports of the rest of the world's finished goods is much higher. For example, in 1995, up to 87% of Mexican VA associated with total exports of French finished goods was generated in the non-manufacturing sectors.

In 2000, more than 420 million dollars of VA were generated in the Transport Equipment sector as a result of Canadian manufacturing exports, which totaled 54% of the income generated in this sector by the rest of the world's manufacturing exports. In contrast, in 2011, 54% of this sector's VA was associated with U.S. manufacturing exports.

If we consider the manufacturing exports of countries such as Spain, France, and Italy in 2000, approximately 90% of Mexican VA was generated in non-manufacturing sectors.

Finally, from Table 7 we can conclude that indirect VA generated in Mexico as a consequence of the rest of the world's exports is not only small, but it also tends to be overly dependent on the exports of United States and Canada.

Table 7. Mexico´s Indirect Value Added content in the Rest of the World's Exports, by sector of origin and country of destination, millions of dollars.

											Share of Mexican IVA by sector of origin			
	Electrical and Optical Equipment	%	Transport Equipment	%	Rest of Manufacturing	%	Non-Manufacturing	%	Total Mexican IVA	%	Electrical and Optical Equipment	Transport Equipment	Rest of Manufacturing	Non-Manufacturing
1995														
United States	93.84	58.1	105.08	31.7	375.14	41.7	665.20	25.7	1,239.26	31.2	7.6	8.5	30.3	53.7
Canada	27.92	17.3	161.56	48.8	121.45	13.5	218.41	8.4	529.35	13.3	5.3	30.5	22.9	41.3
Germany	4.89	3.0	9.44	2.8	37.37	4.2	212.25	8.2	263.94	6.6	1.9	3.6	14.2	80.4
China	1.27	0.8	0.64	0.2	13.31	1.5	24.81	1.0	40.03	1.0	3.2	1.6	33.3	62.0
Spain	0.63	0.4	6.52	2.0	17.79	2.0	113.78	4.4	138.73	3.5	0.5	4.7	12.8	82.0
France	3.50	2.2	5.86	1.8	29.25	3.3	279.75	10.8	318.35	8.0	1.1	1.8	9.2	87.9
Italy	1.06	0.7	1.23	0.4	27.31	3.0	94.54	3.7	124.14	3.1	0.9	1.0	22.0	76.2
Rest of the World	28.31	17.5	40.87	12.3	277.65	30.9	977.16	37.8	1,323.98	33.3	2.1	3.1	21.0	73.8
Total	161.40	100	331.20	100	899.27	100	2,585.91	100	3,977.78	100	4.1	8.3	22.6	65.0
2000														
United States	253.58	38.7	217.69	28.1	632.46	41.6	1,022.14	19.1	2,125.87	25.6	11.9	10.2	29.8	48.1
Canada	129.78	19.8	420.50	54.3	266.81	17.6	459.74	8.6	1,276.83	15.4	10.2	32.9	20.9	36.0
Germany	20.09	3.1	33.70	4.3	55.34	3.6	377.72	7.1	486.85	5.9	4.1	6.9	11.4	77.6
China	11.50	1.8	1.96	0.3	18.15	1.2	49.76	0.9	81.38	1.0	14.1	2.4	22.3	61.1
Spain	3.08	0.5	5.35	0.7	18.50	1.2	311.45	5.8	338.38	4.1	0.9	1.6	5.5	92.0
France	13.03	2.0	10.54	1.4	38.39	2.5	467.43	8.7	529.39	6.4	2.5	2.0	7.3	88.3
Italy	4.16	0.6	3.46	0.4	25.20	1.7	380.13	7.1	412.96	5.0	1.0	0.8	6.1	92.1
Rest of the World	219.82	33.6	81.86	10.6	465.05	30.6	2,285.26	42.7	3,051.98	36.8	7.2	2.7	15.2	74.9
Total	655.04	100	775.06	100	1,519.90	100	5,353.64	100	8,303.64	100	7.9	9.3	18.3	64.5
2011														
United States	444.80	53.1	977.00	54.2	1,719.57	45.0	5,053.77	37.3	8,195.14	41.0	5.4	11.9	21.0	61.7
Canada	91.53	10.9	421.22	23.4	328.04	8.6	691.41	5.1	1,532.19	7.7	6.0	27.5	21.4	45.1
Germany	42.70	5.1	63.82	3.5	163.14	4.3	1,032.12	7.6	1,301.78	6.5	3.3	4.9	12.5	79.3
China	81.68	9.8	31.00	1.7	287.35	7.5	843.20	6.2	1,243.23	6.2	6.6	2.5	23.1	67.8
Spain	4.22	0.5	14.00	0.8	43.34	1.1	849.57	6.3	911.13	4.6	0.5	1.5	4.8	93.2
France	16.04	1.9	35.76	2.0	72.56	1.9	612.77	4.5	737.13	3.7	2.2	4.9	9.8	83.1
Italy	4.22	0.5	14.15	0.8	58.50	1.5	289.78	2.1	366.64	1.8	1.1	3.9	16.0	79.0
Rest of the World	152.42	18.2	245.82	13.6	1,144.61	30.0	4,171.86	30.8	5,714.71	28.6	2.7	4.3	20.0	73.0
Total	837.60	100	1,802.77	100	3,817.11	100	13,544.48	100	20,001.95	100	4.2	9.0	19.1	67.7

Source: Authors' estimate based on the WIOD (2013)

Now, as a percent of the value of Mexican manufacturing exports, in Table 8 we have an estimate of Mexican indirect value added. We can see that, by country of origin, Mexico's share as an intermediate-goods provider is much more modest. In 1995, United States exported more than 196 billion dollars in manufactures, while Mexico only generated income equivalent to 1.239 billion. This fact underscores a very deep difference in the way Mexico and the United States mutually benefit from the exports of the finished goods that each one makes. As we saw in Table 4, in 1995, 24% of the gross value of Mexican exports was due to income paid in the United States; yet the value added generated in Mexico by U.S. exports is not even 1% of these exports' gross value. In absolute terms, Mexican exports in United States generated income of 6.858 billion dollars in comparison to the 1.239 billion in income in Mexico. And this is in spite of the fact that 33% of VA generated in Mexico by the rest of the world's exports is associated with the exports of the United States.

Further, by sector of destination of Mexican intermediate inputs that are incorporated in the rest of the world's exports, in Table 8 we can see that the relatively less modest contribution of Mexican VA is that which is associated with the production of finished goods in the Transport Equipment industry of the United States and Canada. In other words, due generally to the exports of the Transport Equipment sector's main trading partners, Mexico participated with percentages that range from 0.9 to 2.7, between 1995 and 2011.

Table 8. Mexico´s Indirect Value Added content in Other Countries' Exports, millions of dollars.

	Total Mexican IVA	Manufacturing Exports	%	Total Mexican IVA	Electrical and Optical Equipment	%	Total Mexican IVA	Transport Equipment	%	Total Mexican IVA	Rest of manufacturing	%
1995												
United States	1,239	196,091	0.6	242	52,207	0.5	361	41,654	0.9	636	102,231	0.6
Canada	529	68,291	0.8	43	7,704	0.6	423	39,481	1.1	63	21,106	0.3
Germany	264	227,514	0.1	39	37,585	0.1	89	65,490	0.1	136	124,439	0.1
China	40	83,361	0.0	12	19,356	0.1	1	1,320	0.1	27	62,686	0.0
Rest of the World	1,905	1,196,615	0.2	374	249,701	0.1	320	201,415	0.2	1,211	745,499	0.2
Total	3,978	1,771,872	0.2	710	366,552	0.2	1,195	349,359	0.3	2,073	1,055,961	0.2
2000												
United States	2,126	257,330	0.8	497	77,660	0.6	615	53,277	1.2	1,014	126,393	0.8
Canada	1,277	110,317	1.2	169	16,214	1.0	909	54,911	1.7	199	39,192	0.5
Germany	487	239,481	0.2	76	42,671	0.2	199	77,392	0.3	211	119,418	0.2
China	81	121,360	0.1	39	37,265	0.1	2	2,616	0.1	40	81,479	0.0
Rest of the World	4,333	1,415,150	0.3	1,065	347,083	0.3	670	241,202	0.3	2,597	826,865	0.3
Total	8,304	2,143,637	0.4	1,846	520,893	0.4	2,396	429,397	0.6	4,062	1,193,347	0.3
2011												
United States	8,195	452,498	1.8	709	88,911	0.8	2,922	108,750	2.7	4,564	254,837	1.8
Canada	1,532	122,667	1.2	148	12,419	1.2	1,049	52,909	2.0	335	57,339	0.6
Germany	1,302	581,935	0.2	173	84,008	0.2	485	185,801	0.3	644	312,127	0.2
China	1,243	871,859	0.1	678	362,180	0.2	64	43,588	0.1	501	466,091	0.1
Rest of the World	7,730	3,042,074	0.3	1,181	435,169	0.3	1,478	543,285	0.3	5,071	2,063,621	0.2
Total	20,002	5,071,034	0.4	2,889	982,686	0.3	5,998	934,332	0.6	11,115	3,154,016	0.4

Source: Authors' estimate based on the WIOD (2013)

V. Conclusions

The main objective of this paper was to explore the changes in indirect VA associated with Mexican manufacturing exports, as a means of further explaining the fact that when Mexico's manufacturing exports began to expand more or less halfway through the 1980s, the gap between those exports' growth rates and GDP growth rates also began to increase. However, what we have found is not an enormous change in Mexico's generation of indirect value added, but rather a quite significant change in the rest of the value added contained in (or generated by) Mexican manufacturing exports. From 1995 to 2011, United States lost, mainly to China, almost 10 percentage points of VA associated with Mexico's export activity.

Yet, on the other hand, in Tables 4 and 8, it seems as though distant countries such as Japan, South Korea, China, or Germany have a greater share of the income generated by Mexican manufacturing exports than the share Mexico has in the income associated with its main trading partners, i.e., United States and Canada. This leads us to conclude that the true gains from trade are indeed linked to geography, favoring regions that are closest to major markets, but not as strongly as frequently believed. The fact that the main destination of Mexico's finished goods exports is the largest market in the world, in terms of value added, benefits workers and companies located in Mexico, United States, and China at the start of the second decade of the 21st century. Nonetheless, the exports of United States, or of any other country in the world, do not have the same multiplier effect for the Mexican economy.

By analytically breaking down the sources of structural change, future research could possibly find a way to determine if the relative stability of domestic VA contained in Mexican manufacturing exports can be attributed to the stability of technical and value added coefficients, and to the stability of the structure of foreign demand. Alternatively, what we might have is a trade-off between the changes in the variables, meaning that Mexico, as opposed to China, has not been able to increase the content of indirect domestic VA.

References

Amsden, A.H. (2004) "Import substitution in high-tech industries: Prebisch lives in Asia!", CEPAL Review, No. 82, April 2004,

CEPAL (Comisión Económica para América Latina y el Caribe) (2008), *Panorama de la inserción internacional de América Latina y el Caribe 2007. Tendencias 2008* (LC/G.2383-P), Santiago de Chile. Publicación de las Naciones Unidas, N° de venta: S.08.II.G.36.

Chen, X., Cheng, L. K., Fung, K.C., and Lau, L.J. (2005). "The Estimation of Domestic Value Added and Employment Induced by Exports: An Application to Chinese Exports to the United States", paper presented at the 2005 American Economic Association Meeting, Philadelphia.

Chen, X., Cheng, L. K., Fung, K.C., Lau, L.J., Sung, Y., Yang, C., Zhuy, K., and Tang, Z. (2008). "Domestic Value Added and Employment Generated by Chinese Exports: A Quantitative Estimation, MPRA paper No. 15663.

De la Cruz, J. Koopman, R. and Wang, Z. (2011), "Estimating Foreign Value-Added in Mexico's Manufacturing Exports", U.S. International Trade Commission, *Office of Economics Working Paper*, No. 2011-04A.

Erumban, A., Los, B., Stehrer, R., Timmer, M., and de Vries, G. (2011) "Slicing up Global Value Chains". Paper prepared for the World Bank Workshop 'The Fragmentation of Global Production and Trade in Value Added', June 9-10, 2011.

Ferrarini, B. (2011). "Mapping Vertical Trade", ADB Working Paper Series N° 263, Asian Development Bank.

Fujii, G. and Cervantes, R. (2013a), "Mexico: Value Added in Exports of Manufactures", CEPAL Review, N° 109, April

Fujii, G. and Cervantes, R . (2013b), "Indirect Domestic Value Added in Mexico's Manufacturing Exports, by Origin and Destination Sector", Levy Economics Institute of Bard College, Working Paper N° 760

Guerra, A.I. and Sancho, F. (2010) " A comparison of input-output models: Ghosh reduces to Leontief (But 'closing' Ghosh makes it more plausible)". Universitat Autònoma de Barcelona. First version, April 2010.

Ha, S.J. and Swales, J.K. (2010) "The Export Base Model with a Supply-Side Stimulus to Export Sector. SIRE Discussion Paper, SIRE-PP-2010-27. Scottish Institute for Research in Economics, University of Strathclyde.

He, D. and Zhang, W. (2010), "How Dependant Is the Chinese Economy on Exports and in What Sense Has its Growth Been Export-led?", *Journal of Asian Economics* 21, pp. 87-104.

Hicks, J. (1950). *A Contribution to the Theory of the Trade Cycle*, Oxford: Clarendon Press.

Kaldor, N. (1981). "The Role of Increasing Returns, Technical Progress and Cumulative Causation in the Theory of International Trade and Economic Growth", *Économie Appliqué* Nº 4. Reproducido en *The Essential Kaldor* (1989), edited by F. Targetti and A.P. Thirlwall, New York: Holmes & Meier.

Koopman, R., Wang, Z. y Wei, S. J. (2008). "How Much of Chinese Exports Is Really Made in China? Assessing Domestic Value-Added when Processing Trade Is Pervasive", *Working Paper 14109*, National Bureau of Economic Research.

Lau, L., Chen, X., Cheng, L., Fung, K.C., Pei, J., Sung, Y., Tang, Z., Xiong, Y., Yang, C. and Zhu, K. (2006). "Estimates of U.S. – China Trade Balances in Terms of Domestic Value-Added", Stanford Center For International Development, Working Paper N° 295.

Larudee, M. (2012), “Measuring Openness: VADE, Not Trade”, *Oxford Economic Studies,* Vol. 40, No. 1, March, pp. 119-137

Los, B. , Timmer, M. and de Vries, G. (2012) “China and the World Economy: A Global Value Chain Perspective on Exports, Incomes and Jobs.” Groningen Growth and Development Centre, Faculty of Economics and Business, Unversity of Groningen. October, 2012.

Maresa, A. and Sancho, F. (2012) “Leontief versus Ghosh: two faces of the same coin. Document de Trebail, XREAP 2012-18. Xarxa de Referència en Economia Aplicada.

OECD-WTO (2012), Trade in Value Added: Concepts, Methodologies and Challenges, Joint OECD-WTO Note, http://www.oecd.org/sti/ind/49894138.pdf

Shafaeddin, M. and Pizarro, J. (2010) “The evolution of value added in assembly operations: the case of China and Mexico”, *Journal of Chinese Economic and Business Studies*, Vol. 8, No. 4, November 2010, 373–397

Timmer, Marcel P. (ed) (2012), "The World Input-Output Database (WIOD): Contents, Sources and Methods", WIOD Working Paper Number 10,

http://www.wiod.org/publications/papers/wiod10.pdf

Thirlwall, A.P. (1979), “The balance of payments constraint as an explanation of international growth rate differences”, *Banca Nazionale del Lavoro Quarterly Review*, vol. 32, N° 128, Banca Nazionale del Lavoro, marzo.

UNCTAD (2013), World Investment Report, 2013. Global Value Chains: Investment and Trade for Development. UN, New York and Geneve.