China's presence in Mexican manufacturing exports to the U.S. and Canada

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Abstract

China has increased its participation in Global Value Chains (GVC) since 2001 and has been considered an "uninvited member" in the North American integration process. This article uses matrix input-output analysis to analyze China's presence in North American manufacturing chains –from the point of view of Mexican exports– during 2000-2014. The findings demonstrate a decline in the share of U.S. value-added embodied in Mexico's manufacturing exports to North America, displaced mainly by Chinese value-added ultimately consumed in the United States. Moreover, inputs from the United States and Canada –embedded in Mexican manufacturing exports– show signs of reprimarization, while inputs imported from China show increasing levels of sophistication.

Keywords: Global Value Chains (GVC); trade triangulation; North American Free Trade Agreement (NAFTA); China-North America trade relations; input-output analysis.

1. INTRODUCTION

The 1994 North American Free Trade Agreement (NAFTA) marked the adoption of an export-led growth policy in Mexico. The literature identifies two phases of the North American integration process. The first (1994-2000) was characterized by dynamic trade, investment, and employment generation. However, since 2001 the process slowed down its growth rate in these same variables (Dussel-Peters, 2018). The second stage is framed by China's penetration into

North American production chains, which originated a triangulation of the processes of productive and commercial disintegration in North American production chains (Dussel-Peters and Ortiz-Velásquez, 2016). A series of events led to the emergence of a new stage of dynamics that have not yet been fully revealed.[1] By focusing on the period 2000-2014, this article will allow us to examine the changes that took place during the second stage.

This article's primary objective is to study the evolution and characteristics of Chinese value-added contained in Mexican manufacturing exports to its North American partners. This research contributes to the literature in two ways: first, it provides new empirical evidence on the evolution and characteristics of trade triangulation between China, Mexico, and the other two North American countries; second, it develops a decomposition of gross exports in terms of value-added, which allows us to focus the analysis on triangular trade relations between any set of countries at the sectoral level.

The article is structured as follows: after the introduction, the second section presents the relevant data on gross trade in Mexican manufacturing as background information, in addition to some theoretical guidelines related to Global Value Chains (GVCs). The third section goes on to set out the methodology to be used, while the fourth section contains a brief review of the literature related to the analysis. The fifth section then synthesizes and analyzes the findings of the exercises carried out. Finally, the sixth section offers some conclusions, as well as some recommendations based on the findings obtained.

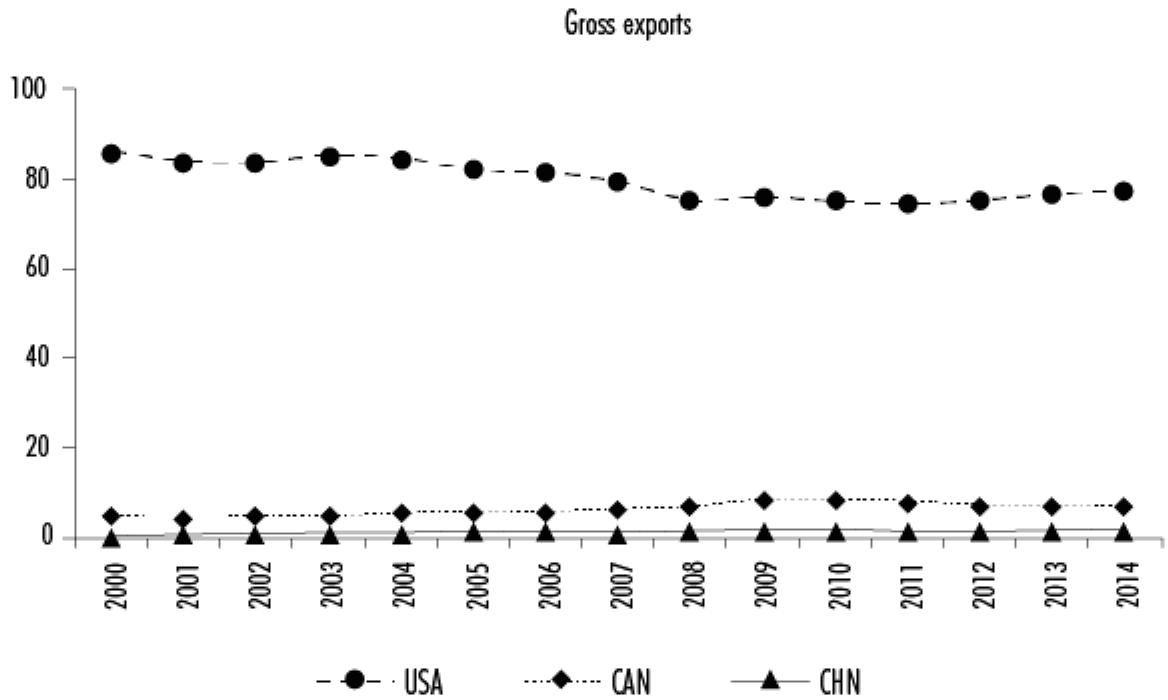
2. BACKGROUND

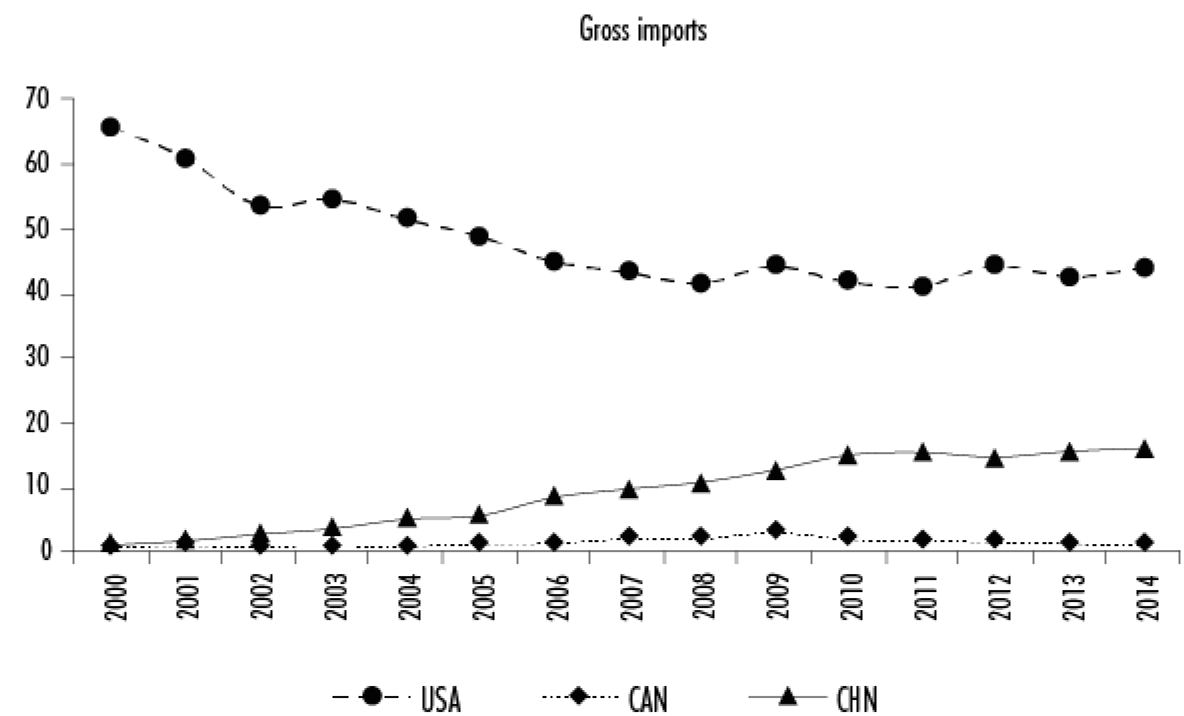
China's rapid insertion into GVCs allowed it to position itself as a dominant player in international trade, and to be considered an "uninvited member" of North American integration (Dussel-Peters and Gallagher, 2013). The factors that led to this boom were its entry into the World Trade Organization (WTO) in 2001, the existence of a sizeable low-wage labor force, the implementation of domestic reforms and industrial policy, a reduction in transportation and information technology costs, and the undervaluation of the yuan (Blecker, 2014).

Figure 1 shows the evolution of the share of the US, Canada, and China in Mexican manufacturing gross trade. The fall in the relevance of the US in imports is almost entirely explained by the rise in imports from China during the period under analysis. Exports to North

America, on the other hand, remained constant at levels above 80%, with the US being the main destination.

Figure 1. Share of the US, Canada, and China in Mexico's gross manufacturing trade, 2000-2014 (percentages)

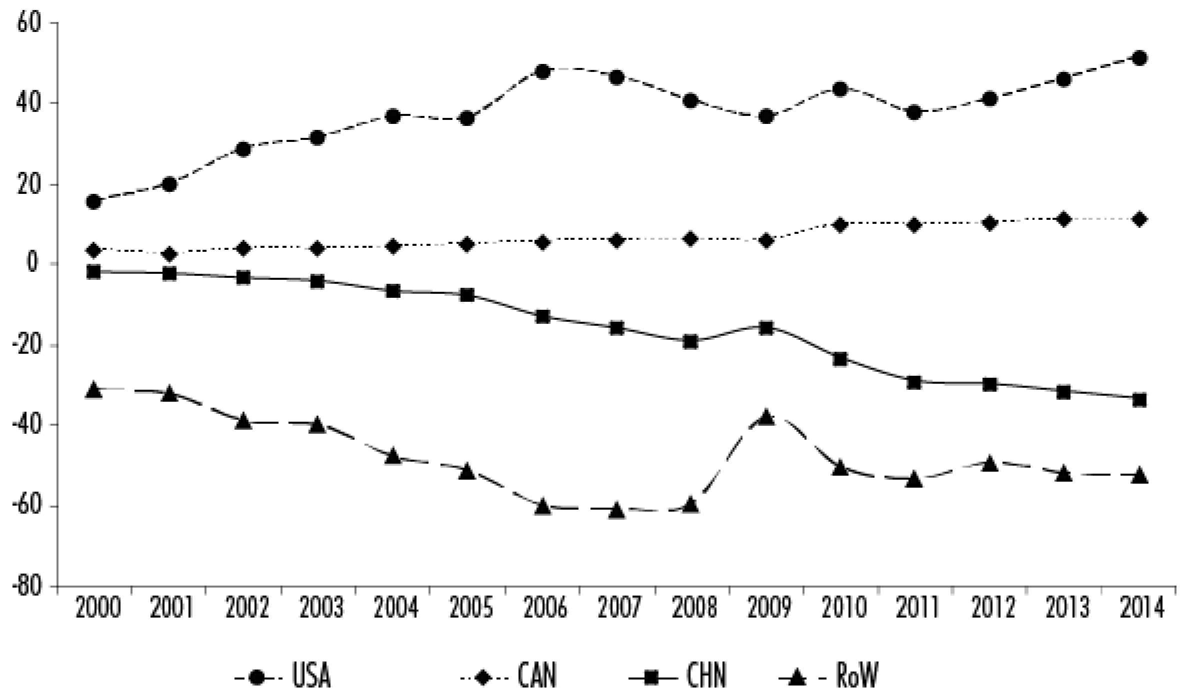




Source: Compiled by the authors based on data from WIOD Release 2016 (Timmer et al., 2016).

This pattern resulted in a growing trade surplus between Mexico and the US and Canada (see Figure 2). However, the positive balance does not translate into increased economic growth or Gross Domestic Product (GDP) per capita (Blecker *et al*., 2021) — rather, on the contrary, it contributes to a weakening of productive articulation and domestic demand (Fujii-Gambero and Cervantes, 2013). Moreover, it fails to counteract the deficit with the rest of the world, especially with China.

Figure 2. Gross trade balance of Mexico's manufacturing industry with
the US, Canada, China, and the Rest of the World, 2000-2014 (billions of dollars)



Source: Compiled by the authors based on data from WIOD Release 2016 (Timmer et al., 2016).

Regarding the trade balance, there are differences between types of manufacturing.[2] In 2014, the surplus with the US of technology-intensive manufacturing reached US$80.5 billion, while Natural Resource Intensive Manufacturing (NRM) registered a deficit of US$28.8 billion. In trade relations with China, the balance of this type of product accounted for 62% of the deficit in manufacturing as a whole.

Table 1 shows the composition of Mexico's trade flows with the US, Canada, and China. Technology-intensive manufacturing is the largest contributor to exports, regardless of the destination; nevertheless, NR-intensive manufacturing increased considerably in exports to China.

Table 1. Sectoral structure of Mexico's gross manufacturing trade flows with the US, Canada, and China, 2000-2014 (percentages)

Type of manufacture	*Gross exports*					
	To the US		*To Canada*		*To China*	
	Average	*Difference*	*Average*	*Difference*	*Average*	*Difference*
Natural resource intensive	**30.7**	**2.9**	**22.9**	**-0.9**	**28.3**	**13.3**
Food, beverages, and tobacco	3.4	2.5	3.0	1.9	2.3	-0.6
Textiles and leather products	5.7	-6.9	2.9	-0.9	1.4	-1.3
Coke and refined petroleum products	2.1	1.0	0.9	1.1	0.1	0.0
Chemical industry	2.7	1.4	0.7	0.2	7.8	-4.3
Others	16.8	4.8	15.4	-3.1	16.7	19.5
Technology intensive	**69.3**	**-2.9**	**77.1**	**0.9**	**71.7**	**-13.3**
Automotive industry	26.3	0.9	29.6	2.6	15.0	26.5
Electronics and optics	26.0	-9.3	34.6	2.2	36.0	-45.7
Electrical equipment	10.0	-0.5	7.7	-7.6	14.1	2.3
Machinery and equipment	6.9	6.0	4.5	3.3	6.4	3.2
Pharmaceuticals	0.2	0.0	0.7	0.5	0.2	0.3
Total	100.0	0.0	100.0	0.0	100.0	0.0
Type of manufacture	*Gross imports*					
	To the US		*To Canada*		*To China*	
	Average	*Difference*	*Average*	*Difference*	*Average*	*Difference*
Natural resource intensive	53.8	15.7	58.0	7.4	34.1	-12.6
Food, beverages, and tobacco	5.8	4.0	8.6	-1.0	1.7	0.9
Textiles and leather products	3.6	-4.9	1.8	-1.0	6.7	-5.8
Coke and refined petroleum products	9.3	10.1	0.4	0.0	0.5	-0.7
Chemical industry	12.8	6.0	3.3	1.4	4.0	-0.7
Others	22.3	0.5	43.9	8.0	21.1	-6.3
Technology intensive	46.2	-15.7	42.0	-7.4	65.9	12.6
Automotive industry	13.0	-1.7	13.6	-4.7	3.6	4.6
Electronics and optics	14.8	-11.7	12.2	-3.6	38.9	9.4
Electrical equipment	6.5	-4.2	5.7	-4.4	12.0	-6.9

Imports show a different structure depending on their origin, with imports from the US and Canada showing a predominance of NR-intensive manufacturing. Additionally, technology-intensive products — mainly electronics and optics — have a greater share and increase in imports from China, compared to those from the US and Canada. This is a consequence of the trade and production triangulation process between China, Mexico, and the US-Canada that began in 2001.

Mexico's trade liberalization coincides with the rise of GVCs; within GVCs, producers in one country buy inputs and add value to them, which is included in a subsequent stage of production that may be carried out in another country, and so on until the final good is obtained. The different stages have different levels of complexity, so that some countries carry out high value-added activities (especially those where the leading companies in the chain come from), while others carry out low value-added activities (generally developing countries that carry out assembly activities). In the case of Mexico, assembly predominates as the main form of insertion in GVCs.

In light of this, incorporating domestic value-added in GVCs is essential for promoting economic growth, not only through the payment of domestic factors of production, but also through the use of domestic inputs in the manufacture of exports (Fujii-Gambero and Cervantes, 2013).

In Mexico, the dynamism of technology-intensive exports to its North American partners is accompanied by a loss in the ability of the manufacturing sector to function as an engine of growth. The main cause would be the low domestic value added incorporated in exports that are not linked to the automotive chain (Blecker *et al*., 2021). The growing use of imported inputs from China reinforces this trend and presents a challenge for Mexico to improve the quality of its insertion in North American production chains.

The US-Mexico-Canada-Mexico Agreement (USMCA) has only been in place for a relatively short space of time. According to Ortiz-Velásquez and Peralta (2019), the purpose of USMCA is to improve the competitiveness of North American chains in relation to China, especially that of the automotive industry. This is evidenced by the increased regional content requirement for goods in the automotive chain and in the clause that obliges member countries to inform in advance if they wish to enter into a trade agreement with a non-market economy.

3. METHODOLOGY

The main source of data is the 2016 version of the World Input-Output Database (WIOD) (Timmer *et al*., 2016). The database is composed of 43 countries and Rest of the World data for 56 economic activities, classified into manufacturing, primary sector, knowledge-intensive services, and others.[3] WIOD is the only available database containing data since 2000 and dividing electrical and electronic-optical products into different sectors. The availability of data since 2000 is important for analyzing the changes brought about by China's accession to the WTO, while the differentiation between electrical and electronic-optical products is crucial, as these are two production chains with fundamental differences in their functioning. Furthermore, the period 2000-2014 is ideal for analyzing the second stage of North American integration.

Wang, Wei, and Zhu's (2013, hereafter WWZ) decomposition makes it possible to trace the value-added contained in exports at the bilateral-sector level, according to their origin and final destination. Assuming an input-output model of N countries and n sectors, the WWZ methodology is based on the classical analysis of the model proposed by Leontief (1936):

$$\begin{bmatrix} X_s \\ X_r \\ X_t \end{bmatrix} = \begin{bmatrix} A_{ss} & A_{sr} & A_{st} \\ A_{rs} & A_{rr} & A_{rt} \\ A_{ts} & A_{tr} & A_{tt} \end{bmatrix} \begin{bmatrix} X_s \\ X_r \\ X_t \end{bmatrix} + \begin{bmatrix} Y_{ss} + Y_{sr} + Y_{st} \\ Y_{rs} + Y_{rr} + Y_{rt} \\ Y_{ts} + Y_{tr} + Y_{tt} \end{bmatrix} \quad (1)$$

Where, X_s and X_r are gross production vectors of order nx1, X_t of order (nN-n2)x1, the subscript "t" represents the rest of the countries (excluding "s" and "r"). A_{ss}, A_{sr}, A_{rs} and A_{rr} are submatrices of the Leontief technical coefficient matrix (A) of order nxn, A_{st} and A_{rt} of order nx(nN-n2), A_{ts}, and A_{tr} of order (nN-n2)xn and A_{tt} of order (nN-n2)x(nN-n2). Y_{ss}, Y_{sr}, Y_{st}, Y_{rs}, Y_{rr} and Y_{rt} are final demand vectors (Y) of order nx1, Y_{ts}, Y_{tr}, and Y_{tt} of order (nN-n2)x1.

$$\begin{bmatrix} X_s \\ X_r \\ X_t \end{bmatrix} = \begin{bmatrix} I - A_{ss} & -A_{sr} & -A_{st} \\ -A_{rs} & I - A_{rr} & -A_{rt} \\ -A_{ts} & -A_{tr} & I - A_{tt} \end{bmatrix}^{-1} \begin{bmatrix} Y_{ss} + Y_{sr} + Y_{st} \\ Y_{rs} + Y_{rr} + Y_{rt} \\ Y_{ts} + Y_{tr} + Y_{tt} \end{bmatrix}$$

$$= \begin{bmatrix} B_{ss} & B_{sr} & B_{st} \\ B_{rs} & B_{rr} & B_{rt} \\ B_{ts} & B_{tr} & B_{tt} \end{bmatrix} \begin{bmatrix} Y_s \\ Y_r \\ Y_t \end{bmatrix} \quad (2)$$

Where, B_{ss}, B_{sr}, B_{rs} and B_{rr} are submatrices of the global inverse Leontief matrix (B) of order nxn, B_{st} and B_{rt} of order nx(nN-n2), B_{ts} and B_{tr} of order (nN-n2)xn and B_{tt} of order (nN-n2)x(nN-n2). Y_s and Y_r are final demand vectors of order nx1 and Y_t of order (nN-n2)x1. I is an identity matrix of the order required to carry out the indicated operation.

Based on equation (1), the bilateral gross exports from country "s" to country "r" is expressed as follows:

$$E_{sr} = Y_{sr} + A_{sr}X_r \qquad (3)$$

Where, E_{sr} is the vector of gross exports directed from country "s" to country "r" of order nx1, Y_{sr} the exports of final goods, and $A_{sr}X_r$ the exports of intermediate goods. In turn, intermediate exports from country "s" to country "r" can be decomposed according to the route they follow in the chain and their country of final absorption:

$$\begin{aligned} A_{sr}X_r = {} & A_{sr}B_{rr}Y_{rr} + A_{sr}\sum_{t\neq s,r}^{N} B_{rt}Y_{tt} + A_{sr}B_{rr}\sum_{t\neq s,r}^{N} Y_{rt} \\ & + A_{sr}\sum_{t\neq s,r}^{N} B_{rt}\sum_{w\neq s,t}^{N} Y_{tw} + A_{sr}B_{rr}Y_{rs} + A_{sr}\sum_{t\neq s,r}^{N} B_{rt}Y_{ts} \qquad (4) \\ & + A_{sr}B_{rs}Y_{ss} + A_{sr}B_{rs}\sum_{t\neq s}^{N} Y_{st} \end{aligned}$$

Where the first term corresponds to the inputs exported from country "s" that are used by country "r" to produce its own end-use goods. While the second to eighth terms include the inputs exported from country "s", which are used by country "r" to produce its exports to the world as a whole (including country "s"). By grouping the eight terms, equation (4) can be rewritten as follows:

$$A_{sr}X_r = A_{sr}\sum_{t}^{N}\sum_{g}^{N} B_{rt}Y_{tg} \qquad (5)$$

To identify flows that cross customs at least once, WWZ and Borin and Mancini (2019) use the Leontief inverse local matrix (L) of country "r":[4]

$$L_{rr} = (I - A_{rr})^{-1} \quad (6)$$

Matrix B includes all countries in the calculation process and matrix L is computed separately, taking into account only the technical coefficients of the required country. Using equation (6), the first term of equation (4) can be disaggregated as follows:

$$A_{sr}B_{rr}Y_{rr} = A_{sr}L_{rr}Y_{rr} + A_{sr}(B_{rr} - L_{rr})Y_{rr} \quad (7)$$

Where the first term is the inputs imported by country "r" from country "s," which are not processed in third countries and are finally consumed in country "r." The second term is the inputs imported by country "r" from country "s," which are processed in third countries before being finally consumed in country "r." This is because the B_{rr} submatrix includes the backward linkages that country "r" has with international production networks.

The value added multipliers can be decomposed, according to their domestic origin (from country "s") or foreign origin (from country "r" or the rest of countries "t"), as follows:

$$V_sB_{ss} + V_rB_{rs} + \sum_{t \neq s,r}^{N} V_tB_{ts} = v \quad (8)$$

Where, the first term is a vector of order 1xn with the domestic multipliers, the second is of order 1xn and contains the foreign multipliers of value added coming from country "r" and the third is of order 1xn and includes the sum of the foreign multipliers of value added coming from the rest of countries "t."

Using the L matrix of country "s", the first term of equation (8) is decomposed as follows:

$$V_sL_{ss} + (V_sB_{ss} - V_sL_{ss}) = V_sB_{ss} \quad (9)$$

Where V_sL_{ss} contains the local value added multipliers of country "s." Defining the operator # as an element-by-element multiplication and as the transpose of a vector or matrix, the exports of final goods from country "s" to "r" are decomposed at the sectoral level according to the origin of the value added:

$$Y_{sr} = (V_sB_{ss})'\#Y_{sr} + (V_rB_{rs})'\#Y_{sr} + (\sum_{t\neq s,r}^{N} V_tB_{ts})'\#Y_{sr} \tag{10}$$

$$(V_sB_{ss})'\#Y_{sr} = (V_sL_{ss})'\#Y_{sr} + (V_sB_{ss} - V_sL_{ss})'\#Y_{sr} \tag{11}$$

Where the first component isolates the value added of country "s," which crosses international customs on only one occasion. The second is the value added of country "s," which undergoes prior processing in third countries and, therefore, crosses borders on more than one occasion.

Similarly, making use of equations (5) and (8), equation (12) disaggregates the exports of intermediate goods from country "s" to country "r" at the sectoral level, according to the origin of the value added:

$$\begin{aligned} A_{sr}X_r = {} & (V_sB_{ss})'\#(A_{sr}\sum_{t}^{N}\sum_{g}^{N} B_{rt}Y_{tg}) + (V_rB_{rs})'\#(A_{sr}\sum_{t}^{N}\sum_{g}^{N} B_{rt}Y_{tg}) \\ & + (\sum_{t\neq s,r}^{N} V_tB_{ts})'\#(A_{sr}\sum_{t}^{N}\sum_{g}^{N} B_{rt}Y_{tg}) \end{aligned} \tag{12}$$

Where the first term represents the value added of country "s", the second term represents the value added of country "r", which returns to this country through imports of intermediate goods from country "s", and the third term represents the value-added from the rest of the countries "t." In this case, matrix L is also used to decompose the first term of equation (12), according to the number of times it crosses international customs:

$$(V_s L_{ss})' \# (A_{sr} L_{rr} Y_{rr}) + \begin{bmatrix} ((V_s B_{ss})' \ (A_{sr} \sum_{t}^{N} \sum_{g}^{N} B_{rt} Y_{tg})) \\ -((V_s L_{ss})'(A_{sr} L_{rr} Y_{rr})) \end{bmatrix} \tag{13}$$

$$= (V_s B_{ss})' \# (A_{sr} \sum_{t}^{N} \sum_{g}^{N} B_{rt} Y_{tg})$$

Where the first term is the value added of country "s", which crosses international customs on only one occasion, and is finally absorbed in country "r". While the difference expressed in the second term is the value added of country "s", which crosses customs on more than one occasion and is finally consumed in any country in the world.

For analytical purposes, the category of "final goods" is used for end-use products, "simple chains" for cases in which the value-added contained in exports of intermediate inputs crosses customs on only one occasion, and "complex chains" for those in which it crosses borders on multiple occasions (Wang *et al*., 2016).

Making use of equations (10), (11), (12), and (13), total gross exports from country "s" to "r" are disaggregated as described in Table 2.

Table 2. Decomposition of gross exports from country "s" to country "r" into final goods, simple chains, and complex chains

Category	Mathematical formula	Description
C1	$(V_s L_{ss})' \# Y_{sr}$	Domestic Value Added (DVA) of country "s" contained in exports of final goods from country "s" to country "r."
C2	$(V_s L_{ss})' \# (A_{sr} L_{rr} Y_{rr})$	DVA of country "s" contained in exports linked to simple chains from country "s" to coun-try "r."
C3	$\left[(V_s B_{ss})' \# (A_{sr} \sum_{t}^{N} \sum_{g}^{N} B_{rt} Y_{tg})\right] + [(V_s B_{ss} - V_s L_{ss})' \# Y_{sr}] - [(V_s L_{ss})' \# (A_{sr} L_{rr} Y_{rr})]$	DVA of country "s" contained in exports linked to complex chains from country "s" to country "r", finally consumed in any country in the world.
C4	$(\sum_{t \neq s}^{N} V_t B_{ts})' \# (Y_{sr} + A_{sr} \sum_{t}^{N} \sum_{g}^{N} B_{rt} Y_{tg})$	Foreign Value Added (FVA) from the rest of the world (including country "r"), contained in exports linked to complex chains from country "s" to country "r", finally consumed in any country in the world.

Source: Compiled by the author based on Wang et al. (2013) and Borin and Mancini (2019).

To analyze triangular trade relations, C4 is broken down according to the country of origin of the value added and the country of final destination. Table 3 details this breakdown in the case of the analysis of the China-Mexico-US triangular relationship, where the relevant countries of origin and destination of value added are China, the US, Canada, and Mexico.[5]

Table 3. Breakdown of Mexico's gross exports to the US, according to the origin of total value added and final destination of Chinese value added

Component	*Mathematical formula*	*Description*
C1	$(V_m L_{mm})' \# Y_{mu}$	Mexican Value Added (VA) contained in Mexico's final goods exports to the US
C2	$[(V_m L_{mm})' \# (A_{mu} L_{uu} Y_{uu})]$	Mexican VA contained in exports linked to simple chains from Mexico to the US.
C3	$[(V_m B_{mm} - V_m L_{mm})' \# Y_{mu}] + \left[(V_m B_{mm})' \# (A_{mu} \sum_{t}^{N} \sum_{g}^{N} B_{ut} Y_{tg})\right] - [(V_m L_{mm})' \# (A_{mu} L_{uu} Y_{uu})]$	Mexican VA contained in exports linked to complex chains from Mexico to the US, ul-timately consumed in any country in the world.
C4.1	$(V_{ch} B_{chm})' \# (Y_{mu} + A_{mu} \sum_{t}^{N} B_{ut} Y_{tu})$	Chinese VA contained in exports linked to complex chains from Mexico to the U.S., ultimately consumed in the US
C4.2	$(V_{ch} B_{chm})' \# (A_{mu} \sum_{t}^{N} B_{ut} Y_{tch})$	Chinese VA contained in exports linked to complex chains from Mexico to the US, which is ultimately consumed in China.
C4.3	$(V_{ch} B_{chm})' \# (A_{mu} \sum_{t}^{N} B_{ut} Y_{tc})$	Chinese VA contained in exports linked to complex chains from Mexico to the US, ul-timately consumed in Canada.
C4.4	$(V_{ch} B_{chm})' \# (A_{mu} \sum_{t}^{N} B_{ut} Y_{tm})$	Chinese VA contained in exports linked to complex chains from Mexico to the US. ul-timately consumed in Mexico.
C4.5	$(V_{ch} B_{chm})' \# (A_{mu} \sum_{t}^{N} \sum_{g \neq m,u,ch,c}^{N} B_{ut} Y_{tg})$	Chinese VA contained in exports linked to complex chains from Mexico to the US, which is ultimately consumed in the rest of the world.
C4.6	$(V_u B_{um})' \# (Y_{mu} + A_{mu} \sum_{t}^{N} \sum_{g}^{N} B_{ut} Y_{tg})$	US VA contained in exports linked to complex chains from Mexico to the US, ultimately consumed in any country in the world.
C4.7	$(V_c B_{cm})' \# (Y_{mu} + A_{mu} \sum_{t}^{N} \sum_{g}^{N} B_{ut} Y_{tg})$	Canadian VA contained in exports linked to complex chains from Mexico to the US, ultimately consumed in any country in the world.
C4.8	$\left(\sum_{t \neq m,u,ch,c}^{N} V_t B_{tm}\right)' \# (Y_{mu} + A_{mu} \sum_{t}^{N} \sum_{g}^{N} B_{ut} Y_{tg})$	VA from the rest of the world contained in exports linked to complex chains from Mexico to the US, ultimately consumed in any country in the world.

On the other hand, a comparative analysis is made of the origin at the country-sector level of the value added contained in Mexican manufacturing exports to the US and Canada. This will allow us to approximate the level of sophistication of intermediate inputs from China and North American countries used in the production of Mexican manufacturing exports to North America. This is possible by applying Leontief's standard decomposition (Wang *et al*., 2013).

Based on the Leontief demand-based input-output model of N countries and n sectors, the matrix of value-added multipliers of the total global matrix is calculated as follows:

$$M^{VA} = \hat{V}B \tag{14}$$

M^{VA} is a matrix of order NnxNn, which contains in its elements the value added multipliers. $\hat{V}$ is the diagonal matrix of order NnxNn of the value added coefficients and B is the Leontief inverse global matrix of order NnxNn.

Multiplying equation (14) by the diagonal matrix of gross exports of the "N" countries to country group "Z":

$$M^{VA}E_{NZ} = \hat{V}B\widehat{E_{NZ}} \tag{15}$$

$M^{VA}\widehat{E_{NZ}}$ is a matrix NnxNn that disaggregates the value added exported by the corresponding country (according to the column or row analyzed) belonging to the "N" countries to a group of countries "Z." $\widehat{E_{NZ}}$ is a diagonal matrix NnxNn, which contains the exports of each of the countries of the global matrix to the group of countries "Z." Extracting and aggregating the columns corresponding to the manufacturing sectors of the columns corresponding to the Mexican manufacturing sectors of the matrix $M^{VA}\widehat{E_{NZ}}$ allows us to estimate the origin of the exports to each of the countries of the global matrix.

The input-output analysis shows that the value added contained in Mexico's manufacturing exports to North America is not only a product of the Mexican manufacturing sector, but also of the Mexican manufacturing sector.

The input-output analysis presents some limitations for the analysis of GVCs. The first is linked to the use of proportionality in the allocation of intermediate inputs to the production of different sectors (De Gortari, 2017). Additionally, due to existing discrepancies between countries' national accounts, changes are made to the matrix of technical coefficients, using a balancing method, in the compilation of the global matrices (Dietzenbacher *et al*., 2013). The third relates to the assumption of constant returns to scale (Miller and Blair, 2009). These limitations decrease their relevance in ex-post analyses covering more than one year due to the change aroused in the production function year by year (Nagengast and Stehrer, 2016).

4. LITERATURE REVIEW

This section presents the main findings of relevant studies on the impact of China on Mexico's insertion into North American and global chains. Dussel-Peters and Gallagher (2013) analyze China's presence in the NAFTA area and argue that, during 2001-2010, China displaced Mexico in the US market and began to compete with it in the Mexican market. The study points out that, between 2001 and 2004, Mexico was the second largest source of US imports, behind only Canada; however, it was displaced by China as of 2004. It notes a drop in the US share of Mexican imports from 75% during the first five years of NAFTA to 50% in 2009. In this scenario, the authors identify that 96% of US exports to Mexico and 81% of Mexican exports to the US are facing the "Chinese threat."

At the sectoral level, the study highlights China's limited presence in the automotive industry, a reality attributed to Mexico's leadership as a supplier of auto parts for the North American chain. Dussel-Peters and Ortiz-Velásquez (2016) explore the impact of China on North American intraregional trade using various foreign trade indicators. These authors claim that intraregional trade peaked in 1999 and since then has suffered a decline due to the regional disintegration caused by China's growing presence in North American production chains. According to the study, China was successfully integrated into the electronics and automotive chains, although with less intensity in the latter. Furthermore, they found that in 2014, 67% of intra-regional exports were under the "China threat."

Chiquiar and Tobal (2019) analyze Mexico's insertion in GVCs from a historical perspective, through a technique that combines input-output analysis and the use of gross foreign trade statistics. The authors argue that China is one of the main factors behind the structural changes in Mexico's insertion pattern in the GVCs. According to the study, China's entry into the WTO in 2001 coincided with a reduction in the number of stages of the production chain carried out in

Mexico, a situation that began to reverse in the mid and late 2000s. However, this return was accompanied by a greater share of relatively less skilled labor-intensive industries.

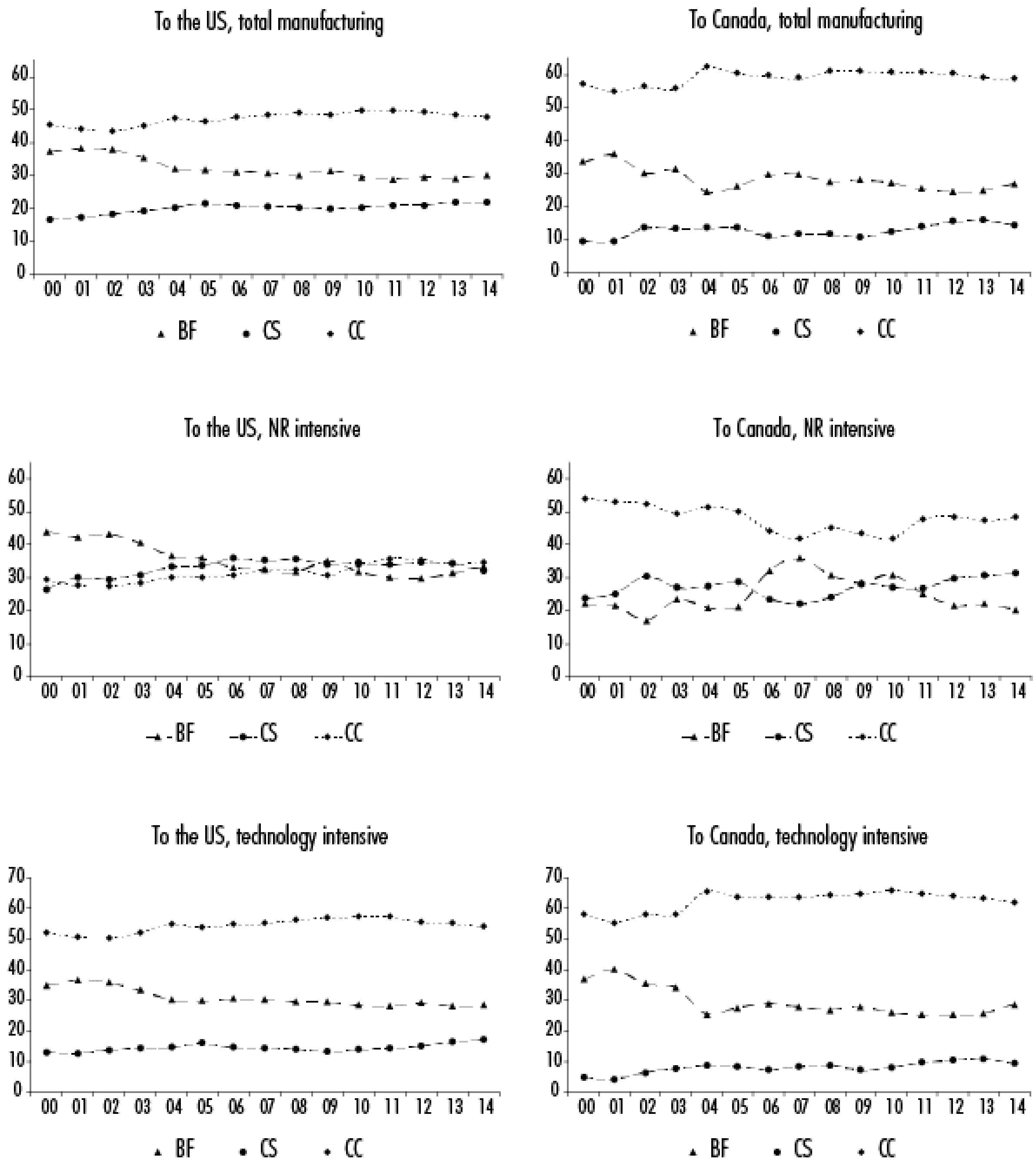
Meanwhile, Dussel-Peters (2020) studies the triangular relationship between China, Mexico, and the US between 1991 and 2017. According to the author, China is the main factor behind the trade disintegration suffered in North America since 2001. Dussel-Peters also emphasizes the growing importance of China as a supplier of capital goods to North American industry (in 2003 it surpassed the US as the main supplier and in 2010 the three North American countries as a whole), evidence of the technological change experienced in the region's imports from China. The study points out that the abrupt imposition of tariffs on imports from China will not easily reverse the trends observed over the last two decades, and that the economic policy agenda must go beyond the trade war and focus on shoring up the internal competitiveness of the North American region.

5. FINDINGS

The insertion of Mexican manufacturing exports to North America in GVCs mainly occurs through participation in complex chains (see Figure 3). This pattern remained stable between 2000 and 2014; however, there are differences between technology-intensive manufacturing and that which processes NR. In 2014, 54.2% of technology-intensive exports and 34.6% of NR-intensive exports to the US belonged to complex chains. The main reason is that NR-based chains tend to be shorter.

A country participates in complex chains in two ways: 1) by using foreign inputs in the production of its exports, or 2) by exporting domestic inputs used by recipient countries to produce their own exports.

Figure 3. Breakdown of Mexican manufacturing gross exports to the
US and Canada into final goods, simple chains, and complex chains, 2000-2014 (percentages)



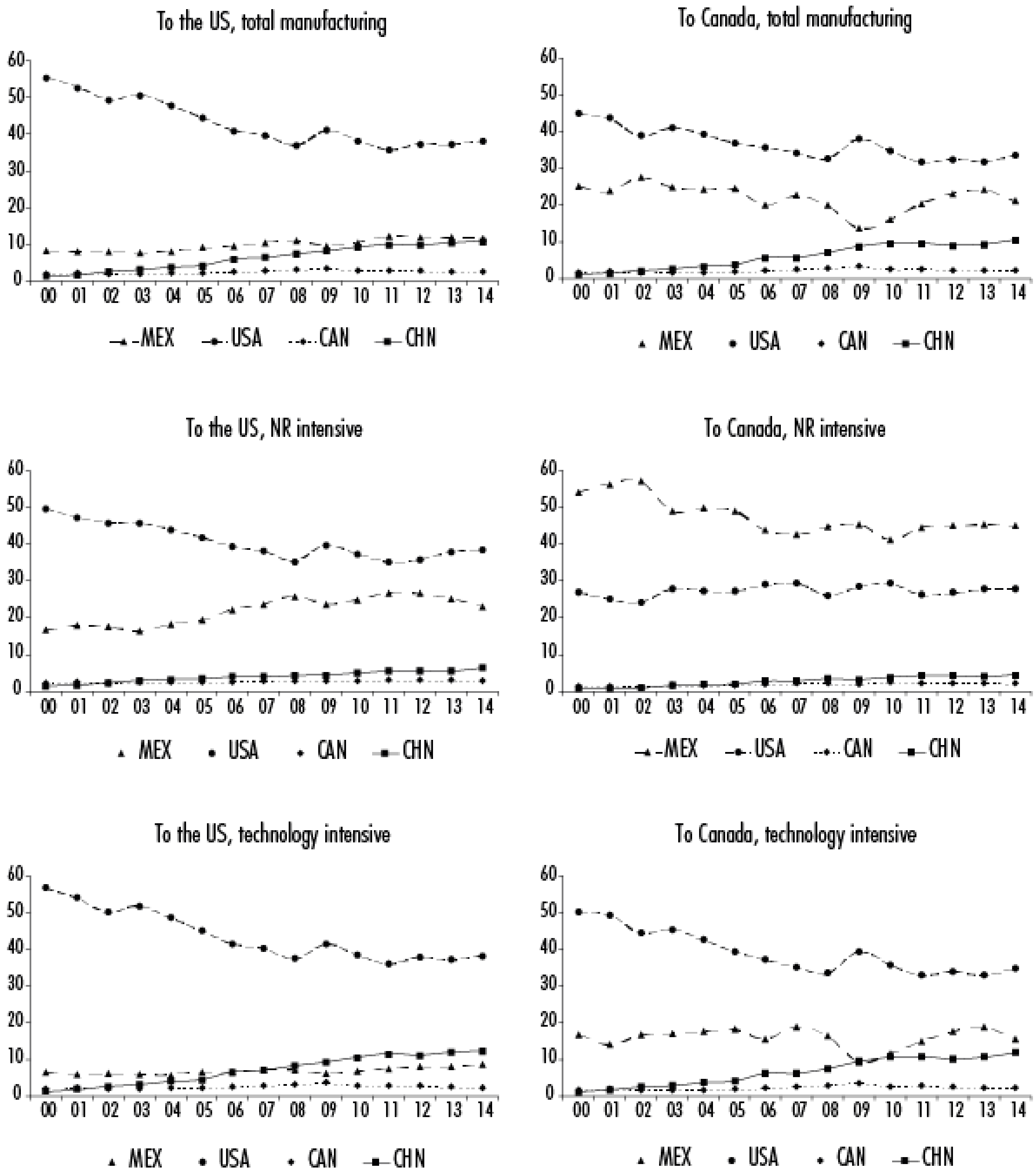
Note: BF: final goods (C1, table 2); CS: simple chains (C2, table 2); CC: complex chains (C3 and C4, table 2).

Source: Compiled by the author based on data from WIOD Release 2016 (Timmer et al., 2016).

In the case of Mexican manufacturing, its participation occurs mainly through the first channel (see Figure 3). In 2014, for every US$100 exported to the US by Mexican manufacturing linked to complex chains, US$89.7 was value added from abroad (this value rises to US$77.1 for NR-intensive products and US$93 for technology-intensive products).

Figure 4 breaks down the value-added incorporated in Mexico's exports of complex chains to North American countries by country of origin. NAFTA led to the transfer of some production stages (mainly assembly activities), which were carried out in the US, to Mexico. With the exception of exports intensive in NRM to Canada, the US was the main country of origin of the value-added incorporated in Mexican exports of complex chains to North American countries. Canadian value added was consistently low throughout the period, suggesting reduced levels of productive integration between Mexico and Canada.

Figure 4. Geographical origin of value added in Mexican manufacturing gross exports to the US and Canada (complex chains), 2000-2014 (percentages)



Note: The percentage not covered by Mexico (MEX), the US (USA), Canada (CAN), and China (CHN) pertains to the rest of the world.

Source: Compiled by the author based on data from WIOD Release 2016 (Timmer et al., 2016).

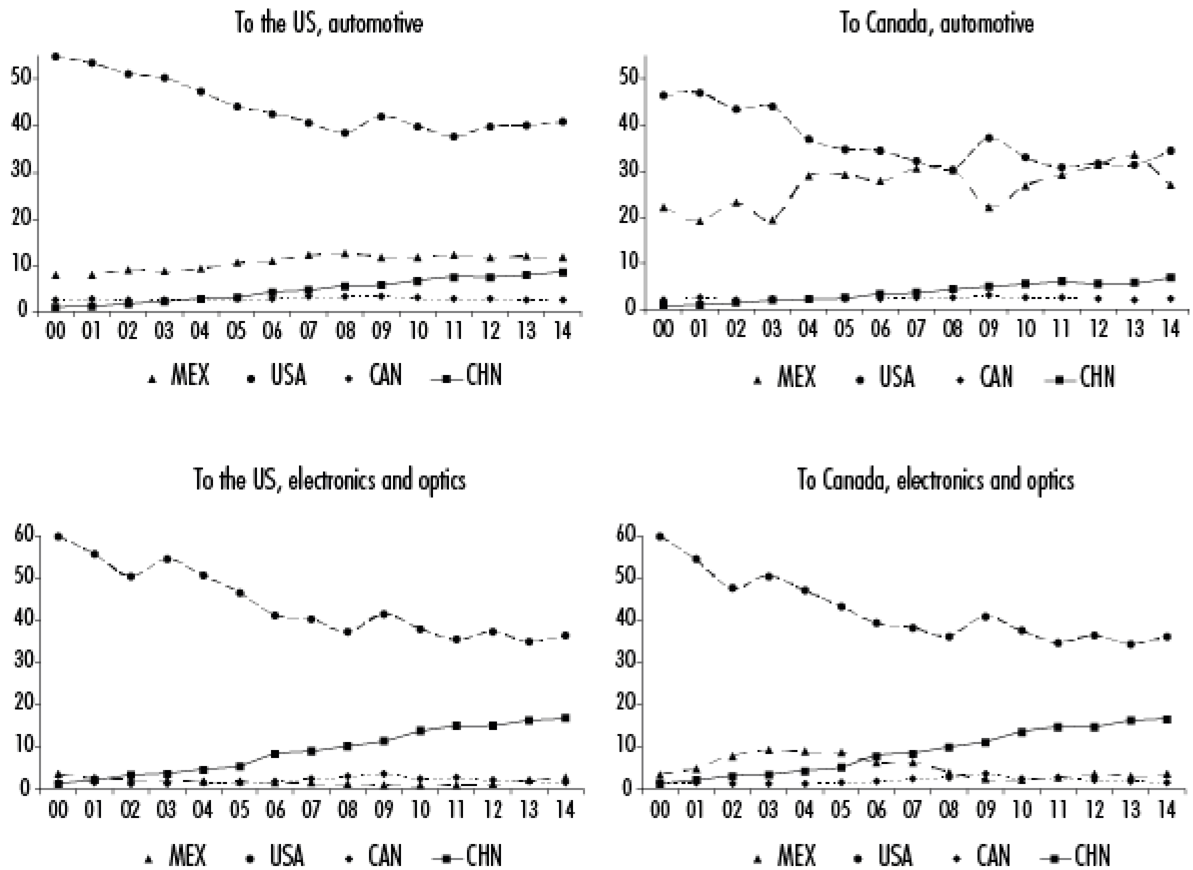
Between 2000 and 2014, US value-added represented, on average, 43% of the value added exported by Mexican manufacturing linked to complex chains to the US, and 36.7% to Canada.

However, in the same period, the share of US value-added fell by 17.1% in manufacturing exports to the US and by 11.6% to Canada, with these levels being higher in the case of technology-intensive products (18.5% and 12%, respectively). This drop was accompanied by an increase in the share of Chinese value-added of 9.5% between 2000 and 2014.

The above is the result of the commercial and productive triangulation between China, Mexico, and North American countries following China's entry into the WTO. China's incursion as a supplier of value added in the complex chains in which Mexican manufacturing exports to the US participate even exceeds the share of Mexican value added in the case of technology-intensive manufacturing. In 2014, for every US$100 exported to the US linked to complex chains, US$8.4 originated in Mexico and US$12.1 in China. The Asian presence in North American complex chains, in which Mexico participates as an exporter, is one of the factors that contributed to the failure of the export-led growth strategy and, in addition, led to the process of productive disintegration in North America since 2001 (Dussel-Peters, 2018).

Figure 5 shows notable differences in the distribution of value-added according to geographical origin in the automotive and electronics-optics chain. Between 2000 and 2014, Chinese value-added contained in automotive exports linked to complex chains to the US represented, on average, 4.7%, while regional value-added (from the US, Mexico, and Canada) 57.8%. For the electronics-optics chain, these values amounted to 9.1% and 48%, respectively. Furthermore, in 2014, for every US$100 exported to the US linked to complex chains, US$8.6 originated in China in the automotive chain and US$16.6 in the electronics-optics chain. This behavior is similar in exports to Canada.

Figure 5. Geographical origin of value added contained in gross exports of Mexico's automotive and electronics-optics chain to the US and Canada (complex chains), 2000-2014 (percentages)



Note: The percentage not covered by Mexico (MEX), the US (USA), Canada (CAN), and China (CHN) pertains to the rest of the world.

Source: Compiled by the author based on data from WIOD Release 2016 (Timmer et al., 2016).

China was able to enter the electronics-optics chain with greater intensity than in the automotive chain, due to the lack of capacity of local suppliers of electronic components to compete with imported inputs. According to data from Mexico's 2013 Input-Output Matrix (INEGI, 2018), only 12% of the production of the subsector "334 — Manufacture of computer, communication, measuring and other electronic equipment, components and accessories" comes from domestic inputs. In contrast, in the case of the subsector "336 — Manufacture of transport equipment," 38% of its production is linked to the use of domestic intermediate products.

One of the purposes of the renegotiation of NAFTA was to increase the regional content in the North American automotive chain, with the aim of halting the advance of China as an input supplier (Ortiz-Velásquez and Peralta, 2019). However, the presence of Chinese value added is greater in the electronics-optics chain, which suggests the interest of the countries of the region in protecting the automotive industry. This is explained by the articulating role that this industry holds in North America (Aroche-Reyes and Márquez, 2018), as well as by the levels of political pressure it tends to exert in the US (Sturgeon and Van Biesebroeck, 2011).

The North American automotive chain generates a division of labor in which Mexico specializes in the manufacture of auto parts and the assembly of light vehicles, while the US and Canada produce technology-intensive inputs and assemble heavy vehicles. Blecker *et al*. (2021) argue that the success of the automotive chain in the framework of regional integration is not due to a free trade scheme, but rather, to the restrictive rules of origin established following NAFTA.

China succeeded in instrumentalizing NAFTA to introduce its value-added into the region by exporting inputs to Mexico, which are then used to produce final goods consumed mainly in the US and Canada (see Table 4). Between 2000 and 2014, for every US$100 of Chinese value-added incorporated into Mexican manufacturing exports to the US, US$95.5 was ultimately consumed in the US. In the case of exports to Canada, the value amounted to US$83.9. The participation of Mexico and the rest of the world as final consumers was low.

Table 4. Distribution of Chinese value-added according to its final destination contained in manufacturing exports from Mexico to the US and Canada, 2000-2014 (percentages).

Country of final destination of Chinese value-added	*To the US*		*To Canada*	
	Aver-age	*Difference*	*Aver-age*	*Difference*
US	95.49	-2.20	11.56	-5.05
Canada	0.93	0.52	83.91	3.79
Mexico	0.43	0.05	0.26	-0.03
North America	**96.85**	**-1.62**	**95.72**	**-1.29**
China	0.30	0.51	0.36	0.35
Rest of the world	2.85	1.11	3.92	0.94
Total	**100.00**	**0.00**	**100.00**	**0.00**

Note: Simple average from 2000 to 2014. The difference is the 2014 value minus the 2000 value.

Source: Compiled by the author based on data from WIOD Release 2016 (Timmer et al., 2016).

Between 2000 and 2014, Chinese value-added not only intensified its presence in Mexican exports to North America, but also had a change in its sectoral composition that suggests an increase in the sophistication of the inputs imported by Mexico (see Table 5). During this period, the share of technology-intensive manufacturing and knowledge-intensive services in Chinese value added embodied in Mexican exports increased by 9.5%.

At the same time, inputs from the US and Canada used by Mexican manufacturing exports to the region underwent a process of reprimarization. Between 2000 and 2014, at the cost of reduced participation from technology-intensive manufacturing and knowledge-intensive services, the primary sector increased its contribution to US value-added incorporated in Mexican exports by 7.6% and to Canadian value added by 13.8%.

The sectoral composition of Mexican value-added incorporated in its own exports to the region remained relatively stable; however, the low participation of knowledge-intensive services and a lower contribution of technology-intensive manufacturing than in the case of Chinese and US value-added stand out.

This study's findings show not only a displacement of the US by China in the incorporation of value-added in Mexican exports to North America, but also a trend towards a loss of sophistication of US and Canadian intermediate inputs compared to those from China.

Table 5. Sectoral composition of North American and Chinese value added in Mexican manufacturing exports to the US and Canada (percentages)

Country/Sector	*2000*	*2014*	*Difference*
US			
Primary sector	5.2	12.8	7.6
NR-intensive manufacturing	28.6	30.0	1.4
Technology intensive manufacturing	32.8	25.9	-6.9
Knowledge-intensive services	14.9	14.4	-0.5
Others	18.5	17.0	-1.6
Mexico			
Primary sector	14.4	14.4	0.0
NR-intensive manufacturing	39.8	39.9	0.0
Technology intensive manufacturing	22.0	19.2	-2.8
Knowledge-intensive services	2.8	3.3	0.6
Others	21.0	23.2	2.2
Canada			
Primary sector	17.0	30.8	13.8
NR-intensive manufacturing	31.1	25.1	-5.9
Technology intensive manufacturing	14.9	9.1	-5.8
Knowledge-intensive services	13.4	13.3	-0.1
Others	23.6	21.6	-1.9
China			
Primary sector	14.4	12.8	-1.6
NR-intensive manufacturing	36.1	26.5	-9.6
Technology intensive manufacturing	19.6	26.8	7.2
Knowledge-intensive services	10.3	12.6	2.3
Others	19.6	21.3	1.8

Note: The difference is the 2014 value minus the 2000 value.

Source: Compiled by the author based on data from WIOD Release 2016 (Timmer et al., 2016).

6. CONCLUSIONS

2001 marked the beginning of China's growing participation in North American trade. Chinese value added in Mexico's manufacturing exports to the countries of the region increased rapidly during the study period, being one of the main reasons for the process of productive and commercial disintegration experienced in North America.

Most of the value-added contained in Mexican manufacturing exports to the US originates in that country. However, the share of US value-added declined, displaced mainly by Chinese value-added, which is ultimately consumed in the US. China's incursion is more intense in technology-intensive manufacturing, to such an extent that in 2014 the Mexican value-added incorporated in manufacturing exports linked to complex chains of this type of goods was lower than the contribution made by Chinese value-added.

The data obtained show Mexico's poor competitive performance in the complex North American chains in which it participates as an exporter, with worse results in the case of technology-intensive products. This behavior has been underpinned by the growing presence of China in the value-added exported by Mexican manufacturing. This research not only finds empirical evidence of the displacement of the US by China in the incorporation of value-added in Mexican manufacturing exports to North America, but also shows a process of reprimarization of intermediate inputs from the US and Canada, which Mexican manufacturing uses to produce its exports, as opposed to inputs from China, which contain increasing levels of value-added generated in technology-intensive manufacturing and knowledge-intensive services.

The results obtained support the hypothesis that the renegotiation of NAFTA was just another step in the trade war between the US and China. Additionally, the specific analysis of the automotive and electronics-optics chain revealed the preference of North American countries to protect the automotive industry from China's advance in the region.

This article opens up the possibility of carrying out future studies in different directions to better understand the evolution and effects of China's presence in the region. In subsequent work, and depending on the availability of recent data, we suggest updating this research to study the effects of the new NAFTA (USMCA), the reconfiguration of GVCs, and COVID-19 on Mexico's and the region's trade relations with China. It is also crucial to analyze the effects of China's presence on the Mexican manufacturing industry, which exports to the domestic market, and to carry out a more detailed study of the sectoral composition of the value added incorporated in Mexican exports to the region.

In methodological terms, the proposed decomposition of gross exports to analyze processes of commercial and productive triangulation can be expanded in future research, via an algebraic treatment that allows the isolation of the double-counting components. Similarly, the introduction of trade and/or business microdata could provide material for a detailed analysis of specific chains. Finally, economic and trade policymakers should go beyond the renegotiation of NAFTA and formulate more and better measures to strengthen the competitiveness of the entire area. In the case of Mexico specifically, new strategies must be designed to strengthen the domestic market through greater incorporation of local value added into international and North American production chains.

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ANNEXES

Table A.1. Grouping of NACE Rev.2 classification economic activities

Primary Sector
Agriculture, livestock, and hunting
Forestry and logging
Fishing and aquaculture
Mining and quarrying
NR-intensive manufacturing industry
Food, beverages, and tobacco products
Textiles, clothing, and leather products
Wood, wood products, and cork, except furniture, straw products, and plaiting materials
Paper and paper products
Printing and reproduction of recorded media
Coke and refined petroleum products
Chemicals and chemical products
Rubber and plastic products
Other non-metallic mineral products
Basic metals
Fabricated metal products, except machinery and equipment
Furniture, other manufactured goods
Technology-intensive manufacturing
Basic pharmaceutical products and pharmaceutical preparations
Optical, electronic, and computer products
Electrical equipment
Machinery and equipment
Motor vehicles, trailers, and semi-trailers
Other transportation equipment
Knowledge-intensive services
Maritime and inland waterway transportation
Air transport
Publishing activities
Motion picture, video, and television program activities sound recording, and music publishing activities; radio and television programming and broadcasting activities
Telecommunications
Programming, consultancy, and other information technology activities; information service activities

Table A.2. Breakdown of Mexico's gross exports to Canada, according to origin of total value added and final destination of Chinese value-added

Component	Mathematical formula	Description
C1	$(V_m L_{mm})' \# Y_{mc}$	Mexican Value Added (VA) contained in Mexico's exports of final goods to Canada.
C2	$[(V_m L_{mm})' \# (A_{mu} L_{cc} Y_{cc})]$	Mexican VA contained in exports linked to simple chains from Mexico to Canada.
C3	$[(V_m B_{mm} - V_m L_{mm})' \# Y_{mc}] + \left[(V_m B_{mm})' \# (A_{mc} \sum_{t}^{N} \sum_{g}^{N} B_{ct} Y_{tg})\right] - [(V_m L_{mm})' \# (A_{mc} L_{cc} Y_{cc})]$	Mexican VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in any country in the world.
C4.1	$(V_{ch} B_{chm})' \# (Y_{mc} + A_{mc} \sum_{t}^{N} B_{ct} Y_{tc})$	Chinese VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in Canada.
C4.2	$(V_{ch} B_{chm})' \# (A_{mc} \sum_{t}^{N} B_{ct} Y_{tch})$	Chinese VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in China.
C4.3	$(V_{ch} B_{chm})' \# (A_{mc} \sum_{t}^{N} B_{ct} Y_{tu})$	Chinese VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in the US.
C4.4	$(V_{ch} B_{chm})' \# (A_{mc} \sum_{t}^{N} B_{ct} Y_{tm})$	Chinese VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in Mexico.
C4.5	$(V_{ch} B_{chm})' \# (A_{mc} \sum_{t}^{N} \sum_{g \neq m,u,ch,c}^{N} B_{ct} Y_{tg})$	Chinese VA contained in exports linked to complex chains from Mexico to Canada, finally consumed in the rest of the world.
C4.6	$(V_c B_{cm})' \# (Y_{mc} + A_{mc} \sum_{t}^{N} \sum_{g}^{N} B_{ct} Y_{tg})$	Canadian VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in any country in the world.
C4.7	$(V_u B_{um})' \# (Y_{mc} + A_{mc} \sum_{t}^{N} \sum_{g}^{N} B_{ct} Y_{tg})$	US VA contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in any country in the world.
C4.8	$\left(\sum_{t \neq m,u,ch,c}^{N} V_t B_{tm}\right)' \# (Y_{mc} + A_{mc} \sum_{t}^{N} \sum_{g}^{N} B_{ct} Y_{tg})$	VA from the rest of the world contained in exports linked to complex chains from Mexico to Canada, ultimately consumed in any country in the world.

BIBLIOGRAPHY

Aroche-Reyes, F. and Márquez, M. (2018). La articulación productiva en América del Norte en 2005. Un análisis de redes. *Economía Teoría y Práctica, 4*. https://doi.org/10.24275/ETYPUAM/NE/E042018/Aroche

Baldwin, R. and Tomiura, E. (2020). Thinking ahead about the trade impact of Covid-19. In R. Baldwin and B. Weder di Mauro (eds.). *Economics in the time of Covid-19* (pp. 59-72). Centre for Economic Policy Research (CEPR).

Blecker, R. A. (2014). The Mexican and U.S. economies after twenty years of NAFTA. *International Journal of Political Economy, 43(2)*. https://www. tandfonline.com/doi/abs/10.2753/IJP0891-1916430201

Blecker, R. A., Moreno-Brid, J. C. and Salat, I. (2021). What policies make sense in a US-Mexico trade deal? In R. Hinojosa-Ojeda and E. Telles (eds.). *The Trump paradox: migration, trade, and racial politics in US-Mexico integration* (pp. 174-188). University of California Press.

Borin, A. and Mancini, M. (2019). Measuring what matters in global value chains and value-added trade. *Policy Research Working Paper 8804*. Washington, DC: World Bank.

Chiquiar, D. and Tobal, M. (2019). Cadenas Globales de Valor: una perspectiva histórica. *Documentos de Investigación No. 2019-06*. Banco de México.

Comisión Económica para América Latina y el Caribe (CEPAL) (2007). Progreso técnico y cambio estructural en América Latina. *Documento de Proyecto CAN 97/025*. CEPAL. Tabla A.2. Descomposición de las exportaciones brutas de México a Canadá, de acuerdo con el origen del valor agregado total y destino final del valor agregado chino.

De Gortari, A. (2017). Disentangling global value chains. *Meeting Papers 139*. Society for Economic Dynamics.

Dietzenbacher, E., Los, B., Stehrer, R., Timmer, M. and de Vries, G. (2013). The construction of World Input-Output tables in the WIOD Project. *Economic Systems Research, 25(1)*. https://doi.org/10.1080/09535314.2012.761180

Dussel-Peters, E. (2018). La renegociación del TLCAN. Efectos arancelarios y el caso de la cadena de calzado. *Investigación Económica, LXXVII(303).* http://dx.doi.org/10.22201/fe.01851667p.2018.303.64154

______ (2020). The new triangular relationship between China, the United States, and Mexico: Implications for intra-NAFTA trade. *The International Trade Journal, 34(1).* https://doi.org/10.1080/08853908.2019.1696256

Dussel-Peters, E. and Gallagher, K. (2013). NAFTA's uninvited guest: China and the disintegration of North American trade. *CEPAL Review (110)*. http:// hdl.handle.net/11362/37000

______ and Ortiz-Velásquez, S. (2016). El Tratado de Libre Comercio de América del Norte, ¿contribuye China a su integración o desintegración? In E. Dussel-Peters, *La nueva relación comercial de América Latina y el Caribe con China ¿integración o desintegración regional?* (pp. 13-58). Unión de Universidades de América Latina y el Caribe.

European Statistical Office (EUROSTAT) (2017). *NACE Rev. 2 Estructura y notas explicativas.* EUROSTAT.

Fujii-Gambero, G. and Cervantes, R. (2013). México: valor agregado en las exportaciones manufactureras. *Revista de la CEPAL (109)*. http://hdl.handle. net/11362/11575

______ and García-Ramos, M. (2015). Revisiting the quality of exports. *Journal of Economic Structures, 4(17)*. https://doi.org/10.1186/s40008-015- 0029-0

Instituto Nacional de Estadística y Geografía (INEGI) (2018). Matriz insumo-producto de México 2013. https://www.inegi.org.mx/programas/mip/ 2013

Leontief, W. (1936). Quantitative input and output relations in the economic systems of the United States. *The Review of Economics and Statistics, 18(3)*. https://doi.org/10.2307/1927837

Miller, R. and Blair, P. (2009). *Input-output analysis foundations and extensions.* Cambridge University Press.

Nagengast, A. and Stehrer, R. (2016). Accounting for the differences between gross and value added trade balances. *The World Economy, 39(9).* https:// doi.org/10.1111/twec.1240196

Ortiz-Velásquez, S. and Peralta, E. (2019). Perspectivas de la industria mexicana ante la renegociación del TLCAN y China. *Economía informa (415).* http:// www.economia.unam.mx/assets/pdfs/econinfo/415/03OrtizVelasquez. pdf

Sturgeon, T. and Van Biesebroeck, J. (2011). Global value chains in the automotive industry: an enhanced role for developing countries? *International Journal of Technological Learning, Innovation and Development, 4(1/2/3)*. https://www.inderscienceonline.com/doi/abs/10.1504/IJTLID. 2011.041904

Timmer, M., Los, B., Stehrer, R. and de Vries, G. (2016). An anatomy of the global trade slowdown based on the WIOD 2016 Release. *GGDC Research Memorandum 162*. University of Groningen.

Wang, Z., Wei, S.-J. and Zhu, K. (2013). Quantifying international production sharing at the bilateral and sector levels. *NBER Working Paper 19677.* February 2018 Version. National Bureau of Economic Research.

______, Wei, S.-J., Yu, X. and Zhu, K. (2016). Characterizing global value chains. *Working Paper No. 578*. Center for International Development.

[1] These events are the US-China trade war, the renewal of the US-Mexico-Canada Free Trade Agreement in 2018, and the reorganization of value chains partially caused by the Covid-19 crisis (Baldwin and Tomiura, 2020).

[2] Two types of manufacturing production can be identified: natural resource-intensive and technology-intensive. For more information on the sectors that make up these types of industries, see Annex A.1.

[3] For more information, see Annex A.1.

[4] The procedure is performed in a similar manner for country "s" or any of the "t" countries.

[5] Annex A.2 details the decomposition to analyze the China-Mexico-Canada triangular relationship.