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Dossier

Determinants of US-Mexico trade under the USMCA

Determinantes del comercio entre Estados Unidos y México bajo el T-MEC

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Abstract: The USMCA will impose a restructuring of the North American supply chains to meet the new input content requirements. To evaluate the determinants of the US-Mexico trade under the new agreement, an econometric model is estimated. The estimations indicate that the distance from the US states to the Mexican border and the size of the economies of the states of Mexico are factors that impact trade between the two countries. Tariffs applied under the USMCA have had a minor but positive impact. Foreign direct investment showed positive effects on trade, indicating the existence of value chains between the US and Mexico. The results suggest that polices to encourage trade between the two countries would require the development of transportation infrastructure, as well as the promotion of investment in strategic sectors to further develop regional supply chains.

Keywords: Trade, NAFTA, USMCA, Mexico, panel models

Resumen: El T-MEC impondrá una reestructuración de las cadenas de suministro de América del Norte para cumplir con los nuevos requisitos de contenido de insumos. Para evaluar los determinantes del comercio entre Estados Unidos y México bajo el nuevo acuerdo, se estima un modelo econométrico. Las previsiones indican que la distancia entre los estados de Estados Unidos y la frontera con México, así como el tamaño de las economías de los estados de México son factores que impactan el comercio entre los dos países. Los aranceles aplicados bajo el T-MEC han tenido un impacto menor pero positivo. La inversión extranjera directa mostró efectos positivos en el comercio, lo que indica la existencia de cadenas de valor entre Estados Unidos y México. Los resultados sugieren que las políticas para fomentar el comercio entre los dos países requerirían el desarrollo de infraestructura de transporte, así como la promoción de inversiones en sectores estratégicos para desarrollar aún más las cadenas de suministro regionales.

Palabras clave: Comercio, TLCAN, T-MEC, México, modelos de panel.

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1. Introduction

Trade between the United States (USA) and Mexico encompasses a great variety of goods and services. One of the main characteristics of that trade is the large share of intra-industry trade, which is principally concentrated in the automobile industry, electronics, and telecommunications. Also, the size of the economies, together with the development of value chains emerging from vertical foreign direct investment (FDI) and transportation costs in the manufacturing sector have been important sources of regional economic integration between the two countries.

The establishment of the North American Free Trade Agreement (NAFTA) was a factor in promoting trade and investment among the member countries. Specifically, NAFTA gradually reduced the tariff structure, and established rules of origin for input content in the North American region, as well as rules for the protection of foreign direct investment. The effects of the establishment of NAFTA have been extensively studied.

Regarding the effects of NAFTA on trade between the three countries, the rapid increase in trade and the growing importance of trade from Mexico and Canada in total trade with the United States stand out. Likewise, it is noteworthy that, with the establishment of NAFTA, there were important changes in trade and investment patterns, generating a greater synchronization of trade with the economic cycles of the United States and Mexico (Villareal and Fergusson, 2014). The implementation of NAFTA accelerated the development of intra-industrial trade between the United States and Mexico. Particularly, vertical intra-industrial trade has been very significant,

reflecting the trade pattern of the region based on the differentiation of traded goods in terms of value, quality and their role in the production process (Ekayanake, Veeramacheneni and Moslaresm 2009). Hillberry and McDaniel (2002) analyzed the characteristics of trade growth between the US, Mexico, and Canada. The authors concluded that there is intense growth in trade in the North American region. In this regard, they indicated that two characteristics of trade between the US and Mexico are that the US industries have faced competition from Mexican imports, and that US consumers and manufacturers have had access to imports from Mexico at a lower cost. In their study, Burfisher, Robinson and Karen (2001) indicated that for the United States, the establishment of NAFTA had a positive but limited impact on that country's trade, and they pointed out small but positive effects for the US economy. Waldkirch (2010), analyzed the impact of NAFTA considering foreign direct investment; the results suggest that there are positive effects on productivity and wages in Mexico. De La Cruz, and Riker (2014) estimated the impact of NAFTA on US labor markets and they found small but positive effects on the real wages of skilled workers in the United States.

The recent changes in US trade policy leading up to the USMCA introduced a scenario of increased value-added content in the North American region for the automobile, electronics, aluminum, and steel industries. The establishment of the US-Mexico-Canada Agreement (USMCA) would modernize aspects of trade in services and digital commerce, and would change the rules of origin, that in this agreement would demand a larger percentage of inputs from the North American region. The modifications of the new agreement could have positive or negative effects,

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depending on the capacity of adaptation of the manufacturing sector, both in the USA and Mexico.

The present paper is aimed at evaluating the determinants of trade between the USA and Mexico, at the regional level. Specifically, the research seeks to estimate the effects of tariffs and transportation costs on trade between Mexico and US states. The research methodology consists of an empirical adaptation of a gravity model for estimating the determinants of trade between countries and regions. This econometric model, based on the gravitational equation, has been extensively used in empirical studies on trade relations between countries. From this perspective, the assumptions are that bilateral trade between the US and Mexico, at the regional level, depends on the level of income, population, distance, and the tariff structure, as well as additional control variables.

The paper is structured as follows: first, the introduction of the objectives of the paper. In the second section, the characteristics of NAFTA and its effects on trade between the US and Mexico are discussed. In section three the characteristics of the manufacturing sector in North America and the new provisions of the USMCA are presented. In section four the major determinants of the US-Mexico trade and the methodology of the empirical model are discussed. In section five the econometric results are explained, and section six presents the conclusions.

2. NAFTA and US Mexico trade

2.1 NAFTA provisions

The most important aspects of NAFTA are related to the establishment of provisions to reduce tariffs, design rules of origin, and protect foreign direct investment. Additionally, provisions for intellectual property rights, government procurement, and dispute resolution were generated. Labor and environmental provisions were included in separate NAFTA side agreements.

The tariffs and non-tariff protectionist instruments were gradually eliminated over fifteen years, with the goal of avoiding negative impacts in sectors sensitive to sudden trade liberalization. Depending on the rules of origin, the industries that experienced the most relevant reductions in tariffs were textiles and apparel, which phased out average tariffs of 16% for US exports to Mexico. The elimination of tariffs within the automobile industry was related to the rules of origin requirement of 62.5% of North American content for automobiles, light trucks, transmissions, and engines, and 60% for auto parts. Thus, Mexican tariffs for automobiles, light trucks and auto parts which complied with the rules of origin were reduced or eliminated.

Regarding the protection of agricultural products, a great deal of agricultural trade was liberated when NAFTA was established. In addition, quotas were converted to tariffs, and tariff-sensitive products like corn and sugar experienced a reduction in tariffs over 15 years. For textiles and apparel, the rules of origin determined that preferential treatment would be granted to goods produced with yarns made in North America.

In addition to including trade dispute resolution and government procurement, the agreement established the mechanisms to settle FDI disputes within NAFTA countries. It also incorporated protection for intellectual property rights, providing the basis for expanding offshoring and outsourcing of firms and expanding global networks.

2.2 NAFTA Tariff Elimination Process

Prior to the implementation of NAFTA, Mexico's tariff rates were higher than those of the United States. In 1993, before NAFTA was signed, more than 50% of Mexico's imports entered the US duty-free based on the US Generalized System of Preferences. The remaining imports from Mexico had an average tariff imposed by the US of 2%. In contrast, the average tariff imposed by Mexico on imports of American products was 10% (Villarreal and Fergusson, 2014).

Immediately after NAFTA was established in 1994, the process of eliminating the structure of import tariffs between Canada, the United States and Mexico was initiated. The process was gradual and was planned for a period of fifteen years, to eliminate barriers to the movement of goods and investment1. The appendices of the agreement associated with trade and investment in the automobile sector specified the terms of the elimination of tariffs.

NAFTA provisions also indicated that consultations may be held to expedite the elimination of tariffs when two or more parties agree to that process. As a result, five rounds of negotiations were conducted between the US and Mexico in 1997, 1998, 2000, 2002 and 2008. In 1997, the United States proposed the elimination of reciprocal tariffs in consultation with the

1. North America Free Trade Agreement document. Retrieved from: https://www.cbp.gov/trade/nafta.

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private sector of both countries for chemicals, fabrics and electrical parts classified to eight digits of the harmonized system (HS).

To summarize, the most notable changes in tariff structure occurred in the textile and clothing, automotive and agricultural industries. In the textile and apparel industries, tariffs were phased out for ten years, until they reached the levels determined by the NAFTA rules of origin. Before the signing of the agreement, 35% of Mexican apparel exports faced an average tariff of 17.9% and US textile and apparel exports had an average tariff of 16%. Regarding the automobile industry, Mexican exports of automobiles and light trucks had tariffs of 2.5% and 25%, respectively and US exports of automobiles and light trucks had tariffs of 20%, with between 10 and 20% for auto parts. Tariffs for agricultural products between the US and Mexico were rather low before NAFTA, (around 12%), but US exports were subject to import licensing (Villarreal and Fergusson, 2014). However, based on the rules of origin and the elimination of quotas, by 2017 most of the tariffs between the US and Mexico were reduced or eliminated for all commodities.**2**

2.3 NAFTA and US-Mexico trade

After the establishment of NAFTA, the trade between the three members of the agreement grew exponentially, increasing from 343.7 billion dollars in 1994 to 1.16 trillion dollars in 2019 (Figure 1). The emergence of the Covid-19 pandemic in 2020 resulted in a break in the expansionary trend of total trade in the region, with negative growth observed in that year. The share of the US-Mexico trade within the NAFTA region expanded from 29.1% in 1994 to 51% in

2. Own estimation with information from Tariff Analysis Online, World Trade Organization

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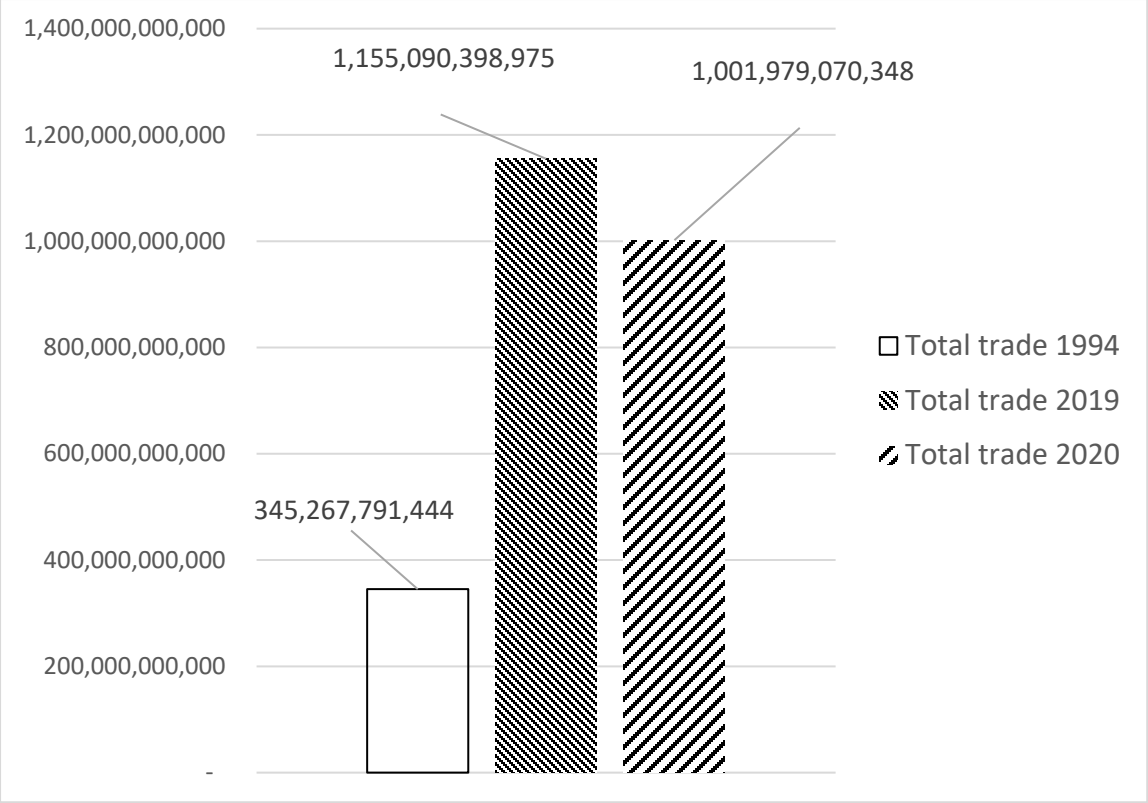
2019[3]. The empirical evidence has created a consensus among economists and policymakers that NAFTA has created an important volume of trade and economic integration among the three countries of the agreement.

Figure 1. Value of trade in the North American region, 1994-2020 (dollars)



Source: Own elaboration with data from United Nations Comtrade data base. https://comtrade.un.org/data/

The trade growth between Mexico and the US was characterized by a more rapid growth in Mexican exports than US exports. Consequently, the trade deficit that Mexico experienced with the US before 1994 became a surplus starting with 1995. In 1995 the trade surplus of the Mexican

3. Estimations based on data from United Nations Comtrade data base. https://comtrade.un.org/data/

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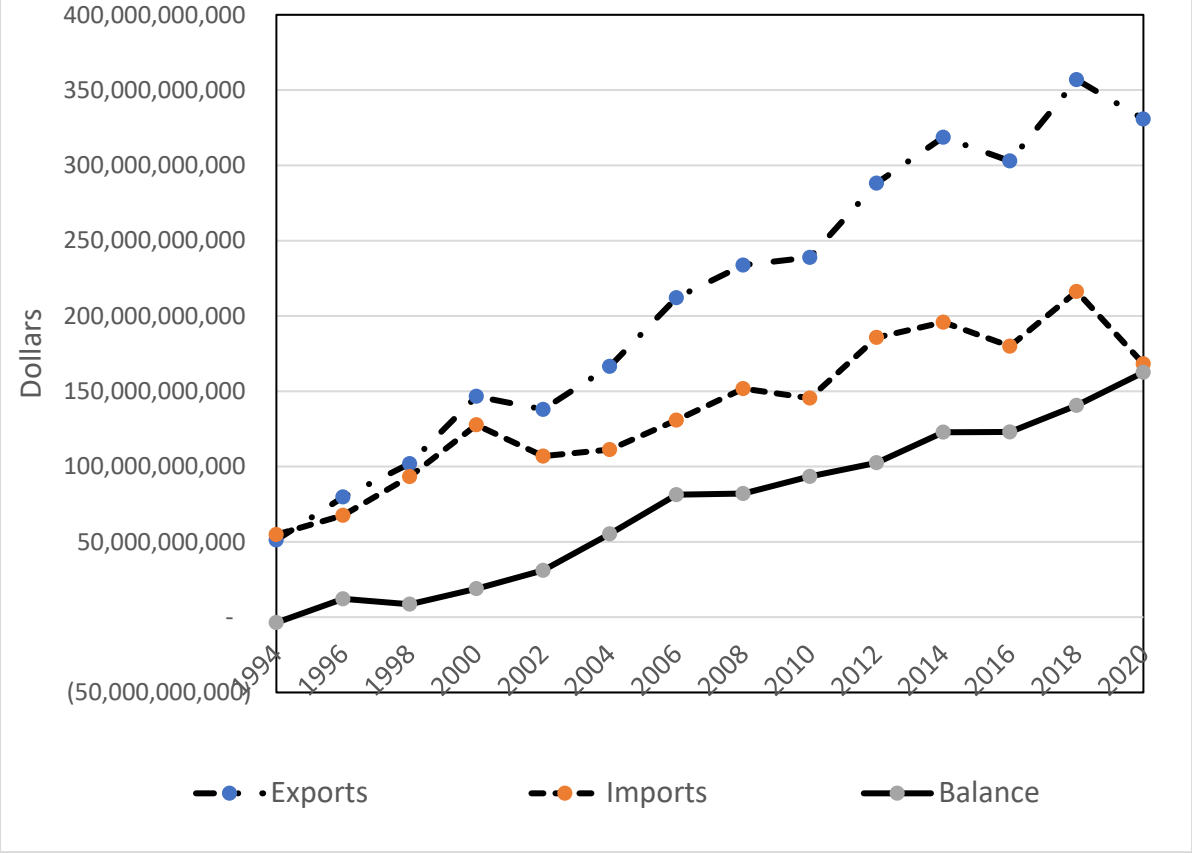
economy with the USA was $11,525 million dollars (Figure 2). The rapid growth of Mexican exports resulted in a surplus of $149,682 million dollars in 2018, more than ten times the surplus of 1995. However, the success of Mexican exports to the USA was, in large part, the result of increasing manufacturing exports from American companies operating in Mexico. It is worth mentioning that by 2020, the contraction of economic activity in the US and particularly in Mexico, markedly reduced the Mexican imports and as a result increased the surplus of this country with the USA to 162,570 million dollars.

Figure 2. Mexico-US trade, 1994-2020



Source: Own elaboration with data from United Nations Comtrade data base. https://comtrade.un.org/data/

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Table 1 shows that the industries with the largest rate of growth of Mexican exports to the USA between 1994 to 2019, were railway parts (16.2%), vehicles (11.6%), beverages (11.84%), optical and medical instruments and parts (11.0%) and machinery and mechanical appliances (10.02%). However, the bulk of Mexican exports were concentrated in vehicles and auto-parts. In 2019, the value of those exports was $100.6 billion dollars. Another important group of Mexican exports are electrical machinery, equipment, and parts, with an export value of $68.9 billion dollars in 2019. Those exports are closely related to the North American supply chain encouraged by US multinational firms in Mexico. Other outstanding exports of Mexico are machinery and mechanical appliances, medical instruments and vegetables and fruits. It should be noted that the average annual growth of Mexican exports in the period was 7.8% between 1994 and 2019. However, this significant expansion experienced an unforeseen break due to the Covid-19 pandemic, showing a significant annual decrease in 2020.

Table 1. Average rate of growth of Major Mexican exports to the US, 1994-2020 (US dollars)

Code	Commodities	US dollars		AARG	
Code	Commodities	2019	2020	AARG (1994-2019)	Annual
	Total exports	358,660,831,881	330,793,896,851	7.80%	-7.80%
87	Vehicles, parts and accessories	100,597,804,264	83,573,849,085	11.60%	-16.90%
84	Nuclear reactors, machinery and mechanical appliances and parts	69,727,907,442	66,164,945,292	10.00%	-5.10%
85	Electrical machinery and equipment and parts	68,897,522,755	64,523,622,474	5.80%	-6.30%
90	Optical, photographic, checking, medical instruments	18,221,037,765	16,982,168,062	11.00%	-6.80%
94	Furniture; bedding, mattresses, lamps and lighting	9,635,119,944	8,623,370,256	8.90%	-10.50%
7	Vegetables and certain roots and tubers; edible	7,183,912,054	8,205,918,353	7.00%	14.20%
39	Plastics and articles thereof	7,058,341,318	7,019,086,792	7.40%	-0.60%
99	Commodities not specified according to kind	6,445,047,757	6,739,431,546	25.50%	4.60%

8	Fruit and nuts, edible; peel of citrus fruit or melons	6,302,716,657	6,277,250,872	10.70%	-0.4
22	Beverages, spirits and vinegar	6,110,191,718	7,105,903,739	11.80%	16.30%
73	Iron or steel articles	5,743,618,265	5,171,071,296	7.60%	-10.00%
71	Natural, cultured pearls; precious, semi-precious stones; coin	5,329,942,415	5,743,625,926	12.30%	7.80%
86	Railway, tramway locomotives	3,699,252,407	1,999,872,937	16.20%	-45.90%
40	Rubber and articles thereof	2,691,403,219	2,496,455,988	9.70%	-7.20%
72	Iron and steel	2,244,108,501	2,038,177,866	5.00%	-9.20%
83	Metal; miscellaneous products of base metal	2,240,619,189	2,199,186,807	7.30%	-1.80%

Source: Own elaboration with data from COMTRADE. https://comtrade.un.org/data/

AARG: Annual average rate of growth for the period 1994-2019.

The US exports to Mexico grew at an average annual rate of 5.3% between 1994 and 2019 (Table 2). Specifically, rapid growth occurred for the following products: mineral fuels (13.8%), vehicles (8.5%), chemical products (7.9%) and iron and steel (6.8%). In 2019, the major imports from the USA, in terms of value, were mineral fuels with $36.0 billion dollars, nuclear reactors, machinery, and mechanical appliances with $28.49 billion dollars, followed by electrical machinery and parts, with $21.16 billion dollars and vehicles and auto parts with $21.16 billion dollars, respectively (Table 2). The analysis of Mexican imports from the US indicates that they are based on comparative advantages and the rapid development of global supply chains. Those imports corroborate that the US and Mexican trade is predominantly based on intra-industry trade in the electrical, automobile and oil industries. However, the emergence of the Covid-19 pandemic had a negative effect on the trend of US exports to Mexico during 2020.

Table 2. Average rate of growth of the major Mexican imports, 1994-2020 (US dollars)

Code	Commodities	2019	2020	AARG, 1994-2019	Annual rate of growth 2019-2020
	Total imports	54,812,850,512	206,142,139,412	5.30%	-18.40%
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	36,003,792,708.00	22,764,771,854.00	13.80%	-36.80%
84	Nuclear reactors, boilers, machinery and mechanical appliances; parts	28,494,972,651.00	23,043,408,435.00	5.60%	-19.10%
85	Electrical machinery and equipment; sound recorders and reproducers; television image, parts and accessories	21,161,594,775.00	17,722,241,390.00	2.50%	-16.30%
87	Vehicles; other than railway or tramway rolling stock, and parts and accessories	20,267,335,322.00	15,507,852,153.00	8.50%	-23.50%
39	Plastics and articles	15,826,093,041.00	14,087,179,246.00	5.60%	-11.00%
99	Commodities not specified according to kind	7,143,809,881.00	5,910,167,402.00	1.30%	-17.30%
90	Optical, photographic, cinematographic, measuring, medical or surgical instruments and parts and accessories	6,095,220,342.00	5,545,539,202.00	5.60%	-9.00%
73	Iron or steel articles	4,855,641,730.00	4,134,160,718.00	3.60%	-14.90%
29	Organic chemicals	4,704,260,288.00	4,001,239,441.00	5.90%	-14.90%
72	Iron and steel	4,163,665,971.00	3,711,794,172.00	6.80%	-10.90%
10	Cereals	4,136,236,592.00	4,050,166,262.00	5.90%	-2.10%
48	Paper and paperboard; articles of paper pulp, of paper or paperboard	3,974,105,376.00	3,679,960,301.00	3.30%	-7.40%
38	Chemical products	3,687,849,958.00	3,508,635,436.00	7.90%	-4.90%
2	Meat and edible meat offal	3,423,272,492.00	3,091,240,294.00	6.00%	-9.70%
40	Rubber and articles	3,173,874,221.00	2,505,084,243.00	6.60%	-21.10%
76	Aluminum and articles	2,944,780,370.00	2,469,111,475.00	5.70%	-16.20%

Source: Own elaboration with data from COMTRADE. https://comtrade.un.org/data/
AARG: Annual average rate of growth.

The success of NAFTA for Mexico and the US was related to three important factors: the development of production supply chains in the manufacturing sector, the different natural

endowments of both countries and the differential in the levels of education, labor skills and wages between the workers of the USA and Mexico. The wage differential is an incentive for trade and investment and compensates for the growing difference in labor productivity between the US and Mexico.[4]The new technology developments in communications, computers and the Internet have resulted in a segmentation of the production process; firms and businesses have taken advantage of the wage differentials to establish production processes using intensive unskilled labor in Mexico (Robertson, 2018).

As a result, foreign direct investment (FDI) and trade substantially increased after the establishment of NAFTA. The most important segment of that trade has been related to the manufacturing sector. The exports from Mexico have complemented the manufacturing industry of the USA by trading manufacturing parts and components that have been used in the USA to gain competitiveness. This process has encouraged the development of integrated supply chains among the members of NAFTA.

2.4 Mexico and US trade at the regional level

There are many studies in the literature about the positive effects of NAFTA on trade between the US and Mexico, and on the economic performance of both countries. Hillberry and McDaniel (2002) analyzed the characteristics of trade growth between the US, Canada and Mexico. The results revealed a broadening of international trade activity in North America.

4. According to information from the OECD, productivity gap between the US and Mexico has been increasing. Between 2014 and 2019 the US labor growth index rose from 0.98 to 1.03 while in Mexico it remained almost constant, passing from 0.99 to 0.98.
https://data.oecd.org/lprdty/labour-productivity-forecast.htm#indicator-chart

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Although US industries have faced competition from Mexican imports, US consumers and manufacturers have had access to imports from Mexico at a lower cost. Burfisher, Robinson and Karen, (2001) pointed out small but positive effects for the US economy. Waldkirch (2010) considered that NAFTA and FDI have positively impacted productivity and wages in Mexico. De La Cruz and Riker (2014) studied the impact of NAFTA on US labor markets, using a CGE model with data on NAFTA preference margins. They found the existence of small but positive effects on the real wages of skilled workers in the United States.

However, to understand the full impact of the establishment of NAFTA it is important to study the regional impacts of that agreement on trade. In 2019, the total trade of the most important US state trading partners with Mexico reached $438.1 billion dollars. The total value of exports to Mexico was $180.5 billion dollars, while imports were $257.6 billion dollars. Around two thirds of the trade between the US and Mexico is concentrated in four states: Texas, California, Michigan, and Illinois. The four of them accounted for 61.7% of all trade between the US and Mexico. In particular, Texas and California stand out as the major trading partners of Mexico (Table 3). The factors explaining the intense trade of those states with Mexico are related to the size of the economy of those states, the relative proximity to Mexico and the characteristics of the commodities traded with that country.

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Table 3. Major US states trading with Mexico, 2019 (dollars)

State	Exports	Imports	Total Trade	Share of total trade
Texas	108,586,390,896	104,320,136,826	212,906,527,722	34.64%
California	27,964,751,222	46,678,417,873	74,643,169,095	12.15%
Michigan	11,160,094,313	58,200,153,323	69,360,247,636	11.29%
Illinois	9,303,981,855	12,828,583,165	22,132,565,020	3.60%
Arizona	8,186,533,528	9,302,136,826	17,488,670,354	2.85%
Ohio	6,882,070,857	8,855,696,961	15,737,767,818	2.56%
Tennessee	4,166,062,929	10,322,011,486	14,488,074,415	2.36%
Pennsylvania	4,241,656,282	7,113,265,359	11,354,921,641	1.85%
Indiana	5,670,673,247	5,157,074,163	10,827,747,410	1.76%
Louisiana	8,427,414,409	2,397,764,935	10,825,179,344	1.76%
Total	180,491,541,882	257,620,401,819	438,111,943,701	71.29%

Source: Own elaboration with data from U.S. Census Bureau: Economic Indicators Division USA Trade Online.

The major states of Mexico receiving exports from the US in 2018 were the northern border states of Chihuahua with 14.1%, the state of Nuevo Leon with 8.4% and Tamaulipas with 5.7%. Other important trading regions were the state of Mexico with 9.4% and Mexico City with 7.5%[5].

Regarding the major exports of US states to Mexico in 2019, exports of oil and derivatives from the state of Texas have the highest value, with $24.6 billion dollars (Table 4) and represented 9.6% of the US exports to Mexico[6]. The increasing energy trade and investment reflects the integration of that industry in the North American region. Chapter 6 of NAFTA eliminated tariffs and quotas in the energy sector but left special provisions for Mexico, allowing it to prohibit foreign direct investment in exploration and distribution of crude, natural gas and electricity

5 Estimations with data from the Bureau of Transportation Statistics. North American Freight Data, by US state and commodity.
6 Estimations with data from United States Census Bureau, USA Trade Home, https://usatrade.census.gov/data/Perspective60/Browse/browsetables.aspx?utosid=cf5d33fff68dcd211f2adc6109bdeece&cache=puc52n

(Hufbauer and Jung, 2017). In 2013, constitutional reforms were signed in Mexico to allow FDI in exploration, refining, transport and storage of crude and natural gas. The establishment of the USMCA could deepen the legal certainty for investments, thus encouraging further growth in that sector.

A second group of US exports that reflects the increasing integration of global supply chains is related to the automobile industry. In 2019, Texas was the major exporter of vehicles, engines and auto parts followed by Michigan, which mainly exported piston engines, with a value of exports of $7.1 and $3.0 billion dollars, respectively (Table 4). The automobile and auto parts exported by the US states showed that they were also involved in the supply chain for the production of automobiles in the North American region. Mexico also exports automobile components and vehicles to US states. In 2018, the automobile industry of Mexico exported $29.8 billion dollars to Michigan, $12.2 to Texas and $11.5 billion dollars to California (Table 5).

The automobile industry trade between the US and Mexico demonstrates the significance of intra-industry trade as a part of US- Mexico economic integration. The increasing interconnection of trade among countries arising from global supply chains is derived from the fragmentation of production. Since the mid-1990s, the integration of the global economy has accelerated, through ever more complex trade relations and global supply chains that create value throughout the production and distribution processes in different countries of the world; particularly within the automobile, electronics and computer industries. According to data estimated by the OECD, there is a significant trade in value added, which represented 15.6% of total US trade and of 46.9% of Mexican trade.

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Table 4. Major exports of US states to Mexico by commodity, 2019-2020

U.S. State	Code (HS)	Commodity (2 digits)	2019	2020	Percentage annual change
Texas	27	Mineral Fuels; Oils and Waxes	24,555,200,396	19,100,992,052	-22.20%
Texas	84	84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	22,547,337,282	15,901,764,474	-29.50%
Texas	85	Electrical Machinery; Equipment and Parts	20,366,118,810	19,165,704,631	-5.90%
Texas	87	Vehicles Other than Railway	7,075,299,618	5,537,081,075	-21.70%
California	85	Electrical Machinery; Equipment and Parts	6,375,164,234	5,875,584,866	-7.80%
Texas	39	Plastics and Articles	6,327,599,955	5,579,467,305	-11.80%
Louisiana	27	Mineral Fuels; Oils and Waxes	6,063,069,586	2,974,020,045	-50.90%
Texas	29	Organic Chemicals	4,211,965,013	3,180,152,028	-24.50%
California	84	Computer-Related Machinery and Parts	3,865,576,144	3,483,023,517	-9.90%
Michigan	87	Vehicles Other than Railway	2,960,647,387	2,165,003,942	-26.90%
Texas	90	Measuring and Testing Instruments	2,940,685,660	2,772,647,019	-5.70%

Source: Own elaboration with data from U.S. Census Bureau: Economic Indicators Division USA Trade Online.

Another group of US exports to Mexico consists of electronics, computers, and electronic circuits. Parts and accessories for computers, and electric machinery and parts were the second and third major exports of Texas and the most important export of California to Mexico (Table 4). These exports underline the relevance of the states of Texas and California in the production of electronics and computer related goods in the United States and the increasing demand of the Mexican economy for these manufactures.

In 2019, the main imports of the US states from Mexico included automobiles and auto parts for Michigan, Texas, and California with a value of $ 42.6, 15.9 and 12.5 billion dollars, respectively. In addition, Mexico also exported electronics products to the USA. In particular, computers and parts and electric machinery, equipment and parts were exported, with a value of $20.5 billion dollars and $10.1 billion dollars, respectively (Table 5). Like exports, in 2020 the US imports from Mexico showed a deep drop as a result of the Covid-19 pandemic. However, towards the end of that year there was a trend towards recovery for both exports and imports.

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Table 5. Major imports of US states from Mexico by commodity, 2019-2020

State	Code	Commodity	2019	2020	Percentage annual change
Michigan	87	Vehicles Oth	42,632,788,786	34,460,255,969	-19.20%
Texas	84	Nuclear Reac	28,524,720,033	22,648,541,259	-20.60%
Texas	85	Electrical Ma	22,441,571,947	19,665,260,098	-12.40%
Texas	87	Vehicles Oth	15,901,465,123	11,869,740,823	-25.40%
California	87	Vehicles Oth	12,448,490,491	10,121,428,328	-18.70%
Texas	87	Vehicles Oth	9,208,465,732	6,291,300,483	-31.70%
California	27	Mineral Fuel	7,707,939,447	8,064,527,013	4.60%
Michigan	85	Electrical Ma	5,438,237,781	4,345,940,409	-20.10%
California	84	Computer-R	5,316,235,764	9,059,220,639	70.40%
Tennessee	87	Vehicles Oth	5,101,468,641	5,588,830,873	9.60%

Source: Own elaboration with data from U.S. Census Bureau: Economic Indicators Division USA Trade Online.

3. Major North American manufacturing sectors under the USMCA

3.1 The automobile industry

The positive effects of the USMCA agreement are related to the continuation of the supply chains in North America and their synchronization with the gradual imposition of the new rules of origin. By eliminating the originating provisions of NAFTA, the USMCA could have the potential effect of increasing long term investment in the US and in Mexico.

According to the Office of the United States Trade Representative (USTR) estimates, the automakers will invest $34 billion dollars in 5 years. The establishment of new rules of origin would encourage investments by companies such as Fiat Chrysler, Ford, General Motors, Toyota, and Volkswagen. The projected capital investment within the USA added to the investment accumulated in Mexico between 2009 and 2018 could intensify the value chains between these two countries. However, both production and exports from those countries would have to rapidly replace the inputs arriving to the region from other countries.

Regarding the automobile companies located in Mexico, they would be required to import fewer inputs from other non-member countries of the USMCA. The challenge for the Mexican automobile industry is to attract more investments in the assembly subsector. Additionally, the industry could take advantage of the new opportunities generated by the new requirements of regional components to expand the investments in the auto-parts subsector.

3.2 The Oil industry and the USMCA

Oil and derivatives make up the second largest category of traded goods between the USA, Canada, and Mexico. The energy sector of the North American region is highly integrated and interdependent. The implementation of the USMCA will continue to support the energy sector with the elimination of tariffs for crude oil, gasoline, and other refined products, which would allow investment security and the expansion of the natural gas sector in Mexico.

However, on the Mexican side, the state-owned oil enterprise, Petroleos Mexicanos (PEMEX), faced several constraints. In the first place PEMEX has not had access to foreign investment for developing projects. The next obstacle it faces is the heavy burden of federal taxes. Finally, it has been argued that PEMEX has a limited capacity to provide efficient management. To cope with those problems, the Mexican government reformed the legislation regarding the energy sector in 2013 (Wood, 2018). As a result, the oil and gas industries have been opened to foreign investment and the structure of the national oil company PEMEX has been reorganized.

According to Gantz and Clayton (2019), the energy reforms consisted of the following major changes: preserving the state ownership of subsoil hydrocarbons resources, while permitting private ownership of resources extracted; creating contracts for exploration,

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production and service; opening the refining, transport, storage, natural gas processing, and petrochemicals sectors to private investment; transforming Pemex into a productive state enterprise with an autonomous budget and a board of directors; and strengthening federal entities with regulatory roles in the hydrocarbon industry.

The required investment for the development of the energy sector in Mexico is estimated to be around $21 billion (Abad and Maurer, 2008). The establishment of the USMCA will continue with zero tariffs for energy products in the North American region and could encourage additional investments that would increase production of oil derivatives and the trade of hydrocarbons by pipelines. Also, it will provide new rules of origin requirements for oil and gas traded in the region (The United States-Mexico-Canada Agreement Fact Sheet, 2018)[7].

3.3 The electronic industry and the integration of the North American region

The USMCA will also change the rules of origin for electronics. In particular, the electronics industry of the USA is highly integrated with both Canada and Mexico. The intense trade of that sector is highly impacted by intra-firm trade, with multinational firms in the electronics sector located in the three countries. According to the IPC-Association Connecting Electronics Industries[8], around 78% of electronics imports from Mexico and 47% of the electronics exports to Mexico are traded between parent and affiliate companies.

7 The United States-Mexico-Canada Agreement Fact Sheet, 2018. Retrieved from: https://ustr.gov/sites/default/files/files/Press/fs/USMCA/USMCA-Energy.pdf
8 Association Connecting Electronics Industries (IPC), 2019, Strengthening Interconnections: The U.S.- Mexico-Canada Agreement and the Electronics Industry. Retrieved from:

In addition, electronics are becoming an important part of vehicles (around 35%). For Mexico and Canada, intermediate inputs for the production of computers and electronics rely on US imports; therefore, an important share of the total value of the production of those countries is sourced from the US. However, electronic inputs from China have been gradually substituting the inputs from the USA.

One of the characteristics of the electronics industry is the importance of supply chains which allow for greater efficiency and lower costs. Low tariffs and geographical proximity have created a supply chain across the North American countries. The establishment of the USMCA will reduce the uncertainties affecting investment, allowing for the further development of the North American supply chain.

Another relevant aspect regarding the electronic industry has to do with the rules of origin of the automobile industry. The electronics industry supplies a variety of parts for automobiles; therefore, the regional value content of the USMCA could have a significant effect on the electronics industry. The regional value content requirement to have an exemption from tariffs is of 75% for core parts, 70% for principal parts and 65% for complementary parts. As a result, both automobile and electronics producers will have to meet the new requirements of value content to have preferential treatment under the USMCA.

http://www.ipc.org/3.0_Industry/3.3_Gov_Relations/2019/usmca-WEB-v2.pdf#search=Strengthening%20Interconnections%3A%20The%20U.S.-%20Mexico-Canada%20Agreement%20and%20the%20Electronics%20Industry%20

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4. Major determinants of the US-Mexico trade

4.1 Global value chains, transportation costs and distance

The growth of trade between the US and Mexico has been carried out within the framework of the development of global value chains. During the eighties, the developing countries changed their trade policy from an import substitution strategy to an export-based growth strategy, giving way to the emergence of global value chains (Milberg and Winkler, 2010). The internationalization of capital and production processes generated a set of activities such as design, phases of production and distribution which constitutes a value chains of a company or a group of companies of the same type of activity (Gereffi and Fernandez-Stark, 2011). The development of global value chains is directly related to the technological characteristics and the phases of production, the geographical considerations such as agglomeration economies, and the institutional structures. (Cattaneo, Gereffi and Staritz, 2010). In the case of the North American region, value chains have developed under NAFTA because of the increasing outsourcing of the production of multinational manufacturing companies. These firms are seeking to reduce transportation and labor costs and as a result, the production of intermediate and final goods has increased significantly.

Additionally, intra-industry trade is associated with global value chains. However, intra-industry trade basically measures the amount of trade between two countries that is related to the same type of product or industry. Goods can be vertically differentiated in quality and price or horizontally differentiated depending on consumer preferences. Both phenomena have a certain independence since they may not necessarily have to coexist at the same time. However,

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both tend to promote the opening of markets to take advantage of low transport costs and location advantages, thus encouraging the consumption of intermediate goods (Baccini, Dür and Elsig, 2018).

Theoretical explanations of the development of intra-industry trade are based on the models established by Bergstrand (1985 and 1990) and Dixit-Stiglitz (1977), which assumed monopolistically-competitive markets and increasing returns to scale in a two-industry, two-factor context. These authors have argued that the following factors are determining the growth of world trade: trade liberalization, transportation costs, convergence of income and increasing outsourcing with vertical specialized intermediate goods and the diversification of the processes of production (Baier and Bergstrand, 2001). Several authors have introduced a market structure to the trade model, (Krugman, 1979, 1980), (Helpman and Krugman, 1985) and (Bergstrand, 1985, 1990). Assuming a monopolistic competitive structure and increasing returns to scale, firms can produce slightly differentiated goods and, therefore, countries can produce goods depending on their economic size, the costs of production, their factor endowments and consumer preferences.

The empirical analysis of the determinants of bilateral or multilateral trade is based on the so-called gravity model. The model considers that the economic activity in a given country or region, along with transportation costs are the most important factors defining the level of trade. The theoretical foundation of the empirical gravity model of trade is derived from a reduced form of a general equilibrium model of international trade of final goods. From this theoretical perspective, exports are considered production capacity and imports would be absorption capacity. Anderson (1979) and Bertrand (1985) included tariffs and transportation costs in a

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gravity model. They concluded that tariff-rate reduction plays an important role in encouraging GDP growth.

Therefore, the standard framework of the gravity model associates the value of bilateral trade to national income, population, distance and contiguity (Eichengreen and Irwin, 1995). The econometric specification is based on a log-linear cross-sectional model which relates trade flows between importer and exporter countries with the nominal gross GDP of both countries, distance between economic centers and a range of dummy variables such as the existence of preferential trade agreements or a common border line (Tinbergen, 1962), (Baldwin, 1994) and (Deardoff, 1998). The states of the USA and Mexico are asymmetric and trade is dispersed due to distance and differing levels of economic activity within Mexico. Therefore, in addition to tariffs, a gravity model should consider that the exporting industries face differing transportation costs and variations in demand at the regional level.

4.2 Data and Methodology

The analysis of trade between the Mexico and US states will be based on the theoretical foundations developed by Krugman (1979), Helpman and Krugman (1985) and Bergstrand (1990). The empirical specification in based on a gravity model, which is a reduced form of a general equilibrium model of international trade, where exports represent the production capacity and imports the absorption capacity of the economy in both countries and regions. The theoretical perspective is based on the expenditure system approach where countries are specialized in the production of goods, and prices are normalized to unity. Within this context, the volume of trade is a function of the income spent in the exporting country and the GDP of the importing country.

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Xij = IiYj, or Ii = Xij / Yj, where

Xij = volume of trade from country i to country j

Ii = fraction of income spent on product i of the country

Yj = real GDP in importing country j.

In their studies, Anderson (1979) and Bergstrand (1985) included bilateral trade barriers such as tariffs and transportation costs. The present paper will develop a gravity model where it is assumed that the quantity of exports and imports of the US states will be positively affected by the economic activity of Mexico and negatively impacted by transportation costs and tariffs. The power of prediction of the gravity model has been documented by several authors, such as Baldwin (1994), Frankel (1997) and Deardorff (1998). This type of model has been used extensively in the empirical studies of trade.

Based on the gravity approach, the empirical research uses a balanced panel data model to estimate potential impacts of the USMCA on the Mexico-US trade. The econometric analysis includes four periods from 2015 to 2019 for the 50 American states, and is structured as follows:

$$\mathrm{In}\ C\ ij = \beta + \beta 1\ \mathrm{In}\ (Yri) + \beta 2In(Ypcj) + \beta 3\mathrm{In}(dij) + \beta 3\mathrm{In}(Tj) + In\beta 4(USFDIij) + In\beta 5(Popij) + \varepsilon ij$$

where

Yri =Real GDP of the US states

Cij = Value of total trade of US states i with Mexico j

Xij = export value from US states, i, and imports from Mexico j

Yi = US per capita GDP

Yj = Mexican per capita GDP

dij = effect of distance between the US states i and the Mexican border j

Tij = simply average tariff imposed in country i and country j

USFDIij = Foreign direct investment of the US in the Mexico ij

TFDIij = Total foreign direct investment in the Mexico ij

The databases consulted are from both US and Mexican sources:

(1) U.S. Census Bureau, US Trade. State and Commodity was the source of trade between states of the USA and Mexico.
(2) World Trade Organization, Tariff Analysis Online provided tariffs average for the USA and Mexico.
(3) Encuesta Nacional de Población y Empleo, Población Total was the source of the Mexican population.
(4) U.S. Census Bureau, Population Division, was the source of the US population by states.
(5) World Bank World Development Indicators, GDP per capita (constant 2010 US$) provided information about the Mexican GDP per capita.
(6) Distance between the closest US states and the Mexican border obtained with a distance calculator. https://www.distancesto.com/us/phoenix-to-tijuana/history/2811804.html
(7) The US FDI in the Mexican states was obtained from the Secretaria de Economia, Mexico.

5. Econometric results

The econometric model estimated the underlying determinants of trade between Mexico and the United States, in particular structural aspects such as the size of the economies of the US states, the distance between the states and the border with Mexico and other control variables such as FDI in Mexico and the average tariff rates applied in the period of analysis. Given the characteristics of the economies of both countries, it is assumed that factors such as transportation costs and the size of economic activity are determinants for the growth of trade, in a context of trade integration and low tariff rates.

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The methodology of estimation was based on a panel data model with fixed and random effects. To determine which econometric model was more appropriate for the panel data set, a Hausman test for the correlated random effects was estimated. The null hypothesis assuming that the effects are not correlated with other regressors was rejected. Therefore, the fixed effect model was preferred to the random effect model. In addition, a Breusch-Pagan test to check for heteroscedasticity was estimated. The null hypothesis of equal variance and distribution of the residuals was rejected, and therefore the test corroborated the pertinence of the fixed model (Table 6).

Table 6. Correlated random effects-Hausman Test

Hausman Test and Breusch Pagan tests		
Test cross-section random effects		
Hausman test [1]		
Ho: difference in coefficients not systematic	Chi-Sq. Statistic	Prob.
	128.3	28.1
Breusch-Pagan test [2]		
	477.7	0

Source: own estimation.

1. Null hypothesis: that there is no endogeneity in the random effects model.
2. Null Hypothesis: Homoscedasticity is present, and the residuals are distributed with equal variance.

The results indicated that trade between the states of the USA and Mexico was positively impacted by the size of the GDP of the US states. The coefficients were statistically significant at 5% and 1% for the fixed and random effects models (Table 7). This result highlights the

importance of the US states in trade with Mexico. Particularly, those that have a significant commercial flow based on proximity and global value chains.

The panel models exhibited a negative and statistically significant sign of the coefficients of the variable distance, suggesting that the distance between the US states and Mexico plays an important role in the trade with Mexico. Thus, the closer the US states are to the Mexican border, the higher the level of trade. Such is the case for Texas, California, and Arizona, which are relatively close to Mexico. This also follows the gravitational equation assumptions. The coefficients of the two models were negative and statistically significant and, therefore, support the assumption that if the distance is shorter there will be increased trade between regions, underlying the importance of transportation costs.

The coefficients of the average tariffs applied by both the United States and Mexico showed a positive sign. However, only the coefficient of the tariffs applied by the USA was statistically significant. These results suggests that the reduction of tariffs has been an important factor in the growth of trade between the two countries, both during the NAFTA and the USMCA periods. In addition, the GDP per capita of the United States and Mexico were included as explanatory variables to observe the effect of the size of both economies, considering the size of the population. The US GDP per capita coefficient was positive and statistically significant, suggesting that the US economy is a major engine for growth for the two countries. For its part, the GDP per capita coefficient for Mexico was also positive, but not statistically significant.

Finally, the amount of total foreign direct investment in Mexico was used as a variable that reflects the growing economic integration of the United States and Mexico and its impact on

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the trade of both countries. The coefficient of this variable was positive and statistically significant at 10% of the confidence level. For both the US and Mexico, trade and FDI are closely related, through intra-industry trade and global value chains.

Therefore, the econometric estimation suggests that the proximity of the US states to the Mexican border, characterized by manufacturing and maquiladora activities, and the level of economic activity of the US states have been important driving forces of US-Mexico trade. In addition, the estimations support the conclusion that low tariffs will continue to promote trade and that the success of the USMCA will depend on the capacity of the manufacturing sector in the US and Mexico to supply the inputs necessary to increase the North American value content of exports.

Table 7. Independent variable: TOTAL TRADE (2015-2019)

Fixed and Random Panel Models

Dependent variable: Total US-Mexico trade	Fixed	Random
C		2.19
		0.11
LUSGDPS	1.10**	1.38*
	1.87	10.37
LDIS	-0.59*	-0.66*
	2.79	2.83
LAPTUS	0.32**	1.86**
	1.79	1.86
LAPTMX	0.7	0.7
	1.27	0.52
LGDPCMX	0.37	0.37
	1.21	1.28
LGDPCUS	0.32***	0.1 ***
	1.44	1.43
LTOFDI	0.48***	0.48***
	1.78	1.77
R squared overall	0.64	0.75
Wald chi-statistic		178.25
Prob >0		0
F-statistic	5.95	
Prob >0	0	

Source: own estimation. LUSGDPS = log of the GDP of US states, LDIS= log of distance, LAPTUS = log of Trade weighted average duty applied by the US, LAPTMX = log of Trade weighted average duty applied Mexico, LGDPCMX = log of the Mexican per capita GDP, LGDPCUS = log of the US per capita GDP. 1% level of confidence, ** 5% level of confidence, *** 10% level of confidence

6. Concluding remarks

The modification of NAFTA to establish the USMCA imposed new challenges and the need to restructure the North American supply chains to meet the new input content requirements proposed in the rules of origin section of the agreement. A major impact of NAFTA was the reciprocal dismantling of the tariff structure within the region composed of the three member countries. There was a significant decrease in the rates imposed by Mexico which, before NAFTA, were higher than those imposed by the United States and Canada. The tariffs were gradually eliminated in some cases, such as for chemicals, electrical parts, textiles, etc. The removal of

tariffs was conditioned on the requirements of the rules of origin that established a minimum content of 62.5% of the value produced in the NAFTA region.

The research and statistical evidence indicate that an increase in trade and investment in the North American region has resulted from the establishment of NAFTA. Particularly, trade between the US and Mexico expanded rapidly. Exports from the United States to Mexico focused on oil, electrical equipment, vehicles, and chemicals. US imports from Mexico were mainly vehicles, electrical machinery, and mechanical appliances as well as fruits and beverages. The result of this trade expansion was related to the development of value chains in manufacturing, differing endowments of factors of production and low transportation costs.

The states of Texas and California have traded predominantly with Mexico, based on those states' diverse economic activity and natural resources. The commercial relationship in this sector has been fundamental for the economic integration of those states with the Mexican economy. Also, the automobile trade between Mexico and the states of Michigan and Texas reflects the importance of intra-industry trade. Finally, the electronics and computer sector has seen an increase after the establishment of NAFTA, indicating the importance of this sector to the trade between the two economies.

The new USMCA agreement modernizes the intellectual property rules, government procurement and adds changes to the rules of origin. In particular, the automotive sector will gradually increase the regional content from 62.5% to 75%. In addition, it introduces the concept of labor requirements, which requires that wages of $16 dollars an hour must be meet by at least 40% of Mexican automobile exports to avoid tariffs. This aspect is still a factor that could

potentially affect trade between the US and Mexico, given the differences in labor productivity in both countries.

The reduction of tariffs under NAFTA has had a positive impact and has deepened the integration of the supply chains between Mexico and the United States. The establishment of the USMCA potentially could increase investments in the automobile, steel, aluminum and electronic industries in the USA and also could attract more FDI to Mexico, which would be necessary to comply with the value content requirement of the agreement. The USMCA tariffs could have a positive effect on trade depending on the fulfilment of the value content requirements.

The results of the panel model estimated suggest that the low tariffs have played an important role in the economic integration of the North American region. The model confirmed that foreign direct investment has a positive effect on trade between the two countries through the link between investment and non-industrial trade. In addition, the findings of the model indicate that a determining factor of trade between the two countries is related to the size of economic activity in the United States at both the national and state level. Distance and economic activity have also contributed to the intensification of trade between the US states and Mexico. Therefore, it can be concluded that polices to encourage trade between the US and Mexico would require the development of communications and transportation infrastructure to take advantage of the relatively short distance between the US border states and Mexico, and to be able to reduce the transportation costs of trade.

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