The impact of China's incursion into the North American Free Trade Agreement (NAFTA) on intra-industry trade

Jorge Alberto López A., Óscar Rodil M. and Saúl Valdez G.

ABSTRACT

China has become a major player in world trade. Although it has not signed any trade agreements with the countries of the North American Free Trade Agreement (NAFTA), China has been gaining ground as a supplier of goods, making vigorous inroads into this area. One of the dominant trends in economic integration has been the development of intra-industry trade, which has flourished in the NAFTA signatory countries. This paper focuses on the analysis of intra-industry trade in the context of this free trade area, where the production structure of the countries involved has changed significantly since trade liberalization, revealing the internationalization of production chains. Lastly, changes in the trade structure induced by the growing presence of China in the NAFTA region are captured. Trade within this area works like a radiated wheel, with the United States acting as the axis, while China, Canada and Mexico operate as the spokes.

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I

Introduction

This paper seeks to analyse the pattern of intra-industry trade (exchange of varieties of the same good) in the context of the emergence of China in the area of the North American Free Trade Agreement (NAFTA). This country has become a prominent player in world trade, in particular in North America. Although this Asian giant has not signed any trade agreements with the NAFTA countries, it has entered into this area, gaining ground as a goods supplier. Our aim is to determine the significance of these trends and their implications, with special attention to the intra-industry integration model.

In addition to analysing intra-industry trade flows over the period 1993-2011, this study ties in with the theoretical debate relating to the establishment of economic areas. These integration processes have sparked off heated theoretical controversy over the trade effects they have generated. For a long time, pioneering authors such as Viner (1950) and Dornbusch (1992) have maintained that the member countries of the economic areas have achieved welfare gains at the expense of the rest of the world. In a case such as NAFTA, reducing domestic barriers could boost competitiveness among member countries by increasing the relative efficiency of the NAFTA economic area and intra-NAFTA imports and exports. Hence, assuming the existence of economies of scale, externalities and dynamic comparative advantages, intra-NAFTA imports would replace those from the rest of the world. However, empirical evidence suggests that the United States has lost market share in Mexico (Dussel and Gallagher, 2013), although this is due mainly

to parts and components originating in China (Gazol, 2007), which has gained market share in Mexico in recent years.[1]

As for the debate about the effects arising from the integration process, different economic theories abound and no definitive answer has been provided about the regional impact of the integration processes, since the effects vary depending on the theoretical approach adopted (Rodríguez-Pose and Petrakos, 2004). Therefore, empirical analysis is needed to establish the main economic changes linked to the NAFTA process, and in particular to demonstrate how China has integrated into the NAFTA zone as a goods supplier.

The paper is structured as follows. Section II addresses the conceptualization and methodological aspects of intra-industry trade. Section III examines China's incursion into NAFTA and its repercussions for complementarity and competition. Globalization, restructuring and models for the integration of two emerging economies, in this case Mexico and China, are covered in section IV. Meanwhile, section V examines China's incursion into the North American market and the ensuing changes to the NAFTA intra-industry trade model. Lastly, the main conclusions of the study are presented in section VI.

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[1] Hence the successive revisions to Annex 401 of NAFTA in order to relax rules of origin; the geographical location of providers has been changed but they remain the same providers (Gazol, 2007).

II

Intra-industry trade: conceptualization and methodological aspects

Theoretically, the problem of intra-industry trade was first discussed in the 1960s with the studies by Verdoorn (1960), Balassa (1963) and Grubel (1967). These authors found that a growing share of trade took place within the same industries and sectors. This novel form of

international trade led to the economic concept now known as intra-industry trade.

Authors such as Krugman (1995) or Grossman and Helpman (1990) focused on intra-industry trade and discovered notable developments on the basis of

new theories of international trade. Modern trade theory provides a set of explanatory elements grounded in imperfect competition, economies of scale and different varieties of goods. Intra-industry trade emerges as a result of increasing returns, product differentiation and consumers with diverse preferences. First, economies of scale promote production concentration, meeting large demands from a small number of production centres. Second, each company can differentiate its products from those of rival companies in order to segment demand and maintain a degree of monopoly over its own variety. Third, one prerequisite for intra-industry trade is the existence of a consumer mass with different preferences for the multiple product varieties offered. These three conditions tend to become more visible in the case of developed economies, which explains why some integration areas, such as the European Union, have excelled in such exchanges.

Several processes have developed in parallel with the rise of intra-industry trade and, in a sense, have been driven by it. Progress in trade liberalization, particularly of industrial products, has occurred both globally under the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO) and regionally through the European Union, NAFTA, the Association of Southeast Asian Nations (ASEAN), the Southern Common Market (MERCOSUR) and the Central American Common Market (CACM). These processes have been guided primarily by the expansion of intra-firm trade in pursuit of the free movement of intermediate and final goods to the benefit of multinational corporations. Some authors (Navaretti, Haaland and Venables, 2002; OECD, 2002; Helpman, 2006) introduced this last aspect in the analysis of intra-industry trade, focusing on the role of multinationals. Indeed, according to these authors, multinationals are the real protagonists of the current globalization process.

To summarize, we can identify three models of intra-industry trade: first, the model based on product differentiation and economies of scale (the most common); second, the model of functionally homogeneous goods (closely linked to border and periodic or seasonal trade); and lastly, the model based on the technology gap, the product life cycle and the internationalization of the production process (intra-firm).

Another perspective is the differentiation between vertical and horizontal intra-industry trade. Horizontal intra-industry trade occurs when two separate production chains of the same industry and a similar level of development exchange goods internationally. Vertical intra-industry trade occurs when the same production line is located in different countries, leading to the re-export of goods (Dussel and León González, 2001).

From a methodological viewpoint, several indicators are designed to measure the degree of intra-industry trade in different economies, the most common being the Grubel-Lloyd (GL) index.[2] This index is built on the basis of bilateral trade flows between countries. These flows can be divided into two groups: inter-industry trade (different goods) and intra-industry trade (similar goods). The GL index ranges from 0 to 1, depending on the absence (GL = 0) or total occurrence (GL = 1) of intra-industry trade.[3] Frequently, an alternative adjusted expression of the GL index is used at the aggregate level to avoid the destabilizing effect of the trade balance.[4] In addition, other authors (Cárdenas and Dussel, 2011) use an index proposed by Hamilton and Kniest (1991) which measures marginal intra-industry trade with respect to total aggregate trade.

An important point to note is that the degree of data disaggregation influences the measurement of intra-industry trade. It is best to use the largest possible sectoral disaggregation in order to accurately identify intra-industry trade flows. The statistics used in this study provide a complete sectoral breakdown for the two-digit level (tariff chapters) of the Harmonized Commodity Description and Coding System, with information from the United Nations Commodity Trade Statistics Database (COMTRADE). Information at the four-digit (heading) level is used only for the chapters where a higher intensity of intra-industry trade is observed.

It should be noted that this paper analyses trade between countries with very different levels of development, for example, between the United States or Canada, on the one hand, and China or Mexico, on the other. These combinations allow us to consider various patterns of trade, including North-North, North-South and South-South.

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[2] The formula of the aggregate index of Grubel and Lloyd is: $GL = 1-[\sum|x_i-m_i|/\sum(x_i+m_i)]$, where x_i and m_i are the value of exports and imports of sector i respectively. The adjusted version of the aggregate index of Grubel and Lloyd is expressed: $GL_{adjusted} = [\sum(x_i+m_i)-\sum|x_i-m_i|]/[\sum(x_i+m_i)-|\sum x_i-\sum m_i|]$, where x_i and m_i are the value of exports and imports of sector i, respectively.

[3] The aggregate version of the GL index is: $GL = 1-[\sum|x_i-m_i|/\sum(x_i+m_i)]$, where x_i and m_i are the value of exports and imports of sector i, respectively.

[4] The adjusted version of the aggregate version of the GL index is expressed as $GL_{adjusted}=[\sum(x_i+m_i)-\sum|x_i-m_i|]/[\sum(x_i+m_i)-|\sum x_i-\sum m_i|]$, where x_i and m_i are the value of exports and imports of sector i, respectively.

III

China's incursion into NAFTA: between complementarity and competition

Prior to the 1990s, China had shown little interest in signing formal agreements and pursuing regional trade; this was partly because it was not yet ready to deal with the rapid liberalization of trade and investment. With the advent of the twenty-first century, however, China's attitude to regional cooperation changed dramatically (Wang, 2004, cited by Yu, Xue and Hong, 2006). Joining WTO forced China to take on several commitments in terms of market liberalization, and integrated the country into the world economy (Yu, Xue and Hong, 2006). China is now a signatory to 10 free trade agreements with 24 countries, including 3 from Latin America (Chile, Costa Rica and Peru). Another three free trade agreements are under negotiation with Australia, Norway and Switzerland (WTO, 2013).

From a theoretical point of view, one of the main arguments in favour of free trade agreements is that they seek to improve the economic dynamics of the signatory countries. However, trade between the NAFTA countries

and China has been growing rapidly, especially between the United States and China, even though none of them has signed a free trade agreement with China. In fact, China has emerged as the leading supplier in the United States market, replacing Mexico in 2003 and Canada in 2009 (see figure 1), and as the second supplier in the Mexican market since 2002, ousting Canada (see figure 2).

The coverage ratio (defined as the percentage of trade conducted under agreements in relation to total trade) stands at 11.2% for China, 34.4% for the United States, 68.4% for Canada and 81.5% for Mexico (Rosales and Kuwayama, 2012) (see table 1). As these data show, China has had no need of free trade agreements to become a world trade power.

Analysts hold opposing views as to whether the role of China and Mexico in the United States market is competitive or complementary. Some authors, such as Feenstra and Looi Kee (2009), estimate that there is increasing competition between these two countries for
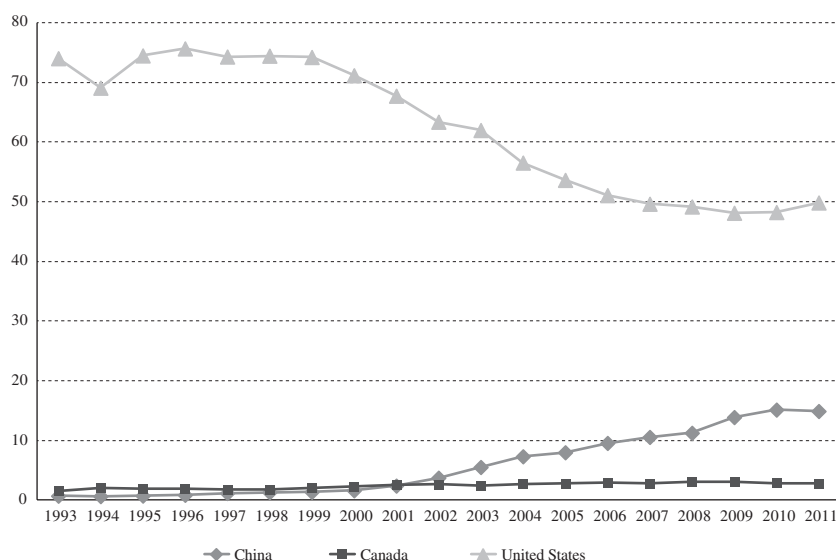
FIGURE 1

United States: imports from China and its NAFTA partners as a share of total imports, 1993-2011
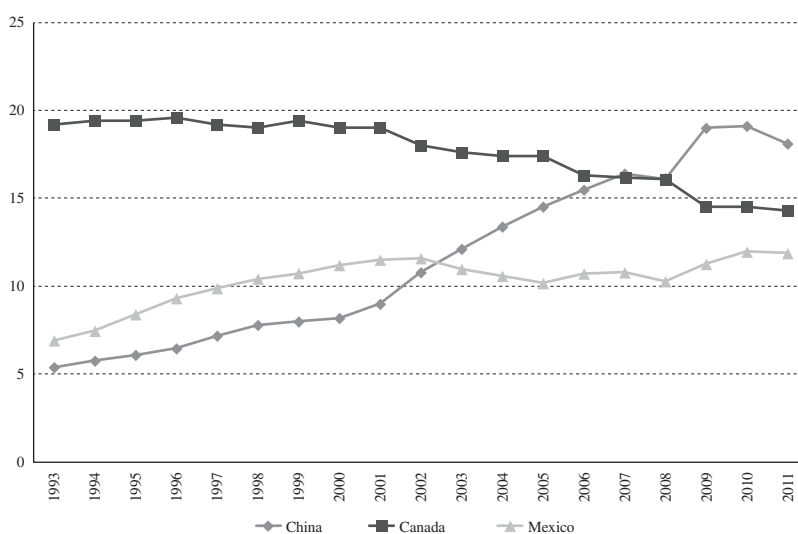
(Percentages)

Source: United States Census Bureau, [online] http://www.census.gov/foreign-trade/statistics/country/, 2013.

FIGURE 2

**Mexico: imports from China and its NAFTA partners
as a share of total imports, 1993-2011**
(Percentages)

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

TABLE 1

NAFTA[a] countries and China: coverage ratio of trade agreements, 2009
(Percentages)

Country	Free trade agreement coverage		
	Exports and imports	Exports	Imports
United States	34.4	40.1	30.5
Canada	68.4	77.7	59.2
Mexico	81.5	93.0	70.2
China	11.2	10.1	12.6

Source: Japan External Trade Organization (JETRO), 2010 JETRO Global Trade and Investment Report. A Global Strategy for Japanese Companies to Open New Frontiers in Overseas Markets, Tokyo, 2010; and O. Rosales and M. Kuwayama, China and Latin America and the Caribbean: Building a Strategic Economic and Trade Relationship, Libros de la CEPAL, No. 114 (LC/G.2519-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), March 2012. United Nations publication, Sales No. E.12.II.G.2.

[a] North American Free Trade Agreement.

the United States market and that foreign direct investment (FDI) has been shifting towards China at the expense of Mexico (De la Cruz, Núñez and Ruiz-Porras, 2008, cited by De la Cruz and Marín, 2011). Feenstra and Looi Kee (2009) further argue that the difference between Mexico and China is that the former slashed its tariffs to an excessive degree while China did so unilaterally, protecting some branches such as agriculture. Neme (2006), however, argues that Mexican manufacturers

do not compete with China in the United States market, but that each country has its own niche, according to the specialization patterns that emerged in the 1990s.

Of particular interest in this paper is the analysis of intra-industry trade, which should clarify to what extent these economies are complementary or competitive. This point is raised with full knowledge of the fact that China has become a leading power globally, and especially in North America.

IV

Globalization and restructuring: models for the integration of two emerging economies, China and Mexico, into the world market

By the early 1980s, Mexico showed limited openness to trade. In fact, in 1983, virtually all imports into Mexico were subject to prior permission (non-tariff barriers) and extremely high tariffs. However, since that year, Mexico has restructured its economy in an attempt to achieve three goals: sound public finances, privatization of State enterprises and trade liberalization. Rationalization of trade protection transformed the country from one of the most closed into one of the most open economies in the world. The opening has been such that in 2006 only 4.1% of the value of non-maquiladoras and 2.7% of total imports were subject to prior permission. Moreover, the tariff average, which was 27% in 1982, fell to 5.9% in August 2012 (the weighted tariff in 1982 was 16.4%, but in 2012, it was only 0.56%) (CEFP, 2006; *Gaceta Parlamentaria*, 2012).[5] A clear sign of this process is the increase in the openness ratio from 30% to 81% between 1993 and 2011 (see figure 3).

In short, this illustrates the accelerated liberalization of the Mexican economy, which is reflected in its increasing openness, tariff reductions and the dismantling of non-tariff barriers. In fact, after these changes, the concentration of foreign trade of Mexico with the United States is two-thirds of total trade in Mexico at present (although in some years it has accounted for more than 70%). This concentration deepened under the NAFTA process until the recession of 2001 and the entry of China into WTO in the same year, which had a dampening effect on this phenomenon.

Meanwhile, since 1978, China has implemented a series of reforms that began with the four modernizations advocated by Deng Xiaoping: agriculture, industry, defence and science and technology (Neme, 2006). The open-economy policy led to the adoption of a legal framework to facilitate international economic relations and foreign direct investment, the creation of special economic zones and open cities to modernize domestic industry by establishing foreign companies that manufacture and export products helped by diverse incentives (Neme, 2006, pp. 30-31). A clear sign of this reform process is China's increasing economic openness since 1993, expanding from 30% in that year to 77% in 2011 (see figure 3).
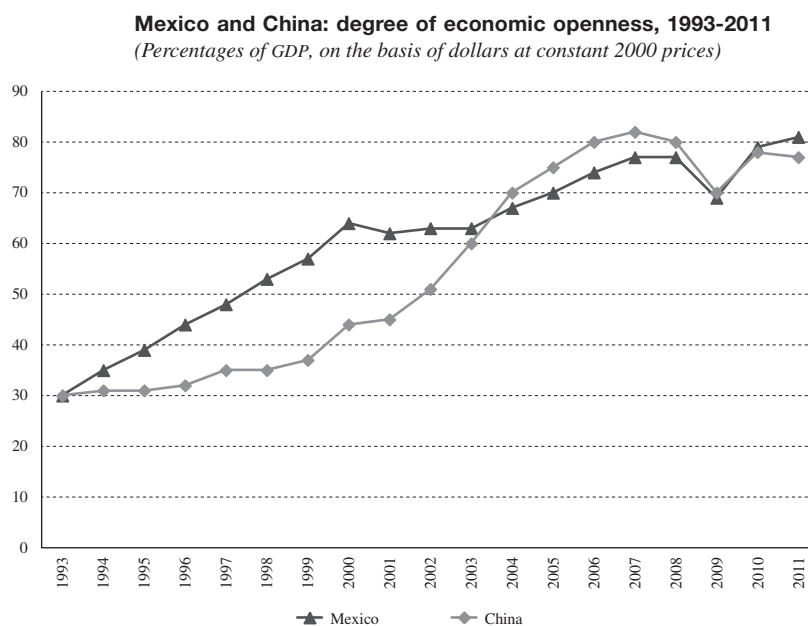
In this context of opening and reform, China and Mexico have become leading players in the global economy, making major advances in exports of manufactures. China became a significant part of the global factory when its share of world exports jumped from 2.8% in 1993 to 15.4% in 2011. Mexico's share, meanwhile, increased from 0.60% in 1993 to 2.0% in 2011, and the country thus became the foremost Latin American exporter of manufactures and an important part of the "global factory".[6]

In recent years, China has become a major player on the world stage and a regional economic power in Asia. Indeed, the country has undoubtedly become a first-order global power. China's share in world manufacturing exports has surpassed that of all the NAFTA countries put together, making it a linchpin of the global factory (see figure 4).

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[5] Gazol (2007) discusses the return to a new phase of protectionism that permitted foreign purchases equivalent to 2.2% in 1995, compared with 10% and 11% in 2005 and 2006, respectively. However, this pattern differs from the one that prevailed in the 1980s.
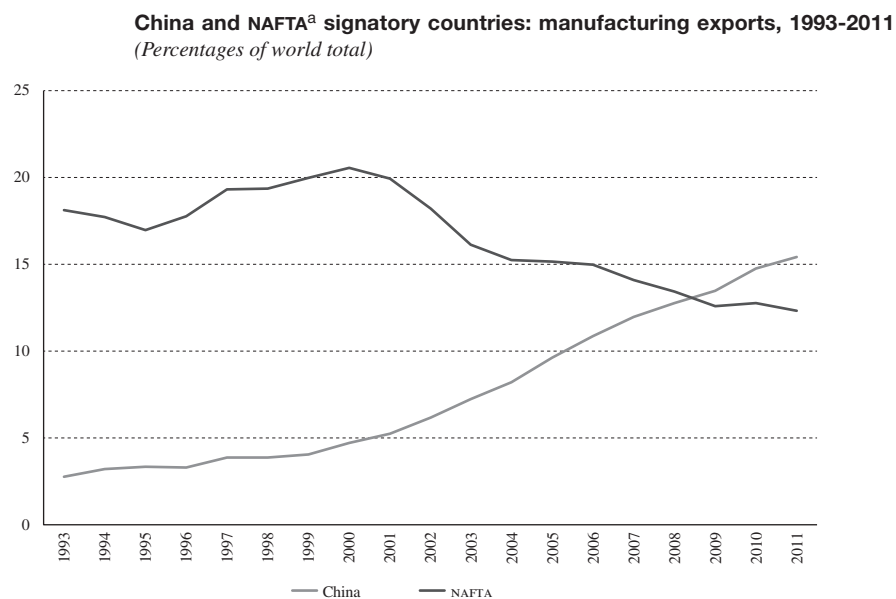
[6] Calculations based on the World Bank DataBank, in current United States dollars.

FIGURE 3

Mexico and China: degree of economic openness, 1993-2011
(Percentages of GDP, on the basis of dollars at constant 2000 prices)

Source: prepared by the authors, on the basis of data from World DataBank.

FIGURE 4

China and NAFTA[a] signatory countries: manufacturing exports, 1993-2011
(Percentages of world total)

Source: prepared by the authors, on the basis of data from World DataBank.

[a] North American Free Trade Agreement.

V

China's incursion into the North American market and ensuing changes to the NAFTA intra-industry trade model

From an empirical viewpoint, this paper seeks to analyse the pattern of intra-industry trade during a period marked by the integration process in North America (NAFTA) and the emergence of China in this region. Previous studies (Dussel and León González, 2001; OECD, 2002; López and Rodil, 2008; Dussel and Trápaga, 2007; Cárdenas and Dussel, 2011; Rodil and López, 2011; Neme, 2006) showed the growth in intra-industry trade between Mexico and the outside world and particularly with the United States. However, there is disagreement concerning China. Some authors, including Neme (2006), argue that, while real competition between Mexico and China is obvious in some groups of products, there is no clear winner and the Mexican exports to the United States market are not displaced by Chinese exports. By contrast, other authors, including Cárdenas and Dussel (2011) and Dussel and Gallagher (2013), hold that Mexico's trade with the United States and China reflects weak integration with China and greater, albeit decreasing, integration with the United States. Meanwhile, others (De la Cruz and Marín, 2011) argue, on the basis of an analysis of causality, that statistical evidence points to a negative relationship between Chinese and Mexican exports in the United States market, and that Mexico must therefore try to avoid displacement.

Bearing in mind this situation, the present study takes a different approach by exploring the phenomenon of intra-industry trade between China and Mexico in the NAFTA region, complementing the previous analysis in order to gain a better understanding of trends at the aggregate level. In fact, different patterns of trade are studied in this work: North-North (United States with Canada), North-South (United States and Canada with Mexico and China), and South-South (Mexico with China). In this article, we focus on these relations, always taking account of the crucial role played by the United States in the NAFTA region.

Intra-industry trade developed as part of an intensive process of integration between Mexico, the United States and Canada, at a time when China's share in NAFTA imports was increasing. The high growth in trade and the concentration of Mexican and Chinese exports and imports under a small number of chapters with respect to trade with the United States reveals a trade pattern dominated by a small group of sectors and China's emergence in the NAFTA region, both as a supplier and as a customer, but especially the former (see figure 5).

More specifically, China's trade with the NAFTA countries is fairly concentrated under just five chapters. In terms of exports, five chapters account for 63.0% of Chinese exports to the United States, 59.8% to Canada and 77.6% to Mexico. As regards Chinese imports, the five main chapters represent 45.3% of those from the United States, 52.8% from Canada and 81.6% from Mexico (see tables 2 and 3). The trade balance in the five main chapters favours China over the United States and Mexico, but in deficit vis-à-vis Canada.[7] In terms of Chinese exports, China shows a clear surplus over all the NAFTA countries in the five major chapters. In other words, China has a surplus in manufactures, but a deficit in respect of natural resources and primary products.

While the United States is China's main trading partner, Mexico also experienced a significant relative increase in its relations with this Asian country. Some products are of particular importance in the relationship between Mexico and China, such as those under chapters 84 and 85, which account for 49.4% of Chinese exports to the NAFTA region. Meanwhile, Chinese imports from NAFTA show a greater dispersion with these two chapters accounting for only 19%.

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[7] Trade between China and Canada is not analysed in detail in this study. Suffice it to say that it is mostly inter-industry trade, based on classic advantages relating to resourcing. In addition, its impact on Mexico's trade is negligible.

FIGURE 5

China: trade balance with the NAFTA[a] region, 1993-2011
(Millions of dollars)
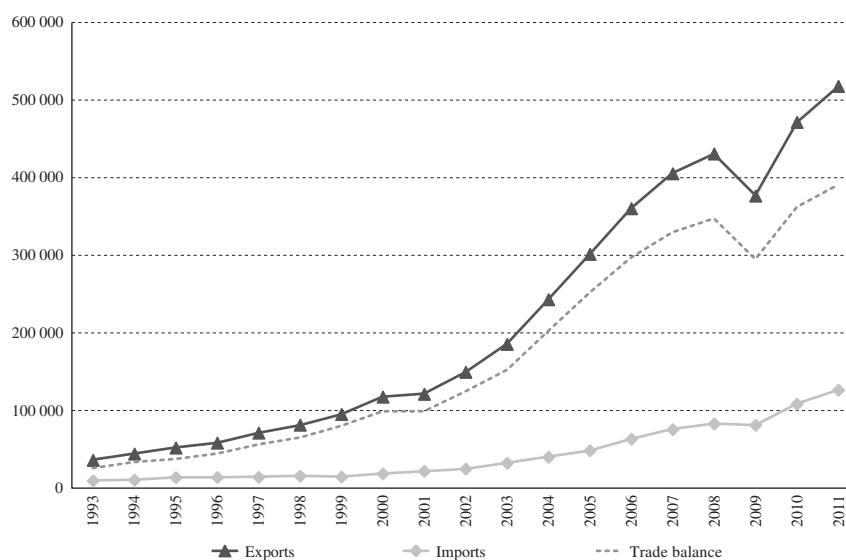
Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).
[a] North American Free Trade Agreement.

TABLE 2

China: products accounting for a larger proportion of exports to Canada, Mexico and the United States, 2011
(Annual average growth rates in percentages)

Chapter	Product	United States		Canada		Mexico	
		2011	1993-2011	2011	1993-2011	2011	1993-2011
84	Mechanical appliances, boilers and parts	23.9	25.7	19.8	28.9	24.8	29.6
85	Electrical machinery and equipment	23.8	18.6	24.3	22.7	43.4	38.5
95	Toys, games and sports requisites	5.7	9.7	5.6	13.3	2.5	26.9
94	Furniture, surgical equipment, not specified elsewhere	5.4	17.6	5.7	20.0	…	…
64	Footwear, gaiters and the like parts	4.2	7.5	…	…	…	…
62	Garments, not knitted	…	…	4.4	11.3	…	…
90	Optical, photographic and medical devices	…	…	…	…	4.4	36.6
76	Aluminium and articles thereof	…	…	…	…	2.5	56.1
	Selected total	63.0	16.5	59.8	20.0	77.6	33.8

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

TABLE 3

China: products accounting for a larger proportion of imports from Canada, Mexico and the United States, 2011

(Annual average growth rates in percentages)

Chapter	Product	United States		Canada		Mexico	
		2011	1993-2011	2011	1993-2011	2011	1993-2011
84	Mechanical appliances, boilers and parts	11.8	11.2	…	…	…	…
12	Seeds, oilseeds, grains and fruits	10.3	39.9	5.5	33.9	…	…
85	Electrical machinery and equipment	9.7	14.4	…	…	5.8	30.7
99	Non-specified products	7.0	28.3	…	…	…	…
87	Land vehicles and parts	6.5	12.5	…	…	14.9	∞
26	Ores, slag and ash	…	…	15.5	27.7	26.1	
47	Wood pulp and derivatives	…	…	15.4	20.6	…	…
44	Wood, articles of wood and charcoal	…	…	8.7	23.3	…	…
27	Petroleum and petroleum products	…	…	7.8	26.8	22.4	∞
74	Copper and articles thereof	…	…	…	…	12.3	91.7
	Selected total	45.3	15.3	52.8	24.3	81.6	51.3

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

∞: the infinity symbol is used as the growth rate was calculated as starting from 0 in 1993.

As regards the intra-industry trade index (GL index) of China, the destabilizing effect of the trade balance in bilateral relations with the NAFTA countries should be taken into account by calculating the adjusted GL index, as mentioned above (see figure 6). The GL index of China's trade with the United States rose from 0.58 in 1993 to 0.63 in 2011. In the case of China's trade with Mexico, the adjusted GL index dropped from 0.63 in 1993 to 0.41 in 2011. Lastly, the GL index of China's trade with Canada fell from 0.43 in 1993 to 0.29 in 2011.

FIGURE 6

China: intra-industry trade with the NAFTA[a] countries, 1993-2011

(Grubel-Lloyd index)

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] North American Free Trade Agreement.

From figure 6, we can draw at least three key conclusions. First, the levels of intra-industry trade found between China and the NAFTA countries are relatively low, especially compared with the patterns observed in developed economies (where intra-industry trade generally accounts for 60% or 70% of total trade). This evidence shows that the emergence of China in the NAFTA region is linked to the global factory, but without reaching full-industry integration. In fact, intra-industry trade is concentrated in just a couple of sectors. Second, China tends to record greater intra-industry trade with the United States than Mexico or Canada. This illustrates the dominant role played by the United States as a global factory, which intensifies the intra-industry trade flows with most of its trading partners. As a result, the relations between its trading partners take on a secondary role, as is the case for South-South trade between China and Mexico and North-South trade between China and Canada. Third, intra-industry trade between China and the NAFTA countries has been trending downward over the last decade; only in the case of the United States has this decline been contained. This trend emphasizes the consolidation of China's integration into the NAFTA region, pivoting around the central and dynamic role of the United States. In contrast, China relates with the other two countries (Canada and Mexico) under a more complementary strategy, although with intra-industry relations in certain specific sectors.

Regarding trade between China and the United States, there are 32 chapters with a GL index value above 0.5, but these do not include the most dynamic chapters (84 and 85). However, if we analyse the adjusted GL index taking into account the trade imbalance, these chapters do appear with high values. This suggests that most of China's trade with the United States is intra-industry trade, owing largely to the contribution of chapters 84 and 85 (mechanical and electrical machinery and equipment, respectively). Meanwhile, 18 chapters have a GL index over 0.5 in relation to trade between China and Canada. However, between 1993 and 2011, the GL index fell and the adjusted GL index was lower than 0.30, which shows that most of China's trade with Canada is complementary (inter-industry).

China's trade with Mexico seems to be of an inter-industry nature, as only 11 chapters have a GL index exceeding 0.5. Moreover, the adjusted GL index decreased from 0.63 in 1993 to 0.41 in 2011, with a sharp fall after 1999 (see figure 6).

The detailed analysis of the most relevant chapters (84, 85 and 87), conducted at a more disaggregated level (headings) shows more clearly the strong intra-industry character of Mexico's relations with the United States (its main trading partner) and China, as well as trends relating to the emergence of China in the NAFTA region. In particular, the calculation of the adjusted GL index for the bilateral trade between China, the United States and Mexico concerning chapter 84 shows a drastic increase in intra-industry trade between China and Mexico (see figure 7). In fact, in recent years, bilateral trade in these products (mechanical machinery and equipment) between Mexico and China has reached top values of almost 1 (that is, nearly 100% intra-industry trade). The comparison with the trade between Mexico and the United States, which shows a clear stagnation and even a decline with regard to the beginning of the period, raises new questions, in particular, whether the intensification of intra-industry trade with China has halted the intra-industry specialization between Mexico and the United States, which had taken off so vigorously in the late 1990s. The data seem to confirm this hypothesis.

The data for the other important chapter for foreign trade between Mexico and the United States and China, chapter 85 (electrical machinery and equipment), show a consolidation of its strong intra-industry nature (90% in 2011). In contrast, the GL index for the other two bilateral trade relationships (Mexico with China and China with the United States) has stagnated (see figure 8). Nevertheless, the GL index of China with the United States is higher than that of China with Mexico, owing to the leading role played by the United States in intra-industry trade.

Something quite different occurs with the analysis of chapter 87 (motor vehicles), in which the strong intra-industry character of trade between Mexico and the United States reappears, reaching maximum values during the last decade (see figure 9). A more irregular pattern is seen, however, for the other two bilateral trade relationships, with a surprising decline in the GL index at the end of the period. This trend clearly affects trade between Mexico and China, as well as trade between the United States and China, reducing intra-industry trade flows to very low levels (close to 10%). Analysis with a higher level of disaggregation (four digits for vehicles, parts and accessories) suggests that the trends in the import and export of engines and vehicle accessories are attributable to the lower labour costs obtained by transnational corporations in China and to the rise of this sector following the process of opening up the Chinese economy in the early 1970s (Cárdenas and Dussel, 2011; Dussel and Gallagher, 2013).

FIGURE 7

China, Mexico and the United States: intra-industry trade under chapter 84,[a] 1993-2011

(Grubel-Lloyd index)
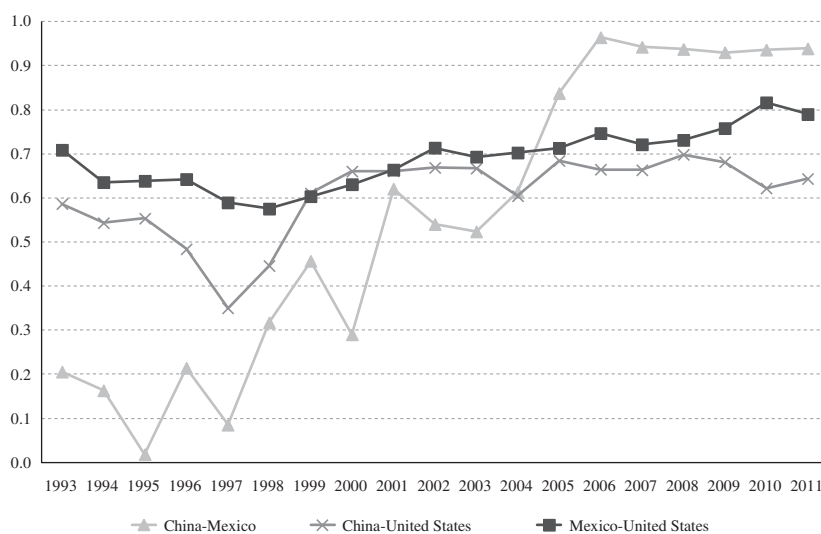
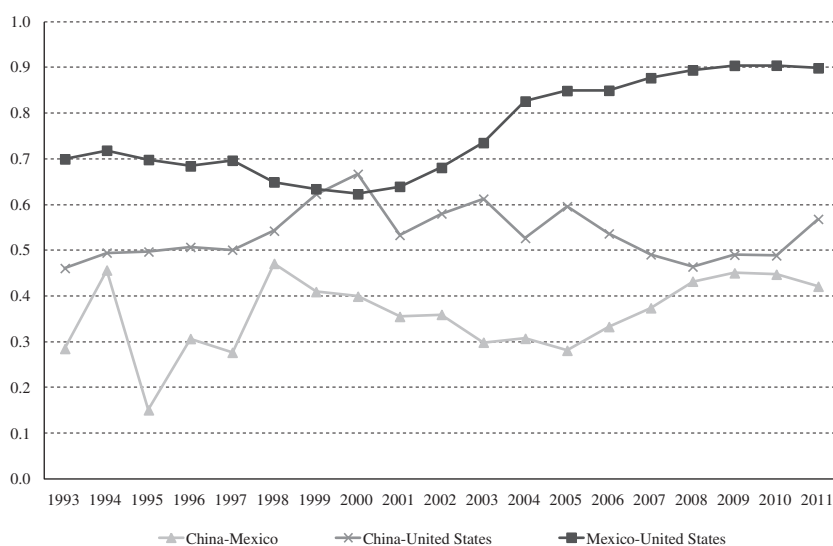─▲─ China-Mexico ─✕─ China-United States ─■─ Mexico-United States

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Mechanical machinery and equipment.

FIGURE 8

China, Mexico and the United States: intra-industry trade under chapter 85,[a] 1993-2011

(Grubel-Lloyd index)

─▲─ China-Mexico ─✕─ China-United States ─■─ Mexico-United States

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Electrical machinery and equipment.

FIGURE 9

China, Mexico and the United States: intra-industry trade under chapter 87,[a] 1993-2011

(Grubel-Lloyd index)

— China-Mexico   — China-United States   — Mexico-United States
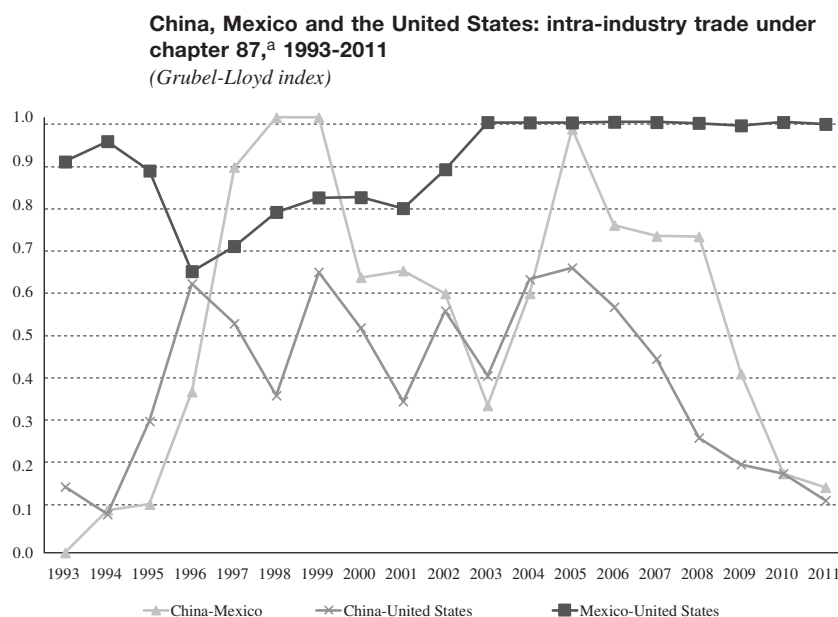
Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Vehicles, parts and accessories.

Moreover, it is useful to compare the evolution of United States imports from Mexico and China under each of the relevant chapters (see figures 10, 11 and 12). With the exception of chapter 87 (motor vehicles), imports from China far exceed those from Mexico.[8] In fact, there seems to be a "substitution effect" for products originating in China, although in many cases, imports from Mexico are not falling in absolute terms, which means that China is gaining a larger market share in other countries.

The above finding does not apply to chapter 87 (motor vehicles) since, as shown in figure 12, Mexico remains the top supplier to (and customer of) the United States in this production chain. The high level of intra-industry trade between these two countries in this sector is in part a reflection of the devolution of the American automotive industry. This is clearly indicated by Mexico's share in the global trade of this industry: Mexico rose from 2.4% of world exports and 0.6% of imports in 1993 to 5.3% of world exports and 2.7% of imports in 2011 (WTO, 2013).
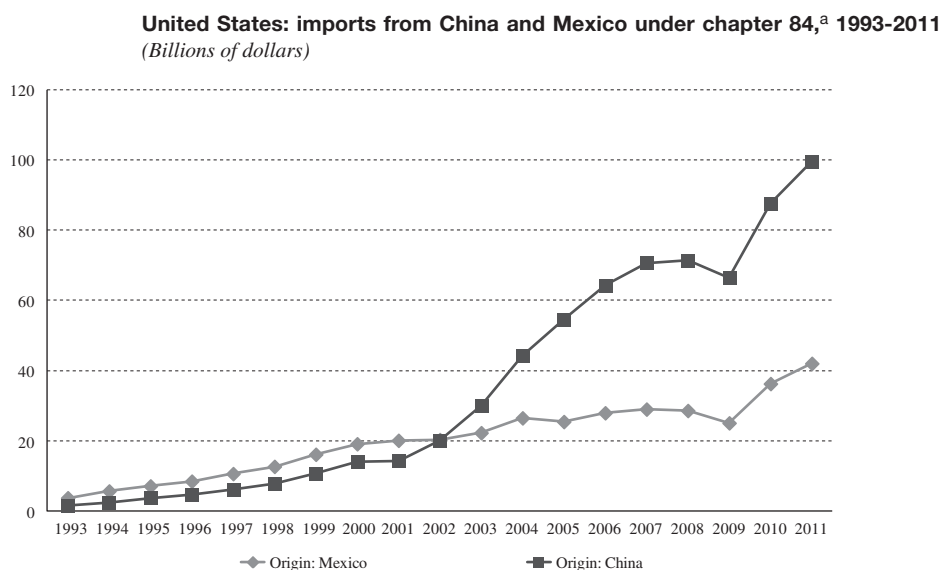
These chapters account for over half of Mexican exports to the United States and have a high rate of intra-industry trade, demonstrating Mexico's integration into global value chains, especially with respect to manufactures, which represent the output of the global factory.

The same chapters (84, 85 and 87) of China's exports to the United States are equivalent to 49.8% of total Chinese exports, although the rate of intra-industry trade is lower than in the case of Mexico. China is less integrated, especially in relation to chapter 87, the area where intra-industry trade between Mexico and the United States is predominant. With respect to these chapters, intra-industry trade is more prevalent between Mexico and the United States, while China's trade with the United States tends to be of a more complementary nature (inter-industry trade). However, the exponential increase in intra-industry trade between China and Mexico under chapter 84 (see figure 7), may be a result of a triangular trade process between China, Mexico and the United States.

Furthermore, given the wide variety of items included in these chapters, it is useful to analyse in detail what happens to the principal items they cover. Figure 13 shows the GL index of intra-industry trade

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[8] In some specific items this trend is even more dramatic, as in the case of the headings 8443, 8471, 8473, 8481 and 8525.

FIGURE 10

United States: imports from China and Mexico under chapter 84,[a] 1993-2011
(Billions of dollars)

Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Mechanical machinery and equipment.

FIGURE 11

United States: imports from China and Mexico under chapter 85,[a] 1993-2011
(Billions of dollars)
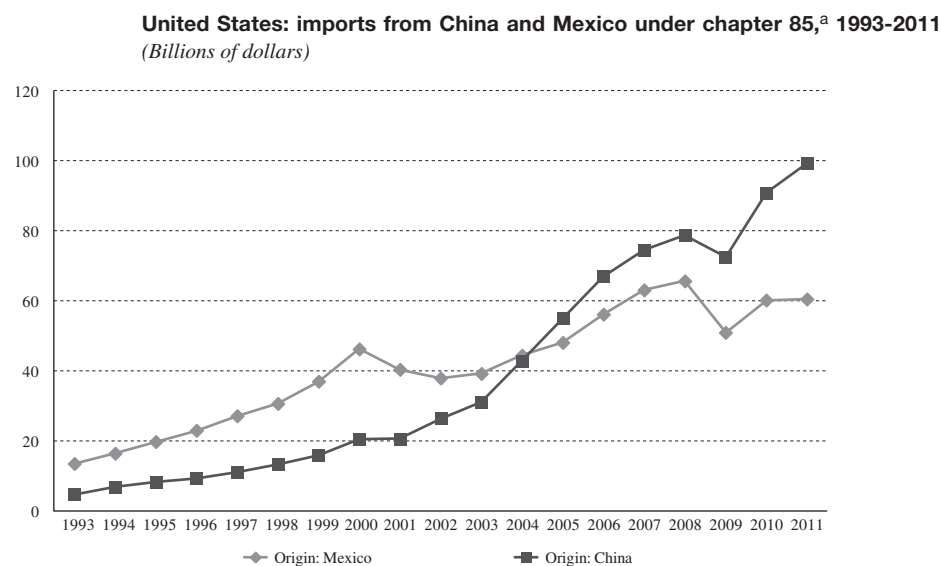
Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Electrical machinery and equipment.

FIGURE 12

United States: imports from China and Mexico under chapter 87,[a] 1993-2011
(Billions of dollars)
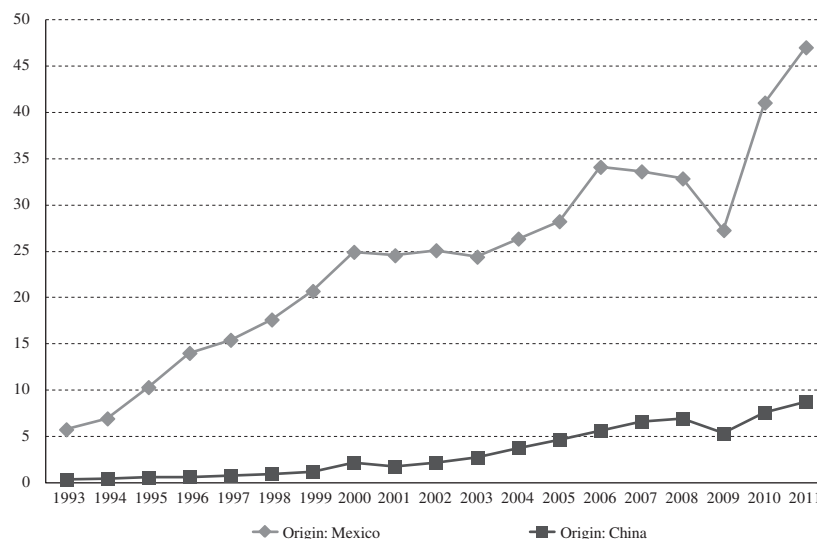
Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

[a] Vehicles, parts and accessories.

for the top 13 items (at the headings level, four-digit disaggregation) in Mexico's trade with its main trading partner (the United States). Three bilateral trade pairings were analysed: Mexico-United States, Mexico-China and China-United States. The results show the prevalence of intra-industry trade between Mexico and the United States, exceeding that of the other bilateral pairings for 10 of the 13 items under consideration. These include headings 8536 (electrical switches, connectors), 8708 (parts and accessories for motor vehicles) and 8408 (compression-ignition engines, diesel). The only three headings with a GL index that was lower for this pairing than for the other two bilateral trade pairings are headings 8409 (parts for spark-ignition internal combustion

engines), 8471 (automatic data processing machines, computers) and 8548 (electrical parts of machinery and apparatus).

In addition to the above headings, China's trade with the NAFTA countries includes the following: 8443 (printing and auxiliary equipment), 8473 (parts and accessories, except covers, for office machines), 8504 (electrical transformers, static converters and rectifiers), 8542 (integrated circuits and microstructures), 8711 (motorcycles and cycles fitted with an auxiliary motor) and 8712 (bicycles and other cycles, not motorized). China's trade in these products involves very low levels of intra-industry trade, with flows predominantly in only one direction.

FIGURE 13

**China, Mexico and the United States: intra-industry trade for
selected headings in chapters 84, 85 and 87, 2011**
(Grubel-Lloyd index)
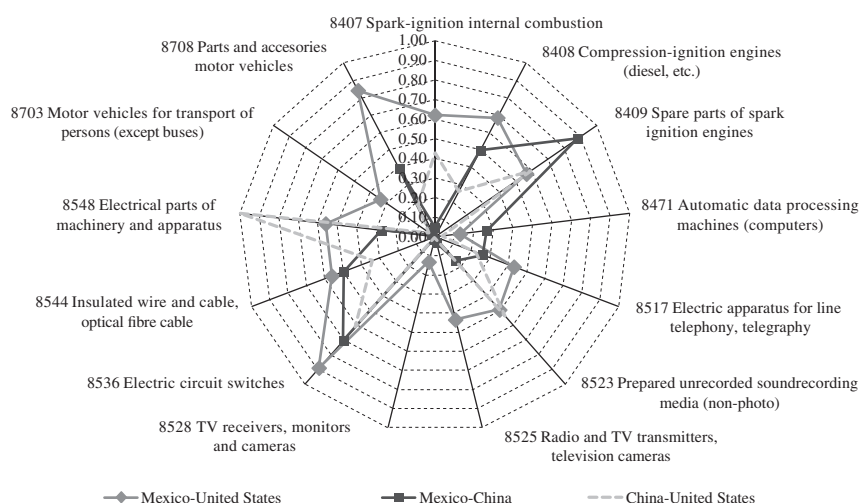
Source: prepared by the authors, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).
nes: not elsewhere specified.

VI

Conclusions

The results obtained in this study show the main trends and implications for trade in the NAFTA countries arising from the emergence of China in North America. The growing role of China over the last decade confirms its position as the leading supplier of the United States market, pushing Mexico into second place. A similar pattern has been seen regarding trade with Mexico, where China has established itself as the second largest supplier, immediately after the United States. Similarly, China is Canada's second largest supplier after the United States.

These trends are attributable to different factors, including, notably, intra-industry trade. In particular, intra-industry trade between Mexico and the United States grew robustly in the early years of NAFTA, with a slight decline in 2000-2011, due to the 2001 recession in the United States economy, and to China's accession to WTO, which turned it into a major player in this region.

From a sectoral perspective, our results highlight the growth in intra-industry trade relating to vehicles, parts and accessories (chapter 87), mechanical machinery and equipment (chapter 84), and electrical machinery and equipment (chapter 85). These three types of products account for more than 52.0% of Mexico's total exports, which is evidence of the country's growing intra-industry specialization. The United States is Mexico's primary market, absorbing 82.2% of Mexican exports under these chapters.

The fact that the United States' intra-industry trade under these chapters is likely to continue expanding, and to a greater extent in relation to Mexico than China, is no minor issue. Horizontal intra-industry trade is the exchange of similar but differentiated products and vertical intra-industry trade refers to the transfer of a product from one country to another at various stages of development (intra-firm trade). Mexico has the highest rate of intra-industry trade, as it integrates both modalities, while China's intra-industry trade is basically horizontal, except under chapters 84 and 85. The high levels of intra-industry trade with Mexico (chapters 84, 85 and 87) and China (chapters 84 and 85) show that they are part of the global factory whose pivot is the United States. In Mexico, most of this trade is intra-firm, as in the case of the automotive industry, in

which Mexico has become a world power. Interestingly, however, none of the companies constituting that industry is Mexican.

In summary, the findings suggest that intra-industry and intra-firm trade are closely connected in Mexico, appearing to form two sides of the same process: Mexico's participation in NAFTA and the progressive relocation of the United States' production industry. Nevertheless, since China joined WTO in 2001, NAFTA seems to have been unable to create intra-area trade, except in the automotive industry. As shown, China has staged a major breakthrough in the NAFTA region, despite having achieved significant levels of intra-industry trade only with the United States. This may be because joining WTO gave China direct access to the United States market. By contrast, trade between China and Canada is mostly inter-industry and in many cases linked to traditional comparative advantages (resource endowment). In fact, Canada is the only NAFTA country with which China has a trade deficit.

China has become the world's factory and enjoys a trade surplus with all the NAFTA countries with respect to its exports under the top four chapters (primarily manufactures). However, China posts a deficit in trade relating to natural resources (oil) and raw materials and food (some of which are covered under its top five import chapters). China has successfully penetrated NAFTA without any free trade agreements or any recognition as a market economy by the NAFTA countries. That free trade area seems to work as a radiated wheel, in which United States acts as the hub, while China, Canada and Mexico operate as the spokes.

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