GLOBAL ECONOMIC GOVERNANCE INITIATIVE

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Premature Specialization?

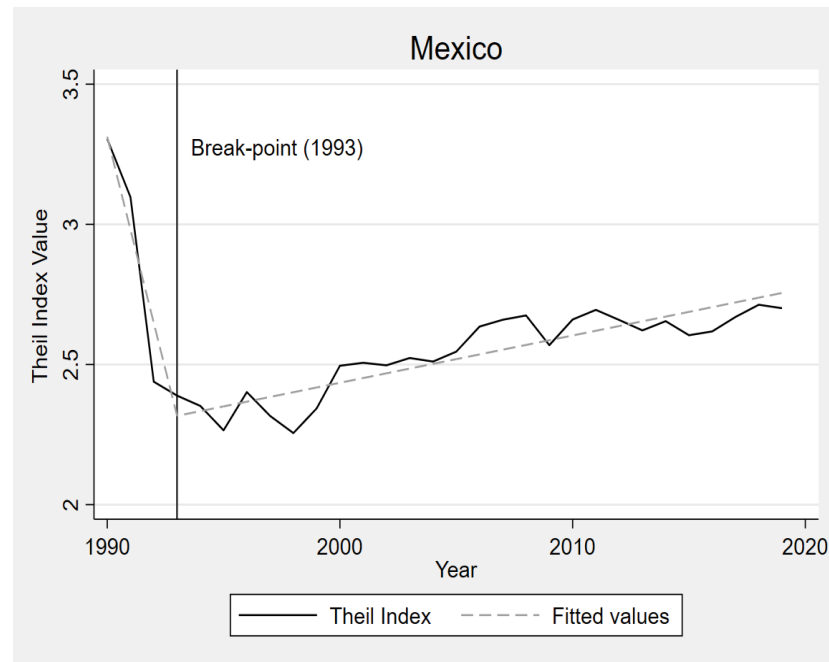## THE EXPORT RE-SPECIALIZATION PATTERN OF MEXICO

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ABSTRACT

Mexico has been on a path of increasing export re-specialization since the early 1990s. This paper examines why this pattern of export re-specialization has persisted in Mexico, by systematically analyzing two major exogenous trade shocks that occurred during the period of analysis: the ratification of the North American Free Trade Agreement (NAFTA) that went into effect in 1994, and the accession of China to the World Trade Organization (WTO) in 2001. I use an event study methodology to analyze the impact of the 1994 North American Free Trade Agreement (NAFTA) and China's accession to the World Trade Organization(WTO) in 2001 on Mexico's product-level export pattern as the re-specialization incidence coincides with the agreement's implementation and further intensified after China's accession. I find that NAFTA positively impacted low-domestic input intensive "Maquiladora" products and that the re-specialization permanently shifted production into these products. The impact of China's accession is negative and more generalized, affecting export shares of all industries rather than specific ones.

1 INTRODUCTION

Mexico has been on a path of increasing export re-specialization since the early 1990s. This phenomenon is unexpected since export re-specialization is typically experienced by advanced economies. Export re-specialization for advanced economies is the sequential shift in a country's exporting pattern from diversification to specialization in more technology and capital-intensive products.

Figure 1: Export re-specialization pattern of Mexico

Source: Authors' calculations using Comtrade data

Figure 1 plots the Thiel index for Mexico, a standard measure of export diversification.[1] By estimating the turning point of the Theil-Index, I find that Mexico began to re-specialize in 1993 at a comparatively low income level. The re-specialization appears to be permanent since the trend has continued for 26 years (from 1993 to 2019). Furthermore, as shown in Table 1, the re-specialization continues to be biased toward middle-high technology exports (rather than high technology exports), and the export basket's complexity level has remained relatively stagnant. The automotive, textiles and petroleum sectors have been the main drivers of the dynamics of the Thiel index for almost three decades.

I examine the potential causes of this re-specialization of Mexico by systematically analyzing two major exogenous trade shocks that occurred during the period of analysis. The first was the ratification of the North American Free Trade Agreement (NAFTA) that went into effect in 1994, and the second was China's accession to the World Trade Organization (WTO) in 2001. Specifically, I first estimate the impact of tariff reductions under NAFTA on the compositional change in Mexico's export basket. Second, I analyze the impacts of export competition through the tariff reductions that resulted from China's accession to the WTO on Mexico's export composition.

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[1] A higher value indicates export specialization while a lower value indicates diversification.

Table 1: Selected export performance indicators for Mexico

Variable	Pre-episode		Post-episode five year averages			
	1990 - 1993	1994 - 1998	1999 - 2003	2004 - 2008	2009 - 2013	2014 - 2018
Value of total exports ($, billions)	37.80	92.60	157.00	241.00	323.00	386.00
Diversification measures						
TI	2.81	2.32	2.47	2.61	2.64	2.65
Gini	0.91	0.89	0.91	0.91	0.92	0.92
HHI	0.08	0.03	0.03	0.04	0.04	0.03
Number of lines	1159	1194	1187	1185	1174	1036
Export basket breakdown						
Agriculture (%)	5.52	3.73	2.48	2.51	2.79	3.47
Commodities (%)	31.70	14.65	11.74	17.65	16.97	10.91
Low tech (%)	10.03	13.67	13.72	10.57	8.92	9.36
Middle-low tech (%)	11.46	9.79	8.06	10.30	11.47	9.15
Middle-high tech (%)	31.83	38.07	39.13	35.66	37.66	45.85
High technology (%)	14.95	23.80	27.34	25.81	24.97	24.74
Economic Complexity Rank			26	25	22	22
Economic Complexity Index value		2.774	2.744	2.493	2.345	2.445

Source: Author's calculations based on Comtrade data

Notes: Technology level classification of the export basket - as per Lall (2000). Economic Complexity - as per Harvard Growth Lab data (2022)

The results show that the tariff reductions under NAFTA benefited low-domestic input-intensive semi-assembly industries, while high-domestic input-intensive industries lost their share of the export basket. Furthermore, Chinese competition negatively impacted all Mexican industries in the long run, where high domestic input-oriented industries were most acutely affected.

2 LITERATURE

2.1 The history of industrialization in Mexico

Mexico's international trade integration started long before NAFTA. The Maquiladora program between Mexico and the US began in 1965. However, the dominant economic development strategy that characterized the period between the 1950s and 1970s was import substitution industrialization (ISI). ISI was a very successful strategy at the time; per capita income rose, a large and educated middle class developed, and there was significant urban industrial growth (Wilson, 1992). This economic development was concentrated in the interior states of Mexico, while states bordering the US, saturated by American-made goods, were excluded from it. To boost growth in these regions, the Boarder Industrialization Program (BIP) was set up in 1965, and plants operating under the BIP were called Maquiladoras (Wilson, 1992). The program allowed Mexican and foreign investors to temporarily import all inputs, machinery, and replacement parts required for assembly, duty-free, under the condition that the completed products would be re-exported.

2.2   Origins of the Maquiladora industry and export-led industrialization in Mexico

The Maquiladora program was mainly aimed at regional development. In terms of national development strategies, there were only mild liberalization efforts in the 1 970s. In 1982, the Mexican government switched to an export-led development strategy, and the Maquiladora program became a primary driver of this development strategy. The government announced its accession to the General Agreement on Tariffs and Trade (GATT) in 1985, and several trade negotiations between Mexico and the US regarding specific sectors followed in the late 80s (1985, 1987, 1989) (Kose et al., 2004). Industries that benefited from these rounds of liberalization, as measured by the production volume index, were vehicles, engines and auto parts, glass, cement and chemicals (Itō et al., 1997). These adjustments mainly allowed the auto industry to grow rapidly, and in 1987, the first "high-tech" auto plant opened in Mexico, commencing the export of vehicles (Itō et al., 1997).

The Maquiladoras also went through some structural changes during this time. Several rounds of new legal frameworks and legal decrees passed by the Mexican government promoted more and full foreign ownership, setting up production in non-border states, permission to sell part of the production within Mexico, sourcing more domestic inputs, and options for Mexican firms (rather than foreign firms) to get involved in exports processing, i.e., PITEX, ALTEX programs.[2]

These structural changes led to increased worker productivity, more capital-intensive production processes, and more manufacturing along with the former assembly activities, shown in Table 2.

Table 2: Characteristics of Maquiladoras

	Average					Average
	1975	1980	75 -'81	1985	1990	82 -'90
Value added per worker (000,000 pesos)	196	174	189	207	243	217
Labor cost as percent of total operating costs	19	18	18	13	13	12
Labor cost as percent of value added	61	59	60	52	51	50
Percent skilled workers	9	10	9	13	-	13
Percent female workers*	78	77	78	69	61	68
Average size of plant (no. of workers)	148	216	186	279	238	262

Source: selected numbers from (Wilson, 1992)
Notes: *Percent of female workers measures skill level; they are assumed to be less skilled than male workers.

However, Table 3 shows the dramatic rise in employment in the transportation equipment industry, primarily composed of automobile sub-assemblies, seemingly at the expense of the electric and electronic equipment and materials industries (Wilson, 1992). This is significant because the industries with more potential for creating backward and forward linkages are the latter. This raises the question of whether the true cost of this takeover by the transportation equipment industry is the potential to develop the electronics industry. Wilson (1992) warns that without state guidance to

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[2] PITEX: Programa para la importación temporal para exportación - which allowed large firms with over $5 million in annual sales to export as little as 10% of gross sales and ALTEX: Programa para las industrial altamente exportadoras - which allowed small firm to export at least 50% of their output and for both types of times to receive the same duty-free exemptions as the original Maquiladora firms.

ensure local linkages from its manufactured exports, NAFTA could simply mean the further maquilization of Mexico's manufacturing industry.

Establishing backward linkages that facilitate domestic inputs is vital to export-led development. Backward and forward linkages refer to the idea that industries may use inputs from further up the supply chain (backward linkages) and become input to production processes further down the production chain (forward linkages) (Hirschman, 1958). Therefore, if an industry creates more backward and forward linkages, there will be a higher probability of integrating the domestic economy into the production process, possibly leading to more economic activity and, thus, growth. Even though there were some technology-intensive activities related to Mexico's transportation industry, the industry was mainly driven by assembly activities at the rear end of the production chain. One of the primary focuses of this study is to analyze whether the tariff provisions in NAFTA led to the lock-in of Mexico's export structure to the transportation industry.

Table 3: Sectoral Composition of Maquiladoras

Sector	Percentage of total employment		
	1979	1982	1990
Transportation equipment	4.5	9.7	21.5
Electric and electronic equipment	25.7	26.1	11.6
Electric and electronic materials	31.2	32.3	25.3
All other	38.5	32.0	41.6

Source: selected numbers from (Wilson, 1992)

2.3   The rise of China and its impact on Mexcian industrialization

The accession of China to the World Trade Organization (WTO) in 2001 was a turning point in the history of international trade. The Chinese economy had been gaining momentum and gearing towards integration into the world economy since the early 1990s. At the time, Chinese exports were characterized as low-technology and low-skill-intensive products. The timing of the accession is important because Mexico was only about six years into enjoying the trade privileges of NAFTA. Six years may be a long enough period to expand trade and establish trading processes and relations bolstered by the tariff concessions of NAFTA. Still, six years may not be enough time for technological upgrading required to face greater international competition, especially Chinese competition, which was also driven by low-cost labor.

Several studies have addressed the impact of Chinese completion on domestic export performance (Mesquita Moreira, 2007; Eichengreen et al., 2007; Jenkins et al., 2008; Alvarez´ and Claro, 2009; Hanson and Robertson, 2008; Sargent and Matthews, 2009; Gallagher and Porzecanski, 2010; Autor et al., 2013; Flückiger and Ludwig, 2015). The geographic coverage of these spans the US, Europe, Asia, and Latin America and the Caribbean (LAC). While some of these studies provide evidence that Chinese competition negatively affected export performance (Alvarez and Claro, 2009; Autor et al., 2013; Flückiger and Ludwig, 2015), others indicate that this negative impact is modest (Hanson and Robertson, 2008; Husted and Nishioka, 2013). In studies that focus on the LAC region, earlier studies warn of China as a formidable competitor in the future (Mesquita Moreira, 2007), and some point out that there are winners and losers at the country-sector level (Jenkins et al., 2008). Sargent and Matthews (2009) study Mexico's Export Processing Zones (EPZ) (where the

Maquiladoras are located in Mexico) and find clear evidence of China's export growth contributing to high maquila mortality at all levels of technology intensity.

The studies that argue that some industries will benefit are based on the idea that China is an untapped market for LAC exports. Yet the counterargument to this idea is that even though there would indeed be export growth, it would mostly be in commodity exports, i.e., soy and metals.[3] This was the case for Brazil and Chile (Gallagher and Porzecanski, 2010). However, Mexico did not benefit from China as an export destination (Gallagher and Porzecanski, 2010). This could have been due to the shift in the export-led growth strategy favoring the auto sector, partly because shipping assembled autos to China may be cost-prohibitive and partly because Mexico did not have commodity exports that could cater to Chinese demand.

Furthermore, at the time of accession, China was a low-wage competitor with wage rates between one-third and half of Mexico's wage rate (Sargent and Matthews, 2009). As Lall et al. (2005) and Freund and Ozden (2006) point out, China's industrial advance boosted by this low-wage labor advantage threatened to force Latin American countries further down the technology scale or in the least limited LAC's ability to move up the export ladder. Mexico experienced a compounded negative effect since there was considerable similarity in the composition of US imports from China and Mexican EPZ products (Sargent and Matthews, 2009). This means that apart from the auto sector, for which Mexico had a clear advantage over China in the US market, the two countries were competing through similar products around the time of the accession.

It is worth noting that although the ratification of NAFTA and China's accession to the WTO were possibly the most important events that affected Mexico's export growth trajectory, several other major trade-related events occurred concurrently with these two events. Among these are the Tequila crisis, which forced a sharp devaluation of the Mexican peso in 1994, the end of the Agreement on Textiles and Clothing (ATC) (that succeeded the multi-fiber agreement) in 2004[4], which may have further exposed Mexico to Chinese competition, Mexico signing other trade agreements with trading partners[5], and the broader international trading environment that favored globalization (Kose et al., 2004).

This paper speaks to the broader literature on the connection between trade liberalization and productivity growth for developing countries (Helleiner, 1992). Regarding the Mexican liberalization experience, the focus has mostly been on trade flows and labor outcomes (Chiquiar, 2004; Moreno-Brid et al., 2005). Even among the studies that examine the longterm impact of NAFTA on the Mexican economy (Weisbrot et al., 2018), there is a paucity of studies that examine the agreement's impact on the composition of Mexico's long-term export basket. This is also the case with China's accession. Therefore, I contribute to the literature by quantifying the impact of both events on Mexico's export basket composition. I discuss the potential implications of these impacts on Mexico's growth trajectory towards the end of this paper.

3 THEORETICAL FRAMEWORK

This theoretical framework lays out the expected trade outcomes for Mexico through the tariff and investment provisions of NAFTA, as well as increased trade competition following China's accession to the WTO. I expect the tariff and investment provisions of NAFTA to increase the intensity of

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[3] Expansion in primary commodity exports, also known as re-primarization (Cooney, 2021), does not promote technological upgrading in an economy which could lead to sluggish growth.

[4] This agreement gradually eliminated quotas that were imposed on exports of textiles and garments from developing countries to developed countries.

[5] These include the Chile-Mexico FTA (1998), EU-Mexico FTA (2000), the G-3 FTA between Colombia, Mexico, and Venezuela (1995)

Maquiladora-based export products, such as autos, electronics and textiles, in Mexico's export basket. I also expect products that Mexico competed with China for the US market to decrease its share in Mexico's export basket and increase specialization in products that Mexico had a clear advantage over China.

The Maquiladora program helped Mexico develop its comparative advantage in the auto parts semi-assembly, electronics and textile sectors through decades of strategic industrial policy implementation. This comparative advantage was mainly driven by cheap labor, attracting cost-cutting outsourcing from US companies. The program had already removed substantial trade barriers between the two countries through special tariff exemptions in Mexico. The US had supplemented these exceptions through the 806 and 807 provisions of the US tariff schedule.[6]

Even if the Maquila sectors and industries benefited through lower tariff rates before ratifying the agreement, most sectors, including the Maquila sectors, received a tariff reduction following the ratification (unless the sectors already received zero percent tariffs). The NAFTA tariff reduction is a positive trade shock, and it should increase trade between the US and Mexico unequivocally since it directly reduces trade costs. There could be heterogeneous effects depending on the sector and the duration of the step-wise tariff elimination. For most products - around 65 percent of products from the total basket of export goods in 1994 - the tariffs were eliminated immediately upon ratifying the agreement in 1994. For the others, they were phased out. These products may have experienced anticipatory trade volume increases. Yet, in all cases, the impact of the tariff reduction must be positive and should increase trade volumes.

I do not address the impact of foreign direct investment (FDI) facilitation in this paper. However, the impact of NAFTA on FDI is a mechanism through which NAFTA affected the composition of Mexico's export basket. In addition to reducing tariff rates between the two countries, a major component of the agreement was removing barriers to investment. Mexico experienced a dramatic increase in trade and investment flows following the ratification of the agreement (Wilson, 1992; Feenstra and Hanson, 1996; Kose et al., 2004; Waldkirch, 2010).

To elaborate briefly, there are two main types of FDI: vertical and horizontal. Vertical FDI takes place when a multinational company (MNC) breaks up the production process into stages and situates stages in different countries depending on the local factor market advantages/competitiveness (Cuevas, 2005). Horizontal FDI takes place when the MNC caters to the local market (not breaking up production into stages). The existence of preferential trade and distance affects whether FDI is vertical or horizontal (Waldkirch, 2010). If a foreign trade partner is close (in terms of distance and trade costs), the MNC may exploit factor price differentials, and if distant, it may engage in market-seeking. Theoretically, NAFTA may have further eliminated any trade barriers that prevented US MNCs from engaging in vertical investments in Mexico. This may explain the surge in investments to Mexico from the US following the agreement's ratification. However, it is important to note that since vertical FDI is based on utilizing local factor market advantages, and in Mexico's case, the cheaper labor, it is less likely to generate positive productivity effects than horizontal investment (Waldkirch, 2010).

Finally, the agreement is also widely regarded as a commitment mechanism, as Mexican leaders envisioned it would prevent the country from swaying away from its export-oriented development path (Itō et al., 1997). As elaborated in previous sections, Mexico set off on this export-oriented development path nearly two decades before the ratification of the agreement. One of its main functions was establishing stability and certainty in the trading environment of the region. I argue that the

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[6] Lines 806.30 and 807.00 of the U.S. tariff schedule stipulated that duties be collected only on the value added abroad for goods sent abroad for processing or assembly activities.

agreement and its underlying commitment to certainty may have locked in Mexico's autos-oriented export structure and set Mexico off on a path of increased export specialization. The implication is that this specialization is premature since it may have crowded out investment space and the potential to diversify Mexico's exports further into high-technology production following NAFTA.

Given that Mexico's re-specialization occurred in 1993, my primary focus is on NAFTA. However, Mexico could only reap the benefits of the agreement for a short period of six years before China officially gained access to the world market in 2001. China was a noteworthy export competitor to Mexico at the time. Both countries competed through low wages and low to medium technology products like textiles. Both were attractive labor sources to MNCs interested in competing with East Asian competition through cost-cutting rather than technology upgrading. The US was (and still is) Mexico's primary export destination, and there was considerable overlap in the products the two countries were competing against in the US market. Therefore, I expect Mexican exports of these products to have felt the impact of China's accession to the WTO more than the auto sector, for which Mexico still had an advantage due to proximity and associated trade and shipping costs.

4   DATA AND METHODOLOGY

4.1   Data

This study aims to analyze the impact of NAFTA on export re-specialization at the product level. To do this, I calculate the Theil Index using data from the World Bank's World Integrated Trade Solutions (WITS) database[7]. Mexican value of exports at the four-digit level of aggregation; also known as the *"Heading"* level in the Harmonized System (HS) of trade classification. The period of analysis is from 1990-2019.

4.2   The product-level export specialization measure

Since this study aims to analyze the impact of NAFTA on export re-specialization at the four-digit product level, my dependent variable is each product's share of the total year-on-year change in the Thiel index. I propose a novel yet simple decomposition of the Thiel index to construct this variable. The standard formula for calculating the Theil index is given below.

$$TI_{it} = \frac{1}{n} \sum_{k=1}^{n} \frac{x_{kt}}{\mu_t} . ln\left(\frac{x_{kt}}{\mu_t}\right) \tag{1}$$

$$\text{where: } \mu_t = \frac{1}{n} \sum_{k=1}^{n} x_{kt}$$

Here TI_{it} is the Theil Index value of country i at time t.[8] It is a function of the value of exports of a product k relative to the mean export value in that year, given by μ_t. It is important to note that n represents the total number or the universe of products a country could produce. This is constant throughout the analysis. Under the HS-0, *heading* aggregation level, this number is 1241 possible product categories. This means that there are 1,241 categories of products a country can export.[9]

[7] Source data from the United Nations Statistics Division's Commodity Trade Statistics (Comtrade) database
[8] I will suppress the country subscript i for the rest of the analysis since I am only looking at Mexico
[9] Therefore if a country does not export one of the possible product categories it will enter the summation term above as a zero.

Equation 1 can be broken down as shown below:

$$TI_t = \frac{1}{n}\left[\left(\frac{x_{k=1,t}}{\mu_t}.ln\left(\frac{x_{k=1,t}}{\mu_t}\right)\right) + \left(\frac{x_{k=2,t}}{\mu_t}.ln\left(\frac{x_{k=2,t}}{\mu_t}\right)\right) + ... + \left(\frac{x_{k=n,t}}{\mu_t}.ln\left(\frac{x_{k=n,t}}{\mu_t}\right)\right)\right] \quad (2)$$

The change in the Theil index from the year before can also be broken down as follows,

$$TI_t - TI_{t-1} = \frac{1}{n}\left(\left[\left(\frac{x_{k=1,t}}{\mu_t}.ln\left(\frac{x_{k=1,t}}{\mu_t}\right)\right) + ... + \left(\frac{x_{k=n,t}}{\mu_t}.ln\left(\frac{x_{k=n,t}}{\mu_t}\right)\right)\right]\right.$$
$$\left. - \left[\left(\frac{x_{k=1,t-1}}{\mu_{t-1}}.ln\left(\frac{x_{k=1,t-1}}{\mu_{t-1}}\right)\right) + ... + \left(\frac{x_{k=n,t-1}}{\mu_{t-1}}.ln\left(\frac{x_{k=n,t-1}}{\mu_{t-1}}\right)\right)\right]\right) \quad (3)$$

$$\Delta TI = \frac{1}{n}\sum_{k=1}^{n}\Delta Z_{kt} \quad (4)$$

where: $\Delta TI_t = TI_t - TI_{t-1}$, $\Delta Z_{kt} = Z_{k,t} - Z_{k,t-1}$

and: $Z_{k,t} - Z_{k,t-1} = \left(\frac{x_{k,t}}{\mu_t}.ln\left(\frac{x_{k,t}}{\mu_t}\right)\right) - \left(\frac{x_{k,t-1}}{\mu_{t-1}}.ln\left(\frac{x_{k,t-1}}{\mu_{t-1}}\right)\right)$

Therefore, ΔZ_{kt} is the relative contribution of each product to the total change in the Theil index from one year to the next [10]. As mentioned above, Z_{kt} captures how similar the export value of product k is to the yearly mean μ_t value of exports. I normalize this value so that if $Z_{kt} = 0$, the total export value of product k equals the mean export value of year t. A positive(negative) Z_{kt} value indicates that the export value of product k is greater(smaller) than the average export value. Furthermore, the larger the value of Z_{kt}, the higher(lower) the level of export specialization in product k.

Tariff data is from the WITS - TRAINS database.[11] The data is at the country and HS four-digit level. I take the effectively applied tariff rate (AHS)[12] and the ad valorem equivalent (AVE).[13] Specifically, I use US AHS tariff rates imposed on Mexican imports.[14]

A primary weakness of this dataset is the fairly significant amount of missing data. The most significant is the lack of any tariff data for 1994, an essential year for this study. For 1994, I use tariff data published by Feenstra et al. (2001).[15]

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[10] It's important to note that:

$$1 = \frac{\Delta Z_{k=1}}{n.\Delta TI} + \frac{\Delta Z_{k=2}}{n.\Delta TI} + ... + \frac{\Delta Z_{k=n}}{n.\Delta TI}$$

[11] Source data from the United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS) database

[12] The effectively applied tariff rate is the lowest available tariff rate; for example, if a country can be charged either a bound rate (which is the maximum level of tariff), a lower, most favored nation (MFN) rate (which is the tariff rate applied to members of the World Trade Organization (WTO)), and an even lower, country-specific preferential (PRF) rate, the AHS considers the PRF rate.

[13] The AVE accounts for any tariff rates that are not originally in a percentage form.

[14] It is important to note that if an imported good did not meet the conditions required to apply the lower PRF, the MFN rate would be applied instead.

[15] This data is at the HS eight-digit level; therefore, I used Mexican trade data for 1990 as weights to aggregate this data to the four-digit level.

4.3   Tariff- rate mapping

I use US-applied tariff rates on imports of Mexican goods to the US to measure the trade impact of NAFTA. Tariff rates are usually applied at the eight-digit level. Since the Theil index is at the four-digit level, I use the simple average of the eight-digit tariffs (the WITS platform automatically calculates these averages). I use the absolute decrease in the US-Mexico-specific import tariff rate.

The primary independent variable is the above-mentioned US import tariff rate applied to Mexican goods. Table 4 gives a schedule of these tariff rates for selected products. While some products, such as fruits and base metals, received dramatic decreases in tariff rates, others, such as cotton yarn, received small and gradual decreases. While some others, such as computers and cars, turned to zero immediately after the agreement was enacted in 1994.

Though not shown in the table, some products already received zero percent tariffs by 1993. These products are essential to the identification strategy, as explained in the next section.

Table 4: NAFTA tariff reductions for selected product _(k)_ and years (largest to smallest)

HS Code	Product Description	Applied Tariff Rate			1993 Trade value
		1993	1994	1995	in '1000 USD
6401	Waterproof footwear	37.5	22.62	24.69	745.00
0804	Dates, figs, pineapples, etc.	35	4.8	1.75	132,830.00
...		...	...	...	
6109	T-shirts, singlets, tank tops	20	4.79	1.96	59,700.00
7111	Base metals, silver or gold	20	0	0	-
...		...	...	...	
1517	Margarine	16.25	2.67	0.73	387.00
...		...	...	...	
5206	Cotton yarn	10.8	9	7.7	3,917.00
...		...	...	...	
7505	Nickle bars, rods, wires, etc.	4.42	0	0	244.00
...		...	...	...	
8471	Automatic data processing machines	2.91	0	0	826,060.03
8703	Motor cars and other motor vehicles	2.5	0	0	4,242,558.98

Source: TRAINS Database, 2019

4.4   Distinguishing between Maquiladora and non-Maquiladora sectors/industries

Table 5 shows the share of gross output per Maquiladora industry (the total is the output of all Maquiladora industries). For this study, I consider textiles, paper products, rubber and plastics, electronics, transport equipment and miscellaneous manufacturing industries as Maquiladora industries, where the share of gross output is greater than two percent. Table 6 gives the share of domestic content intensity for the same Maquiladora industries. Accordingly, I consider any industry with a share of less than 25 percent domestic content a low domestic content industry. These include textiles, transport equipment, electronics and miscellaneous manufacturing.

Table 5: The size of Maquiladora industries

Maquiladora industries	Gross output shares		
	1983	1995	Average
1 Food, beverages, and tobacco	1.6	0.6	1.10
2 Textiles and textile products	13	9.3	11.15
3 Leather, leather and footwear	1	0.9	0.95
4 Pulp, paper, printing and publishing	1.6	3.4	2.50
5 Chemicals and chemical products	0	0.2	0.20
6 Rubber and plastics	2.4	2	2.20
7 Other non-metallic minerals	0.4	0.7	0.55
8 Base metals and fabricated metal	2.5	3.1	2.80
9 Machinery	1.2	1.9	1.55
10 Electronics	50.3	48.7	49.50
11 Transport equipment	21.1	20.8	20.95
12 Miscellaneous manufacturing	2.2	7.5	4.85

Source: Castillo and De Vries (2018)

Table 6: Domestic content intensity of the Maquiladora industries

Maquiladora industries	Domestic content		
	1983	1995	Average
1 Food, beverages, and tobacco	0.34	0.59	0.47
2 Textiles and textile products	0.18	0.21	0.20
3 Leather, leather and footwear	0.3	0.23	0.27
4 Pulp, paper, printing and publishing	0.51	0.18	0.35
5 Chemicals and chemical products	-	0.45	0.45
6 Rubber and plastics	0.3	0.26	0.28
7 Other non-metallic minerals	0.42	0.33	0.38
8 Base metals and fabricated metal	0.23	0.28	0.26
9 Machinery	0.39	0.18	0.29
10 Electronics	0.18	0.11	0.15
11 Transport equipment	0.21	0.15	0.18
12 Miscellaneous manufacturing	0.26	0.19	0.23

Source: Castillo and De Vries (2018)

4.5 Empirical Specification

I run a difference-in-difference local projections model based on (De Chaisemartin et al., 2022) to estimate the impact of the NAFTA tariff reduction shock on the Mexican export basket composition. The main estimating equation is as follows:

$$Z_{k,t+h} - Z_{k,t-1} = \alpha_k^h + \beta^h TA_{k,t} + \theta Z_{k,t-1} + \epsilon_{k,t}^h \tag{5}$$

$$\text{where: } TA_{k,1994} = \sum_{t=1994}^{T=2008} \sum_{q=1}^{Q=10} \gamma^q * ta_{k,t} \quad for \ q = 1, ..., 10 \tag{6}$$

Here, $Z_{k,t+h}$–$Z_{k,t-1}$ is the cumulative change in the value of Z for product k, h estimation periods into the future. β^h is the impact of the product level "shock" measure, i.e., tariff cut, θ^h is a measure of path-dependence[16], and α_t^h captures time fixed effects. *h* is the estimation horizon, i.e., h number of years after the event.

I model the NAFTA tariff reduction as a one-time shock implemented in 1994. I do so for ease of computation and because almost 65 percent of products received a total elimination of tariffs to zero in 1994. For the rest of the products, I use a net present value calculation of the total step-wise tariff cuts from 1994 to 2008. I weight the tariff reductions with a discount factor, γ, which I set to 0.9, as shown in Equation 6.

I include an interaction term with a dummy variable that is one for the Maquiladora sectors to capture the differential impact of NAFTA on the Maquiladora versus non-Maquiladora sectors as follows:

$$Z_{k,t+h} - Z_{k,t-1} = \alpha_k^h + \beta^h TA_{k,t} * Dom + \theta Z_{k,t-1} + \gamma^h X_{k,t} + \epsilon_{k,t}^h \tag{7}$$

I use a domestic content dummy that is equal to one for high domestic content sectors to capture the differential impact of high and low domestic input intensity as follows:

$$Z_{k,t+h} - Z_{k,t-1} = \alpha_k^h + \beta^h TA_{k,t} * Dom + \theta Z_{k,t-1} + \gamma^h X_{k,t} + \epsilon_{k,t}^h \tag{8}$$

Finally, to estimate the impact of the "China shock," I run the same estimating equation as Equation 5, but replace the tariff shock term with the US tariff rate reduction China experienced. Additionally, I control for the product level US tariff rate on Mexican imports:

$$Z_{k,t+h} - Z_{k,t-1} = \alpha_k^h + \beta^h CTA_{k,t} + \theta Z_{k,t-1} + MTA_{k,t} + \epsilon_{k,t}^h \tag{9}$$

$$\text{where: } CTA_{k,t} = \sum_{t=1993}^{T=2001} \sum_{q=9}^{Q=1} \gamma^q * cta_{k,t} \quad for \ q = 9, ..., 1 \tag{10}$$

Here, $Z_{k,t+h} - Z_{k,t-1}$ and θ^h are the same as in Equation 5, and similarly includes time fixed effects. β^h captures the impact of the product-level tariff shocks experienced by China during this period.

As with the NAFTA tariff shock, I model the tariff reduction of China joining the WTO as a one-time shock implemented in 2001. This is given by $CTA_{k,t}$ in Equation 9. To calculate this (see Equation 10), I use a similar net present value calculation as in Equation 6, that captures the total tariff reductions from 1993 to 2001. I also weight the tariff reductions with a discount factor, γ, which I set to 0.9, as shown in Equation 10.

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[16] Due to the limited number of data points before 1994, I am limited to the number of lag terms of the dependent variable I can include in the estimation 17All NAFTA-related step-wise tariff cuts ended by 2008.
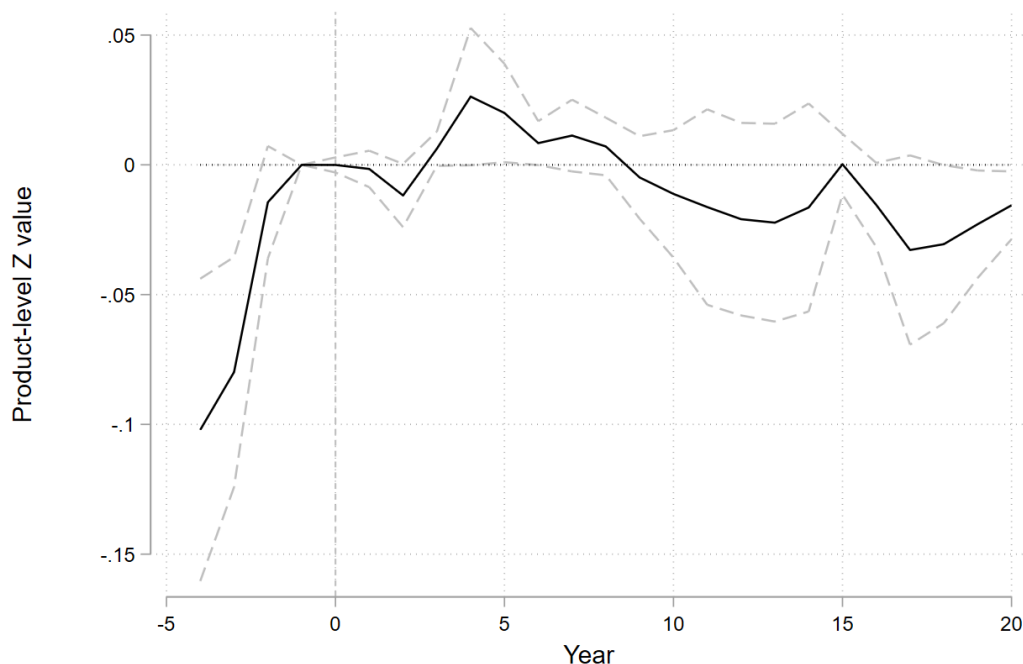
5   RESULTS

5.1   The impact of NAFTA

The estimation result of Equation 5, graphed in Figure 2, shows that the overall effect of the NAFTA tariff reduction is ambiguous. The effect is not significant at a ninety percent confidence level.[17] Since these are difference-in-difference local projections, the results should be interpreted as follows - the products that received a tariff reduction following NAFTA appear to be increasing in export special-ization (as represented by the increasing product level z value) about four years after the shock (not statistically significant in this case), in comparison to products that did not.

Figure 2: The impact of NAFTA on all Mexican export products

Source: Authors' calculation

Furthermore, there is a statistically significant increase in this specialization level for Maquiladora industries starting around three years after the shock (see Figure 3). Though it remains positive and statistically significant until almost 10 years after the shock, the specialization level decreases about five years after. In comparison, the non-Maquila industries experience a decrease in specialization levels for roughly eight years following the shock.

The positive effect of the tariff reduction is even more pronounced for industries that use a low level of domestic inputs (see Figure 4). And the negative effect is similar to that of non-Maquila industries for industries that use more domestic inputs.

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[17] It is common practice to estimate Local Projections at the 90 % confidence level

Figure 3: The impact of NATFA on Maquiladora and non-Maquiladora industries

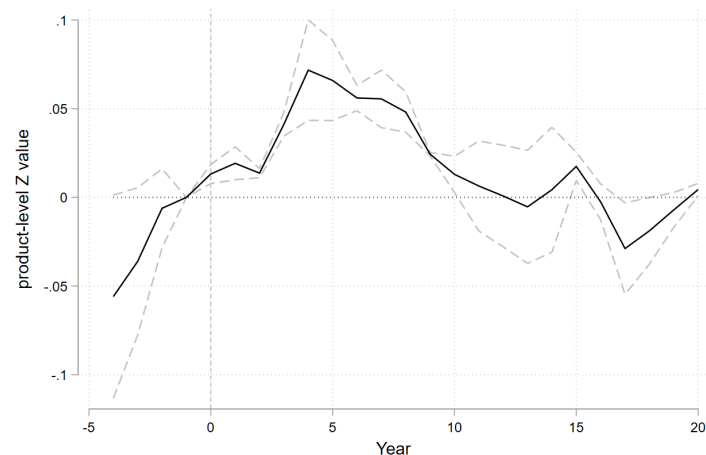### *(a) Maquiladora industries*
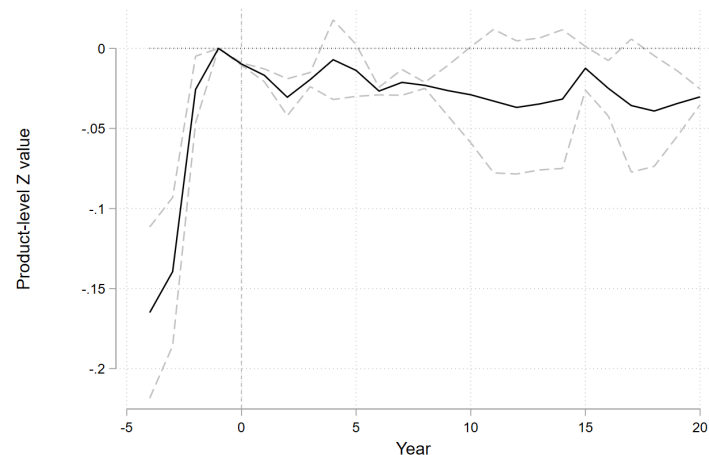

(b) Non-Maquiladora industries

Source: Authors' calculation

Figure 4: The impact of NAFTA by domestic input intensity

(a) Low domestic inputs

(b) High domestic inputs

Source: Authors' calculation
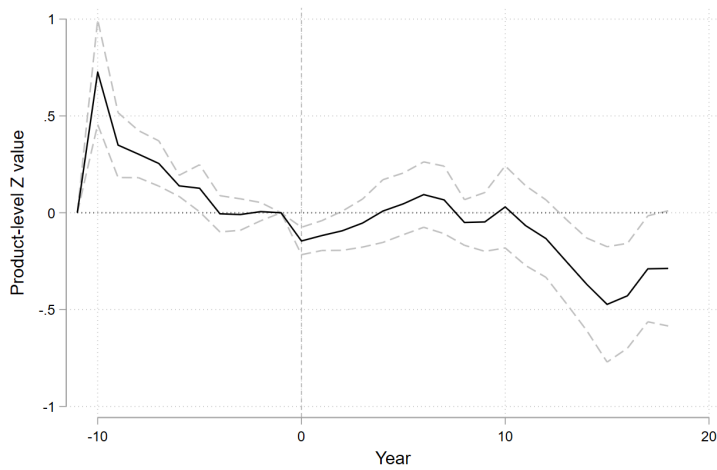
5.2   The impact of the "China shock"

As seen in Figure 5, there is an overall negative short-term impact of about two years following the "China shock" on all Mexican export products. There is also a statistically significant negative impact that appears about twelve years following China joining the WTO in 2001.

Figures 6 and 7 confirm this pattern. However, the impacts are similar across the Maquiladora and non-Maquiladora industries and among low and high-domestic input industries. Figure 6b shows that the long-term negative specialization impacts were the strongest among non-Maquiladora industries.
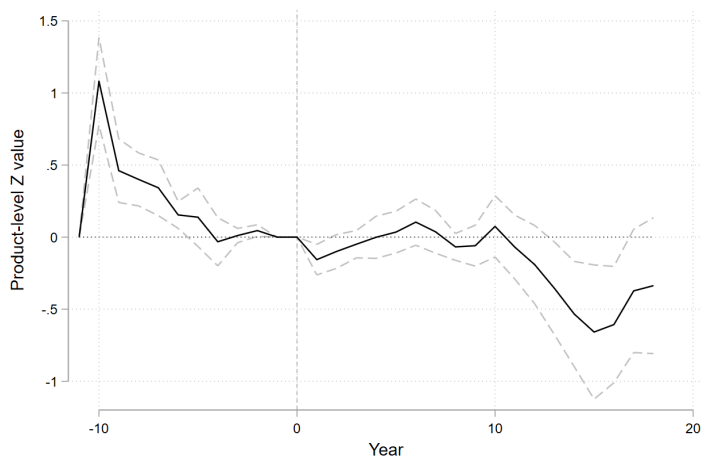
Figure 5: The impact of the "China shock" on all Mexican export products
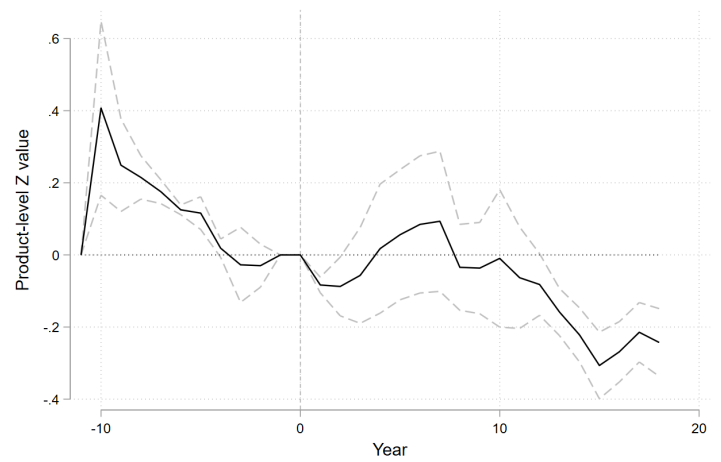
Figure 6: The impact of the "China shock" on Maquiladora and non-Maquiladora industries

(a) Maquiladora industries

(b) Non-Maquiladora industries
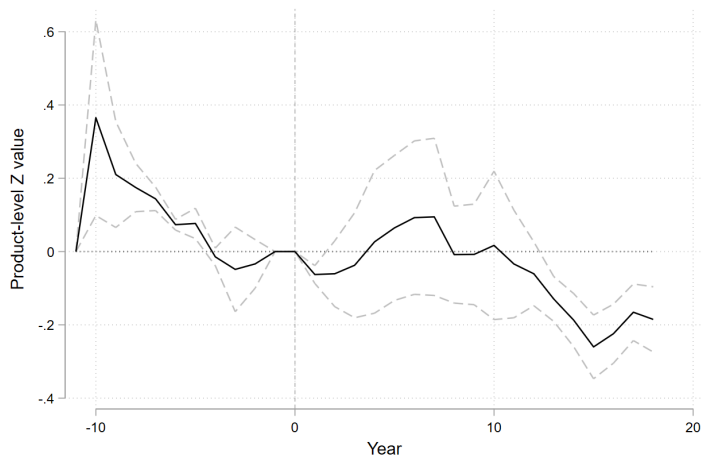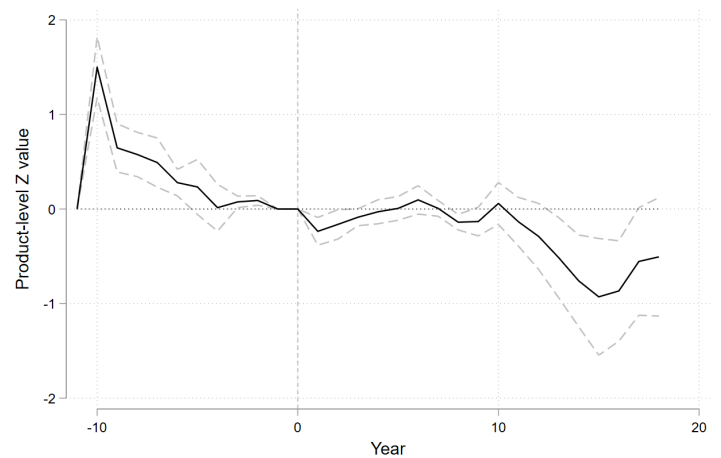
Figure 7: The impact of "China shock" by Mexico's domestic input intensity

(a) Low domestic inputs

(b) High domestic inputs

6 CONCLUSION

I study the impacts of two major trade shocks that Mexico experienced on the composition of its export basket. I find that the tariff reductions under NAFTA benefited low domestic input-intensive Maquiladora industries in the short-run and negatively impacted high domestic content-intensive non-Maquiladora industries. However, these benefits were short-lived as China joined the WTO in 2001, just six years into the agreement, which negatively impacted all industries regardless of Maquiladora status and domestic input intensity. Furthermore, the "China shock" had a lasting negative impact in the long run on non-Maquiladora industries. Further investigation is necessary to understand which industries were impacted by both shocks at a disaggregated product or industry level. This will be the next step of this study.

In conclusion, NAFTA further facilitated export specialization in the growing Maquiladora industries, mainly including semi-assembly low-labor cost-oriented industrial activity in Mexico. Specializing in these industries was not beneficial for technological upgrading because they did not produce the parts locally but rather imported and assembled them. This means that there were minimal technological spillovers to the rest of the economy from these industries. The frontrunner among these Maquiladora industries was the auto industry. Mexico prematurely specialized in the auto sector and did not focus on expanding other domestic input-intensive industries. In fact, these domestic input-intensive industries were negatively affected following NAFTA. This lack of domestic productivity upgrading may have contributed to Mexico's inability to cope with the competition from Chinese products that entered the market in the following years.

Given that developing strong backward and forward linkages is essential for technological upgrading, improving domestic productivity, and, ultimately, economic growth, this study underscores the importance of negotiating trade agreements that benefit the growth of domestic input-intensive industries that may lead to technological upgrading along with those that rely on imported inputs.

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