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Abstract as of September 2024

This paper investigates whether the 2018/19 US-China trade war triggers adjustments in Global Value Chains (GVCs) and nearshoring to Mexico and provides first firm-level evidence on GVC adjustments taking place in response to the US-China trade war. Using confidential longitudinal firm-level trade data from Mexico (2015-2021), we merge customs data with the Ministry of Economy's GVC registry, IMMEX, and construct firm-level measures of trade policy exposure based on pre-shock trade at the HS 6-digit level. Our results show that US tariffs on China significantly boost Mexican firms' trade with the US, a response driven entirely by GVC firms, particularly in skill- and technology-intensive manufacturing. These firms' exports of relatively technology-intensive intermediate goods exhibit larger and more sustained growth. While GVC firms also increase input sourcing from the US and Asia, their exports net of imports rise.

Using industry-level exposure to US tariffs, we further show that US tariffs on China significantly increase the likelihood of new GVC entry to Mexico and reduce the risk of exit. By identifying headquarter locations of GVC firms' global ultimate parent companies using Dun and Bradstreet and S&P Global data, we show that foreign MNEs, especially US-owned, play a key role both at the extensive (firm entry) and intensive (within-firm) margins.

The heightened tariffs on Chinese imports drive GVC activities in Mexico with deeper linkages to US and Asian GVCs. Meanwhile, China's retaliatory tariffs negatively impact export services but have a positive effect on agricultural GVCs in Mexico, underscoring the complexity of the trade war's effects. Overall, our findings demonstrate a reorganization of GVCs towards Mexico, illustrating the influence of trade policy in reshaping global production networks.

The US-China Trade War and the Relocation of Global Value Chains to Mexico*

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Did the 2018/19 US-China trade war trigger adjustment of Global Value Chains (GVCs) and nearshoring to Mexico? We address this question with confidential longitudinal firm-level trade data from Mexico that covers the universe of international trade transactions over 2015-2021. By merging the firm-level customs data with the Ministry of Economy's registry of GVC firms and constructing firm-level measures of trade policy exposures based on firms' pre-shock trade at the level of HS 6-digit products-destination pairs, we show that increased Chinese import protection in the US has a significant positive impact on Mexican firms' trade with the US, and this positive impact is entirely driven by GVC firms, and especially those in skill-intensive manufacturing industries. The nature of the impact of the heightened Chinese import tariffs on GVC firms' sourcing suggests a rise in GVC activities in Mexico with linkages to Asian and US-based GVCs. Our analysis also reveals increased net exports and product offerings of Mexican GVC firms in response to the heightened Chinese import protection in the US, suggesting increased domestic activities in Mexico. However, we also document a negative impact of the retaliatory tariffs of China, primarily affecting export services and a counterbalancing negative effect of the US tariffs via GVC firms' inputs from China, highlighting the complex dynamics at play. Overall, our findings show a reorganization of GVCs towards Mexico as a consequence of the trade war and provide evidence for the role of trade policy in reshaping GVCs.

Keywords: Trade War, GVCs, Nearshoring, Mexico, US, China
JEL classifications: F13; F14; F23; F61; F68

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1 Introduction

China's dominant position in the US market suffered a significant blow when the US invoked Section 301 of the Trade Act of 1974 on the grounds that Chinese trade practices are discriminatory and harmful to US intellectual property rights and innovation. After a long period of stable and liberalizing trade policies, in 2018/19, the US and China engaged in a trade war, mutually escalating tariffs that covered about $450 billion in trade flows (Fajgelbaum et al. 2021). In a world with fragmented production and services (Johnson and Noguera, 2012; 2017), bilateral trade policies may have important implications for bystander countries. The US-China trade war, characterized by its sudden and unprecedented nature, represents a major shock to integrated production and service processes worldwide, with the potential to trigger a decoupling of the two major economies.

The trade dispute between the United States and China in 2018/19 raises the question of whether it led to adjustments in global value chains (GVCs) and increased nearshoring activities to Mexico. Mexico possesses important advantages that make it an attractive manufacturing base for the North American market, including a high level of economic integration with the United States, participation in the United States-Mexico-Canada Agreement (USMCA), and competitive labor costs. Moreover, Mexico's geographical proximity to the United States, with a land border spanning 3,000 kilometers, enables multinational corporations to enhance coordination within their supply chains and reduce shipping times. Consequently, Mexico had long been the most important economic partner of the United States in the emerging world, hosting significant foreign direct investment until China's rise at the turn of the century. Since then, China outperformed Mexico as the most important manufacturing base for the US, as Mexican manufacturers faced stiffer competition from their Chinese counterparts in the United States (Utar and Torres-Ruiz, 2013). Are the tables now turning in favor of Mexico? In fact, when President Trump advised US firms to immediately start looking for an alternative to China at the height of the trade war (Breuninger, 2019), a vigorous discussion emerged among policymakers and international businesses on 'nearshoring', 'friendshoring', and Mexico's opportunities.

In this paper, we study whether and how Mexican firms were impacted by the trade war between the United States and China and examine the extent to which it strengthened Mexico's involvement in global value chains. To address this question, we employ firm-level trade data that cover the universe of international trade transactions in Mexico from 2015-2021. The legislative environment of Mexico allows to directly identify firms operating under international production and service networks, as GVC participant firms in Mexico register with the Ministry of Economy under a program titled, "Maquiladora Manufacturing Industry and Export Services" (IMMEX), which grants them exemptions from 16% value-added taxes on their imports and provides various custom processing facilitations.

By obtaining monthly directories of firms registered under the IMMEX export-platform program from the Ministry of Economy and merging them with confidential transaction-level customs data via firms' unique tax identification numbers, we provide the first study that can positively identify GVC firms in Mexico in customs data and provide sharper insights into the role GVCs play in how economies respond to changes in domestic and foreign trade policy. The availability of longitudinal firm-level trade data until recent months, including both manufacturing and non-manufacturing sectors, combined with the sudden and unprecedented shift in US trade policy with its extensive coverage across different products and sectors, enables rigorous causal analysis to quantify the possible nearshoring impact of the US-China trade war.[1]

We construct firm-level measures of trade policy exposures based on firms' pre-shock trade at the level of HS 6-digit products-destination pairs and focus on within-firm changes before and after the implementation of tariffs after controlling for aggregate, sector, and firm-specific trends. Our analysis shows that trading firms in Mexico are impacted differentially depending on their involvement in global value chains. We find that the US-China trade war had a significant impact on firms' export, and this effect is almost entirely driven by IMMEX export-platform firms. The direction of the effect indicates Mexico's GVCs in manufacturing and services are a substitute for China's GVCs and complements US manufacturing. In particular, Chinese import protection in the US over 2018-19 has a significant positive impact on Mexican GVC firms' export to the US, amounting to a 16.5% increase in 2019. Despite a temporary dampening of this effect in 2020 at the height of the COVID pandemic, the positive effect remains significant at 17% by 2021. The protectionist turn in the US targeting China also causes imports of Mexican GVC firms from the US and Asian countries to increase, but less so than their exports, resulting in a significant increase in their overall net exports. These results show that the recent shift in US trade policy played a role in reshaping GVCs and provide evidence of their relocation towards Mexico.

The question of how trade policy unfolds in an integrated global economy is a topic of great interest among both policymakers and scholars. Handley et al.(2020) document that firms that were impacted by the 2018-19 US import tariffs were bigger on average, and accounted for 84 percent of US exports and represented 65 percent of manufacturing employment. Such firms are more likely to be involved in international production networks. IMMEX firms in Mexico, which we show are responsible for the spill-over effect of the US-China trade disputes to Mexico, are also bigger on average and represent 86 and 65 percent of nationwide export and import, respectively. Focusing on the short-run impact of the US-China trade war on the stock values of US firms, Huang et al. (2022) emphasize the importance of

[1] Studies find that the 2018-19 tariff changes associated with the tariff war were uncorrelated with previous price and import trends across products, making the event an ideal laboratory environment to understand the trade policies and GVCs (e.g., Cavallo et al. 2021, Fajgelbaum et al. 2020, Amiti et al. 2020). For a comprehensive overview, see the review by Fajgelbaum and Khandelwal (2021). Details regarding the product and sector coverage of the trade war can be found in Bown (2021).

global value chains in transmitting the effect. Given the extensive production sharing between Mexico and the US through IMMEX, it becomes essential to study the impact of the trade war on Mexico, particularly on GVC firms in Mexico, to better understand the responses of US firms and industries and the mechanisms underlying the responses. Our paper aims to fill this gap.

Despite the US government's objective of helping US manufacturing when initiating the trade policy change toward China, Flaaen and Pierce (2019) document that US industries more exposed to tariff increases did not increase production in the US and even experienced a relative reduction in employment. At the firm level, we show that the positive effect on firms' US exports and net exports resulting from the US tariffs on Chinese goods is primarily driven by manufacturing GVC firms in Mexico. Within manufacturing, this positive effect is not attributed to traditionally labor-intensive industries like textile, footwear, or clothing, but rather to relatively skilled industries such as electrical machinery and automotive.

We further show that firms that are more susceptible to the increased Chinese import protection in the US expand their export product portfolio, but selectively. We document that the number of product offerings increases among consumption but not intermediate goods, implying heterogeneous adjustment costs within GVCs. These results suggest that the dramatic protectionist change in US trade policy, which costs US consumers and producers $4.6 billion per month (Amiti et al. 2019), may have fulfilled its "stated" aim by bringing manufacturing back to America— although perhaps to southern North America, not to the US, and elucidate how trade policies spill over between countries due to the intricate international production and service networks, and underscore unexpected effects of trade policies in the presence of GVCs.

Our paper also informs structural trade studies that focus on trade policy in the context of global supply chains (Blanchard et al. 2021; Grossman et al. 2023; Antras et al. 2022a) and shows that trade policy plays an important role in the readjustment of GVCs. Our results show that firms more susceptible to the increased tariffs on Chinese goods increase their inputs purchase, especially from the US, China, and other important GVC locations in Asia. Mexican GVC firms are also more likely to apply for preferential duty permits and procure inputs with preferential duty rates from key GVC locations in Asia, namely Taiwan, Thailand, Vietnam, Japan, Korea, and India. These results point to the importance of trade facilitation instruments in easing GVC relocation costs but also indicate a rise in GVC activities in Mexico, driven by both Asian and US-based GVCs, in response to the heightened US tariffs on Chinese goods.

By focusing on trading firms in Mexico our study contributes to our understanding of the impact of the trade war on the US, as we can identify firms in Mexico that participate in the US-market-based GVCs, but it also contributes to the recent literature on global reallocations in response to rising protectionism. Most notably, based on country-product level trade data, Fajgelbaum et al. *forthcoming*

study how the US-China trade war tariffs impacted exports from the world's largest exporters and find that a typical country's export increases to the US but decreases, although imprecisely so, to China. Our results at the firm level show a consistent pattern with a positive effect on firms' exports to the US, emphasizing Mexico as an alternative location to China, but, at the same time, our findings highlight the importance of distinguishing GVC trade from non-GVC trade in identifying these results. In particular, we show a limited negative impact of China's retaliatory tariffs on Mexican GVC firms' exports, which mainly affected export services GVC firms such as logistics and distribution. We also identify a counterbalancing negative effect of the increased US tariffs on Chinese goods on GVC firms' exports when their import portfolio, before the trade war, was concentrated on targeted Chinese goods. These findings highlight the significance of firm-level analysis in capturing the nuanced dynamics of GVC adjustments in our interconnected world.

Our research also demonstrates that the shift in US trade policy, aimed at reducing the US economy's reliance on China, significantly increases Mexican GVC firms' import of inputs from China and other Asian countries. This suggests that the increased export of Mexican firms to the US due to the heightened US tariffs on China is more than the potential increase in domestic value-added in Mexico. These findings contribute to the growing literature on the impact of the US-China trade war on China (Jiao et al. *forthcoming*; Ju et al. 2020; Chor and Li, 2021; Shu et al. 2023) and other Asian countries (Rotunno et al. 2023) on various margins. Among these works, only Jiao et al. *forthcoming* is a longitudinal firm-level analysis, as in this study. By focusing on a coastal city in China, they document an increase in Chinese firms' exports to Europe due to the increased US tariffs, but not to other four destinations that they consider. They classify Mexico with the "rest of the world" and so do not capture impacts on trade with Mexico specifically.[2] At the same time, our findings suggest that such increased trade between Mexico and Asia may not be fully captured by focusing on targeted goods themselves, as the increased import from China and other Asian countries to Mexico is driven by input purchases of Mexican GVC firms whose export portfolios were concentrated on targeted goods. These findings underscore Mexico's pivotal role as an important export-platform location and highlight its significant contribution to the ongoing process of GVC relocation occurring in Asia in response to the US-China trade war.

The next section describes the legislative background of the IMMEX export platform, how it was affected by NAFTA, and provides background information on the 2018/19 tariff war. We introduce and describe our firm-level data in Section 3. Section 4 introduces our empirical approach for studying firm-level impacts of the US-China tariff war, and we also discuss how challenges to identification are addressed. Next, we show that the US-China trade dispute significantly affects Mexican firms' export, and firms operating at the IMMEX export platform are the main channel through which the

[2]Similarly, Ju et al. 2020's quantitative analysis does not include Mexico among the five major export destinations that they consider.

US-China trade war spills over into Mexico. In section 6, our focus shifts to GVC firms. We demonstrate the significant positive effect of the heightened Chinese import protection in the US on GVC firms' export, import, net export, and the number of products they export. Section 7 delves into changes in GVC firms' input sourcing to highlight the nature of the supply chain reorganization that occurred in response to the significant and unexpected change in the US tariffs. Section 8 explores the heterogeneity among manufacturing GVC firms and reveals that the positive effects of the US tariffs are more pronounced in skill-intensive manufacturing sectors. We also demonstrate the robustness of our results by focusing solely on variations in tariff changes across products within narrowly defined manufacturing industries. Section 9 provides a concluding discussion summarizing the key findings of our study, while the Appendix includes important additional results and information referred to throughout the paper.

2 Identifying Global Value Chain Participants in Mexico

2.1 The Creation of the IMMEX Export Platform

Participation in global value chains has been a longstanding and crucial economic development strategy pursued by Mexico. In line with this objective, the Maquiladora Industry was established in the US-Mexico border region as one of the world's first export processing zones under the Border Industrialization program in 1965. Over time, the maquiladora industry has transitioned from consisting of predominantly labor-intensive assembly plants owned by foreign MNEs to encompass more advanced manufacturing processes. The rise of Chinese imports following China's accession to the World Trade Organization (WTO) had a substantial impact on the maquiladora industry, particularly in traditionally labor-intensive sectors such as apparel and toys. However, it also prompted a shift within the maquiladora sector towards more advanced industries like manufacturing chemicals, machinery, and automotive products (Utar, Torres-Ruiz, 2013). The majority of establishments operating under the maquiladora program were owned by US-based multinationals (MNEs) and enjoyed the privilege of importing inputs, machinery, and equipment used in production without tariffs long before NAFTA took place. In 2005, 91% of capital equipment investment in maquiladoras originated from the US, with Canada, Switzerland, the Netherlands, and Japan each holding a 1% share (Utar, Torres-Ruiz, 2013).

Mexico had another export promotion program called the Program for Temporary Imports to Promote Exports (PITEX), which was established in 1990. This program aimed to provide domestic producers who met certain criteria, with similar trade facilitating benefits as those enjoyed by maquiladoras. PITEX plants were typically located in the older industrial belt in central and southern Mexico, while

maquiladoras were more prevalent in states along the US-Mexico border.[3] In 2005, maquiladora and PITEX firms accounted for 85% of nationwide exports and 65% of nationwide intermediate goods imports. Recognizing the shared goal of facilitating Mexico's integration into global value chains, the Ministry of Economy merged the Maquiladora and PITEX programs in 2007, resulting in the creation of a new program called the Maquiladora Manufacturing Industry and Export Services or simply, IMMEX.

Any establishment involved in GVCs has an incentive to officially register under the IMMEX directory in order to benefit from a waiver of the 16 percent value-added tax typically levied on all purchases, including imported inputs and capital equipment.[4,5]Firms registered under the IMMEX also have lower custom processing fee and have options to defer tariff payments associated with their non-NAFTA inputs at the time of re-exporting. For a company to be eligible for the IMMEX Program, it must meet either of the following criteria: either have an annual export value of at least 500,000 USD or generate a minimum of 10% of its revenue through exports. We obtain the registry of IMMEX firms from the Ministry of Economy. The registry includes the unique tax identification of firms as well as their names and addresses. As the customs data also report tax ID's of the firms, we were able to match the IMMEX firms with their customs report. Therefore, we are able to distinguish GVC firms from non-GVC firms in the trade data. Our study is the first to identify IMMEX firms in the customs data and characterize their export and import behavior in comparison to non-IMMEX firms. As of 2016, our data reveal that GVCs account for 86% and 65% of nationwide export and import, respectively.[6]

Below we describe the legislative environment surrounding the IMMEX, with more details provided in the Appendix.

2.2 The Rule of Origin and The Import Regime for GVCs

The establishment of the North American Free Trade Agreement (NAFTA) among Canada, Mexico, and the United States resulted in the formation of a trilateral trade bloc in North America. Effective from January 1, 1994, this agreement aimed to dismantle trade and investment barriers between the three countries. The immediate implementation of NAFTA led to the elimination of tariffs on over

[3]By 2006, all auto assembly plants and the majority of auto part suppliers were registered under the PITEX program (De La Cruz et al., 2011).

[4]Value Added Tax regime in Mexico was introduced in 1980, and it is administered by the Ministry of Public Finance and Credit.

[5]There are additional benefits from operating as IMMEX, such as being exempt from custom processing fees (see Appendix C.1 for details).

[6]A diverse array of foreign multinationals, including United Technologies, Abbott Labs, Volkswagen, Ruhrpumpen, LG Electronics, Toyota, Sun Belle, Novartis, Ford, Honeywell, Panasonic, Pepsico, Zebra Pen, and many more, operate in Mexico under this program.

half of Mexico's exports to the US and more than a third of US exports to Mexico, with the remaining tariffs set to be phased out within a decade (although certain agricultural products were subject to a 15-year phase-out period). Notably, NAFTA introduced significant changes to the Maquiladora program, specifically pertaining to the duty-free import of inputs originating from non-NAFTA countries. Article 303 of NAFTA, which took effect on January 1, 2001, restricted the ability to import such inputs without incurring customs duties.[7] With the replacement of NAFTA by the USMCA on July 1, 2020, the original Article 303 was retained as Article 2.5 within the USMCA framework.

To address the restrictions imposed by Article 303 of NAFTA on maquiladoras that are dependent on inputs from non-NAFTA countries, the Mexican Ministry of Economy introduced a trade promotion mechanism known as the Sectoral Promotion Programs (PROSEC) in 2002. The PROSEC Program enables firms registered under this program to import a specified set of inputs pre-determined by the government at preferential rates. Once authorized under PROSEC, firms are allowed to apply for an additional trade facilitation instrument called the Eighth Rule (Regla Octava). The Eighth Rule potentially enables manufacturing firms to access non-NAFTA-sourced inputs and machinery with no duties or a maximum duty rate of 5 percent. By leveraging the customs data, we identify firms that take advantage of this firm-specific trade instrument to import non-NAFTA intermediate goods and examine the behavior of firms accessing this mechanism to shed light on the role of trade facilitation mechanisms in shaping firms' response to the trade war.

2.3 The US-China Trade War

In April 2017, the United States opened an investigation under Section 232 of the Trade Act of 1962 to determine if steel and aluminum imports constitute a national security threat. Turning attention to China specifically, in August 2017, the US opened another investigation under Section 301 of the Trade Act of 1974 to determine whether any of China's laws, policies, and trade practices are discriminatory and harmful to US intellectual property rights, innovation, or technology development. These investigations were resolved in early 2018, concluding that steel and aluminum imports pose a national security threat and the Chinese government is conducting unfair trade practices harming US intellectual property and innovation.

In April 2018, the Chinese government retaliated against steel and aluminum tariffs (the Section 232 tariffs), and both the US and China announced their respective $50 billion list of Chinese/American products under consideration for 25 percent tariffs. The actual implementation of tariff escalation between the US and China started in July 2018 and continued until September 2019 in five phases

[7] Article 303 of NAFTA, subsequently replicated as Article 2.5 in the United States, Mexico, and Canada Agreement (USMCA), imposed a general prohibition on the refund or exemption of customs duties for non-originating goods imported into a party's territory.

which included additional lists of goods along the way. The US and China canceled a sixth tariff wave in December 2019 in anticipation of an agreement. The two parties signed an agreement to halt further tariff escalations in January 2020. Under the agreement, which entered into force on Feb 14, 2020, China agreed to purchase more US goods, but most of the existing tariffs remain in place as of 2022, except a few sets of US goods that were removed from China's retaliatory tariff list over 2020-21.[8]

Tariff Escalation between the US and Mexico

Initially, the US government granted an exemption to Mexico, along with Canada and the European Union, from the Section 232 tariffs imposed on steel and aluminum products. However, this exemption was lifted in June 2018. In response to these steel and aluminum tariffs, Mexico imposed a series of tariffs on some US products, including a few steel and aluminum items, farm products, pork, cheese, apples, potatoes, and certain beverages like bourbon. The trade flow impacted by these retaliatory measures amounted to approximately $1.4 billion. Together with the Section 232 tariffs on Mexico, the total US-Mexico trade flow affected by the trade war was $3 billion, minor compared to the US-China trade flow impacted by the trade war, which was a staggering $450 billion. In May 2019, Mexico removed the retaliatory tariffs it had imposed on imports from the US following the US's removal of the Section 232 tariffs targeting Mexico.

3 Data

We employ confidential transaction-level customs data covering all export and import transactions conducted by Mexican firms. Each export and import transaction includes product codes, country information, and the value of the transaction, in both Mexican pesos and USD. The products are reported at the Mexican Import and Export General Tariff Act (TIGIE) classification, which closely matches the Harmonized System (HS) classification at the six-digit level.

We link the confidential transaction-level customs data with the six-digit products and country pairs subject to newly imposed import and export tariffs as part of the 2018/19 trade war. We employ the datasets of tariff changes on US imports and exports over 2018-2019 as assembled by Fajgelbaum et al. 2020 and updated by Fajgelbaum et al. 2021. We aggregate the tariffs at the six-digit HS level, which is the level of detail provided in the Mexican customs data.[9] We also link information

[8] Bown and Kolb (2021) provide a comprehensive timeline of the events. See also Fajgelbaum and Khandelwal (2021) for an excellent review of the literature on the economic impacts of the US-China trade war.

[9] To calculate the tariff changes in HS 6-digit goods, we use the share of each HS 10-digit good in total US HS 6-digit import in the pre-trade war year, 2017, as a weight to collapse the US import tariffs data into the HS6 level. Similarly, we calculate the share of each HS 8-digit good in total US HS 6-digit export as a weight to collapse the retaliatory tariff data into the HS6 level. See Appendix B.

on whether a firm registered under the IMMEX program at a given month of the year with firm-level trade data based on firms' unique tax identifiers, names, and addresses. Thus, we can determine which firms operate under the IMMEX export platform and which firms are being directly affected by newly imposed tariffs.

Table 1: Summary Statistics on Exporters in 2016

Variable	(1) Mean	(2) Median	(3) SD	(4) Min	(5) Max	(6) Obs
Panel A. All Exporters in 2016						
IMMEX Firms	0.167	0	0.373	0	1	34,911
Firms w/ Preferential Duty License	0.064	0	0.245	0	1	34,911
Export	1	1	0	1	1	34,911
Import	0.521	1	0.500	0	1	34,911
Number of Goods (HS6) Exported	9.410	2	25.068	1	591	34,911
Number of Goods (HS6) Imported	32.766	1	75.644	0	1,119	34,911
Log Value of Export	11.383	11.146	3.073	-2.996	23.473	34,911
Log Value of Import	13.542	13.632	2.776	-0.020	23.687	18,183
Panel B. IMMEX (GVC) Firms in 2016						
IMMEX Firms	1	1	0	1	1	5,830
Firms w/ Preferential Duty License	0.247	0	0.432	0	1	5,830
Export	1	1	0	1	1	5,830
Import	0.934	1	0.249	0	1	5,830
Number of Goods (HS6) Exported	28.948	11	46.530	1	591	5,830
Number of Goods (HS6) Imported	102.251	54	124.618	0	1,104	5,830
Log Value of Export	14.863	15.148	2.894	-0.020	23.344	5,830
Log Value of Import	15.004	15.274	2.685	-0.020	23.072	5,443

Notes: Values are expressed in USD.

We conduct our analysis at the firm-year level after we aggregate the transaction level data. Table 1 presents summary statistics of the firm characteristics as of 2016. There are close to 35,000 exporters as of 2016, and 52% of them also import. There are roughly 6,000 IMMEX export platform firms in 2016, which constitute 17% of all exporting firms (Table 1) and 9% of all importing firms as of 2016 (not shown). 93% of all IMMEX firms also import, reflecting their participation in GVCs. Those IMMEX firms that did not import in 2016 are disproportionately in agriculture, warehousing, and waste management sectors. The median exporter exports 70,000 USD worth of goods, while the median IMMEX company's export is around 3.8 million USD. Based on the log value of export and the number of goods, Table 1 also confirms that IMMEX export platform firms are in general larger

exporters. We will control for the size differences between exporters and allow for differential time trends based on firms' size as well as their GVC status in the empirical analysis.

As described in Section 2.2, an important trade facilitation instrument in Mexico is the Eighth Rule (*Regla Octava*) that enables an authorized company to use tariff items under Mexico's TIGIE heading 98 "special operations." The authorized companies can import machinery, equipment, materials, inputs, parts, and components at preferential tariff rates per the Ministry of Economy's authorization as long as that particular component/input is required for the production of a product that will be re-exported or required to perform export-related services. We identify firms that import under the Eighth Rule based on the customs data as we see if firms import any goods under the heading of "special operations". Doing so, we document that one in every four IMMEX firms benefits from this trade facilitation instrument (Panel B of Table 1). The utilization of the Eighth Rule by these firms increases to nearly 30% in 2021. We will demonstrate in Section 7.1 that the imposition of US tariffs on China plays a significant role in driving this observed increase.

Table 2: Firms' Trade Across Destinations

	Mean	Median	Mean	Median
	(1)	(2)	(3)	(4)
	All Exporters		**IMMEX Firms**	
Panel A. Share in Firm's Exports				
USA	0.647	1.000	0.803	0.996
China	0.014	0.000	0.016	0.000
Canada	0.019	0.000	0.023	0.000
Europe	0.057	0.000	0.035	0.000
Other Asia	0.019	0.000	0.026	0.000
Panel B. Share in Firm's Imports				
USA	0.447	0.409	0.541	0.595
China	0.173	0.023	0.132	0.035
Canada	0.024	0.000	0.025	0.000
Europe	0.176	0.019	0.117	0.016
Other Asia	0.090	0.005	0.114	0.021

Notes: Exporters as of 2016. The numbers of observations are 34,911, and 5,830, respectively in columns (1)-(2) and (3)-(4) in Panel A. The numbers of observations are 18,183, and 5,443, respectively in columns (1)-(2), and (3)-(4) in Panel B. Europe refers to the following countries: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the UK. Other Asia refers to the following set of countries: Taiwan, Thailand, Vietnam, Japan, Korea, and India.

Table 2 shows exporters' trade shares across broad regions (as of 2016). Mexican exports are heavily

concentrated in the US market, with the average share of the US in firm-level exports being 65%. Among IMMEX firms, the share of the US market is 80%.

On the import side, the US remains the most important source country. However, in this case, other regions like Asia and Europe also serve as significant source destinations for Mexican firms' inputs. The share of the US in firm-level imports is 45% and 54% for all exporters and IMMEX firms, respectively. It's also worth noting that China's share in firm-level imports is lower among IMMEX firms compared to other exporters.

Having introduced our data, we now describe how we construct firm-level measures of the trade policy exposures and introduce our empirical strategy.

4 Empirical Strategy

In order to identify the causal impact of the sudden protectionist turn in US trade policy with respect to China, we construct firm-level measures of exposure to tariffs based on firms' product-level exports and imports as of 2016.

4.1 Firm-Level Exposures to the US-China Trade War

4.1.1 US Import Tariffs on China

Nearshoring

Our primary focus centers on the US import tariffs imposed on China, which encompassed a total value of $350 billion worth of US imports from China (Fajgelbaum and Khandelwal, 2021). Let $USIT^{CH}$ be the set of HS 6-digit products subject to the 2018/19 US import tariffs from China and $\Delta\tau_j^{USIT^{CH}}$ measures the change in the US import tariff rate for HS 6-digit good j from China in percentage points due to the tariff war and let X_{ijk}^{2016} be the value of exports of Mexican firm i to destination k in good j in year 2016.[10] Then, the level of exposure of firm i in Mexico to the Chinese import protection in the US can be determined as follows:

$$TM_i^{US-CHN} = \frac{\sum_{j \in USIT^{CH}} \sum_k X_{ijk}^{2016} \times \Delta\tau_j^{USIT^{CH}}}{\sum_j \sum_k X_{ijk}^{2016}} \tag{1}$$

[10] Given that the tariff escalations occurred in multiple phases between 2018 and 2019, we calculate the change in tariffs by comparing the pre-2018 period to December 2019.

Here, TM_i^{US-CHN} measures the weighted value of Mexican firm i's exports in goods that will be subject to import tariffs from China in the US market, relative to the firms' total exports as of 2016. By multiplying firm i's exports in goods that will be subject to the increased import tariffs from China with $\Delta\tau^{USIT^{CH}}$, we assign varying weights to the exported goods based on the extent of the tariff increase they are set to encounter if they would have been originated from China.

While, on average, 65% of a typical exporting firm's exports in Mexico are destined for the United States, this ratio is 80% for a typical GVC firm (see Panel A in Table 2). Equation 1 does not distinguish export destinations because the costlier entry of Chinese goods to the US market is expected to increase the overall attractiveness of the US market for Mexican exporters compared to other markets. In other words, even if exporters were directing their affected goods to other markets before the shock, they are still impacted by the heightened attractiveness of the US market. Moreover, firms involved in global value chains may export to a third country while indirectly catering to the US market.

Nonetheless, we also introduce an alternative measure of exposure where we explicitly define the export destination of the exposed firm as "the US". This alternative measure is defined as follows:

$$TMA_i^{US-CHN} = \frac{\sum_{j \in USIT^{CH}} X_{ij}^{2016,US} \times \Delta\tau_j^{USIT^{CH}}}{\sum_j \sum_k X_{ijk}^{2016}} \tag{2}$$

In this case, TMA_i^{US-CHN} measures the tariff equivalent value of US exports in firm i's total exports as of 2016. While Equation 1 is our preferred exposure measure, we will also present and show the robustness of our results using Equation 2.

Importing Affected Goods from China

We control for potential confounding impact of firms that use imported goods from China, now targeted by the US trade policy. To do that, we distinguish firms that as of 2016 import goods from China that will be subject to higher tariffs in the US and construct a firm-level measure as follows:

$$CHNIM_i^{USIT} = \frac{\sum_{j \in USIT^{CH}} M_{ij}^{2016,CH} \times \Delta\tau_j^{USIT^{CH}}}{\sum_j \sum_k M_{ijk}^{2016}} \tag{3}$$

Here, M_{ijk}^{2016} denotes the value of firm i's import in 2016 from destination k in good j. For firms that do not import as of 2016, we assume $CHNIM_i^{USIT}$ takes the value of zero. As in the above firm-level exposures of the trade policy, we distinguish firms depending on their import basket's hypothetical tariff incidence if they would have been imported by a US company. Interacting this measure with time-fixed effects allows us to capture differential trends of firms that, before the shock, were importing

affected goods from China.

Input Channel

Under normal circumstances, US imports enter Mexico duty-free. However, new tariffs on Chinese products in the US can alter the prices of all goods in the same market regardless of the origin due to decreased competition or increased input costs. Hence, we also consider the possible impact of the US import tariffs from China on Mexican exporters via input cost changes.

$$IC_i^{USIT} = \frac{\sum_{j \in USIT^{CH}} M_{ij}^{2016,US} \times \Delta\tau_j^{USIT^{CH}}}{\sum_j \sum_k M_{ijk}^{2016}} \tag{4}$$

Equation 4 allows us to distinguish Mexican exporters whose imports depend on US goods that will be subject to higher import protection from China.

4.1.2 China's Retaliatory Tariffs on US Exports

To investigate if China's retaliatory tariffs on US exports spill over on Mexican exporters, we identify Mexican firms that export the affected goods before the trade war. Let $USRT^{CH}$ be the set of HS 6-digit products subject to China's retaliatory tariffs, and $\Delta\tau_j^{USRT^{CH}}$ measures the retaliatory tariff rate increase for good j in percentage points as of December 2019.

$$TX_i^{CHN-US} = \frac{\sum_{i \in USRT^{CH}} \sum_k X_{ijk}^{2016} \times \Delta\tau_j^{USRT^{CH}}}{\sum_i \sum_k X_{ijk}^{2016}} \tag{5}$$

TX_i^{CHN-US} measures the weighted value of exports in goods that are targeted by China's retaliatory tariffs relative to the total exports of firm i as of 2016. As before, we assign weights to the exported goods based on the corresponding rates of export retaliatory tariffs, ensuring that Mexican firms with a greater concentration of exports in goods subject to higher export tariffs are regarded as more exposed, holding all other factors constant.

As before, we also construct an alternative exposure variable for the export-retaliatory tariffs similar to equation 2 based on firms' US exports.

Input Channel

As for the US import tariffs, we also consider the possible confounding impact of China's retaliatory tariffs via the input-cost channel and allow for differential trends for firms whose imports concentrate on US goods affected by China's retaliatory tariffs. In this case, retaliatory export tariffs may depress

the prices of the affected US goods, potentially benefiting Mexican exporters that use these goods as inputs.

We construct the following firm-level measure based on firms' import portfolio as of 2016:

$$IC_i^{USRT} = \frac{\sum_{j \in USRT^{CH}} M_{ij}^{2016,US} \times \Delta\tau_j^{USRT^{CH}}}{\sum_j \sum_k M_{ijk}^{2016}} \tag{6}$$

Equation 6 allows us to distinguish Mexican exporters whose imports depend on US goods that will become subject to retaliatory export tariffs imposed by China.

Tariffs Escalation between Mexico and the US

Before the US government specifically targeted China, Section 232 tariffs invoked retaliation from Mexico, among other countries. In order to control for a potentially confounding role of the US-Mexico tariff spikes on US-Mexico GVCs, similar exposures variables at the firm level are constructed as follows:

$$TM_i^{US-MEX} = \frac{\sum_{j \in USIT^{MEX}} X_{ij}^{2016,US} \times \Delta\tau_j^{USIT^{MEX}}}{\sum_j \sum_k X_{ijk}^{2016}} \tag{7}$$

Since the Section 232 tariffs were product based rather than country-specific, TM_i^{US-MEX} also essentially controls for the US import tariff escalation that affected countries other than China and Mexico.

To measure the effect of the Mexican retaliatory tariffs, we focus on firms that, before the shock, were importing goods from the US, which will later be subject to Mexico's retaliatory tariffs. Let $USRT^{MEX}$ be the set of HS-6 products subject to the retaliatory tariffs of Mexico, and $\Delta\tau_j^{USRT^{MEX}}$ measures the change in the Mexican import tariff rate for good j from the US in percentage points and let M_{ijk}^{2016} be the value of firm i's import in 2016 from destination k in good j. The firm-level exposure to the Mexican government's retaliatory tariffs is then given by the following:

$$TX_i^{MEX-US} = \frac{\sum_{j \in USRT^{MEX}} M_{ij}^{2016,US} \times \Delta\tau_j^{USRT^{MEX}}}{\sum_j \sum_k M_{ijk}^{2016}} \tag{8}$$

As we focus on exporters as of 2016 in our empirical analysis, all firm-level exposure measures, which are based on firms' export portfolios as of 2016, are well-defined. However, not all firms import as of 2016. We assume $TX_i^{MEX-US} = 0$ for non-importing firms.

Table A.1 presents the summary statistics of the tariff exposure variables. The average exposure of

Mexican exporters to the US tariffs on Chinese goods, as measured by equation 1, is 17%, indicating that, on average Mexican exporters' Chinese competitors now confront a 17% increase in tariffs in the US. A similar exposure level of 16% is observed for Mexican exporters' exposure to China's retaliatory tariffs on US products. Conversely, the Mexican exporters' exposure to the US tariffs and their exposure to Mexico's retaliatory tariffs via their US imports, are more restrained both at 0.2% and 0.1%, respectively. Panel B of Table A.1 also presents these measures among IMMEX firms, revealing no major differences.

4.2 Empirical Model

In order to identify the causal effect of the US-China trade war on Mexican firms, we employ the firm-level trade policy exposures described above that we construct for all firms with positive exports in 2016 and focus on the same set of firms' trade trajectories over 2015-2021.

Identifying the Impact of the US-China Trade War on Mexican Firms

Let Y_{it} be firm i's outcome variable at time t, for example, the log value of firm i's US exports at period t. Then, to understand the effects of the US-China trade war on Mexican firms in general and Mexico's GVC firms in particular, we form the following generalized triple difference in differences (DDD) equation:

$$\begin{aligned} Y_{it} = \beta_0 &+ \sum_{h=2016}^{2021} \alpha_h 1[t=h] \times TM_i^{US-CHN} + \sum_{h=2016}^{2021} \alpha_h^{IMM} 1[t=h] \times TM_i^{US-CHN} \times IMM_i \\ &+ \sum_{h=2016}^{2021} \beta_h 1[t=h] \times TX_i^{CHN-US} + \sum_{h=2016}^{2021} \beta_h^{IMM} 1[t=h] \times TX_i^{CHN-US} \times IMM_i \\ &+ \sum_{h=2016}^{2021} \delta_h 1[t=h] \times TM_i^{US-MEX} + \sum_{h=2016}^{2021} \delta_h^{IMM} 1[t=h] \times TM_i^{US-MEX} \times IMM_i \\ &+ \sum_{h=2016}^{2021} \mu_h 1[t=h] \times TX_i^{MEX-US} + \sum_{h=2016}^{2021} \mu_h^{IMM} 1[t=h] \times TX_i^{MEX-US} \times IMM_i \\ &+ \sum_{h=2016}^{2021} \psi_h 1[t=h] \times CHNIM_i^{USIT} + \sum_{h=2016}^{2021} \psi_h^{IMM} 1[t=h] \times CHNIM_i^{USIT} \times IMM_i \\ &+ \xi_t \times IMM_i + Z_{it} + \eta_i + \varepsilon_{it} \end{aligned} \tag{9}$$

In equation 9, the continuous firm-level tariff exposure variables are interacted with time indicators to examine the yearly evolution of the impact of different components of the trade war. IMM_i indicates if firm i is an IMMEX firm as of 2016. We additionally interact the firm-level tariff exposures with IMM_i

to distinguish any disproportionate impact of the US-China trade war on GVC participant firms. To be able to causally capture the disproportionate impact of the trade policy exposure on IMMEX export platform firms, we control for time trends specific to these firms by interacting year fixed effects, ξ_t, with IMMEX firm indicator, IMM_i .

The vector Z_{it} includes potentially confounding time trends that can vary by firms in different initial sizes. These measures are constructed by interacting firm size variables (based on both the number of exported goods and the export volume) with year-fixed effects, ξ_t.[11] The vector Z_{it} also includes controls for the input costs channels via firms' US imports, namely the interaction of Equations 4 and 6 with the year fixed effects. We also allow for a differential impact of the input costs channels on IMMEX firms by forming a third difference for each of the exposure measures.

We control for time-invariant firm characteristics such as management skills, production technology, and line of business with firm fixed effects, η_i. This means that coefficients are estimated from within-firm variation over time as the influence of any observed or unobserved initial firm characteristic that may be correlated with a firm's future exposure to the change in the US trade policy is absorbed by firm fixed effects. The error term ε_{it} is assumed to have a zero mean, and we allow for correlation within firms by clustering standard errors at the level of the firm, which is the level at which our treatment variables vary (Abadie et al., 2023).

The yearly coefficients α_h in equation (9) are the well-known difference-in-differences estimates that measure any disproportionate impact on firms that are most susceptible to increased US import tariffs from China. Similarly, the treatment effect of China's export-retaliatory tariffs for US exporters is given by β_h. The triple difference-in-differences coefficients, α_h^{IMM} and β_h^{IMM} in equation 9 measure the potential differential impact of the US-China trade war on GVC participant firms.

The triple difference estimator additionally mitigates any potential bias due to a possible differential trend between treated and control firms as this is differenced out in the third difference, namely the difference between non-GVC and GVC firms (Olden and Møen, 2022). In other words, the identifying assumption is that in the absence of the US-China trade war, the relative outcome of GVC firms compared to non-GVC firms should trend the same way across firms with different exposure levels.

We estimate equation 9 among exporters as of 2016 over 2015-2021. Since the endogeneity of tariffs is a potentially important concern in analyses of the effects of trade policy (Goldberg & Pavcnik, 2016), we go back one year and start our analysis from 2015 to estimate the 'counterfactual impact' two years before the trade war.

[11] We measure firm size based on the number of HS 2-digit goods a firm exports as of 2016 and interact this variable with time-fixed effects. We also create a size dummy based on the total export value as of 2016 and separately interact the size dummy with time-fixed effects. Hence, Z_{it} includes differential time trends for firms of different sizes based on the number of exported goods and the export volume as of the initial year.

IMMEX export platform firms

To examine the impact of the US-China trade war on GVC firms specifically, we also estimate a generalized difference-in-differences (DD) equation among IMMEX export platform firms as follows:

$$\begin{aligned} Y_{ist} =& \beta_0 + \sum_{h=2016}^{2021} \alpha_h 1[t=h] \times TM_i^{US-CHN} + \sum_{h=2016}^{2021} \beta_h 1[t=h] \times TX_i^{CHN-US} \\ &+ \sum_{h=2016}^{2021} \delta_h 1[t=h] \times TM_i^{US-MEX} + \sum_{h=2016}^{2021} \mu_h 1[t=h] \times TX_i^{MEX-US} \\ &+ \sum_{h=2016}^{2021} \psi_h 1[t=h] \times CHNIM_i^{USIT} + Z_{it} + \xi_{st} + \eta_i + \varepsilon_{it} \end{aligned} \tag{10}$$

By leveraging industry information provided in the IMMEX registry from the Ministry of Economy, in equation 10, we additionally control for industry-specific time trends, ξ_{st} where the subscript s distinguishes one digit NAICS. As before, Z_{it} includes firm-size-specific trends and differential trends for firms whose US imports are concentrated in affected goods. We will show the robustness of our results when we additionally include three-digit NAICS by year fixed effects hence only focusing on tariff changes within narrowly defined industries (Figure A.7).

To address a potentially confounding role of local labor market shocks driven by labor shortages and COVID closures, we augment Equation 10 with municipality-by-year fixed effects, killing all variations that vary at the level of the local labor markets. These results are presented in the Appendix (Table A.4).

5 The Firm Level Impact of the US-China Trade War

This section starts by establishing the significant impact of the US-China trade war on Mexican firms' exports. In particular, heightened Chinese import protection in the US has a significant positive effect on Mexican firms, while China's retaliatory tariffs for US exporters have a negative effect. We then show that the US-China trade war has a differential impact on Mexican exporters depending on their GVC status, and the effect of the US-China tariff war is primarily driven by firms operating in Mexico's export platform, IMMEX.

5.1 The average impact on all exporters

First, we estimate a simplified version of equation 9 that does not distinguish GVC firms. In this simplified version (equation A.1 in the Appendix), we interact the firm-level trade policy exposures with a post-shock dummy that takes the value of one from the year 2018 onwards. This initial analysis will help capture an average effect on all firms over the four post-shock years. The results from this analysis are presented in Table 3. The dependent variables are the logarithm of firms' exports to the US (columns (1) & (2)) and firms' total exports (columns (3) & (4)). The specifications in columns (1) and (3) only include the direct exposures to the US-China trade war, specifically TM_i^{US-CHN} and TX_i^{CHN-US}, for comparison purposes.

The results in column (1) show that the heightened Chinese import protection in the US significantly increases Mexican firms' exports to the US. After introducing controls for the US-Mexico tariff escalation and firms' exposures to the tariffs via their imports in column (2), the coefficient estimate for the heightened Chinese import protection, TM^{US-CHN}, slightly diminishes in magnitude, but it remains precisely estimated. Considering two Mexican exporters, one at the 75 and the other at the 25 percentile of exposure to the Chinese tariffs on the US products, the coefficient of 0.46 indicates an $e^{0.46*0.16} - 1 = 8\%$ relative increase in firms' exports to the US.[12]

The results in columns (3) and (4) on firms' total exports show similar patterns. The coefficient estimate in column (4) and the 25/75 percentile exposure difference indicate a 9% relative increase in firms' total exports due to the increased Chinese import protection in the US. This shows that firms do not merely redirect their exports to the US from other destinations; instead, the new tariffs on Chinese goods in the US causes a significant positive effect on Mexican firms' exports, and firms' US exports mainly drive the positive effect on firms' total exports.

The coefficient estimate for China's retaliatory tariff exposure, TX^{CHN-US}, is weakly significant and negative in all columns; the estimate of -0.152 in column (2) together with the 25/75 percentile exposure difference to China's retaliation (see Table A.1) indicates a $(e^{-0.15*0.13} - 1 =)2\%$ relative reduction in Mexican firms' US exports. The magnitude of the effect is similar on firms' total exports (column (4)).

It is plausible that the reduced demand for American exports due to China's retaliatory tariffs spills over to a certain degree on some Mexican firms, especially those engaged in finishing, polishing, packaging, distribution, or similar services without fundamentally altering the nature of the goods. We will show below that the negative effect of US import protection in China tends to be concentrated among IMMEX companies that specialize in export-related services.

[12] Firms at the 25th and 75th percentiles of exposure to heightened Chinese import protection have TM_i^{US-CHN} values of 0.09 and 0.25, respectively (see Table A.1).

Table 3: Heightened Chinese Protection in the US Increases Mexican Firms' Export

	(1)	(2)	(3)	(4)
Sample	All Exporters as of 2016			
Dep. Var.	Log US Export		Log Worldwide Export	
$TM_i^{US-CHN} \times Post2018_t$	0.559^a	0.462^a	0.616^a	0.530^a
	(0.107)	(0.113)	(0.094)	(0.100)
$TX_i^{CHN-US} \times Post2018_t$	-0.157^c	-0.152^c	-0.147^c	-0.165^c
	(0.091)	(0.092)	(0.084)	(0.085)
$TM_i^{US-MEX} \times Post2018_t$		0.567		0.657
		(0.619)		(0.636)
$TX_i^{MEX-US} \times Post2018_t$		0.898		0.380
		(0.668)		(0.812)
$CHNIM_i^{USIT} \times Post2018_t$		0.299		0.195
		(0.270)		(0.201)
$IC_i^{USRT} \times Post2018_t$		0.014		0.514^c
		(0.293)		(0.263)
$IC_i^{USIT} \times Post2018_t$		0.282		0.072
		(0.238)		(0.216)
Firm FEs	✓	✓	✓	✓
Initial Firm Size × Year FEs	✓	✓	✓	✓
Observations	123,698	123,698	159,378	159,378
R-squared	0.886	0.886	0.882	0.882

Notes: Sample: Firms with positive export as of 2016. Estimation of equation A.1. The dependent variables are given in column headings. Initial Firm Size × Year FEs include the number of exported HS 2-digit goods as of 2016 interacted with year fixed effects and a big exporter dummy based on the 75 percentile of the total export value as of 2016 interacted separately with year fixed effects. Robust standard errors are clustered at the firm level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% levels respectively.

Table 3 also shows that the US-Mexico tariff escalation which persisted for less than a year, did not have a significant long-term effect on firms' export on average. Similarly, firms' exposures to the US-China tariffs via their imports do not turn out to have a significant effect on firms' exports. One exception is the impact of China's retaliatory tariffs via firms' US imports; the coefficient estimate of IC_i^{USRT} is 0.514 and weakly significant for the total exports (column (4)). In comparison, the coefficient estimate for IC_i^{USRT} is close to zero and not significant in column (2), indicating that the positive effect is due to firms' non-US exports. Consider a Mexican distributor of American soybean products. In response to the Chinese soybean tariffs, it is reasonable to expect this firm increases its worldwide exports of soybeans, say to Latin American countries. In other words, on average, Mexican firms' worldwide exports are positively affected if their imports from the US rely more heavily on goods subject to higher Chinese tariffs for the US exporters. Based on the 25/75 percentile exposure difference, it indicates a $(e^{-0.514*0.079} - 1 =)$ 4% relative increase in firms' worldwide exports.

In sum, this analysis reveals a significant positive effect of the new US import tariffs on China on Mexican firms' exports. The analysis also reveals a weakly significant effect of China's retaliatory tariffs. Its effect runs in the opposite direction depending on the nature of firms' exposure to it. Otherwise, Section 232 tariffs on Mexico and Mexico's retaliatory tariffs, as well as other import channels, do not turn out to cause a visible impact on firms' exporting over 2018-2021. The analysis presented in Table 3 is not expected to capture if such effects are short-run or heterogeneous, say, felt differently among GVC firms versus other exporters. By analyzing the yearly evolutions and distinguishing GVC firms from others, we will address both of these points next.

5.2 Yearly Impact of the US-China Trade War

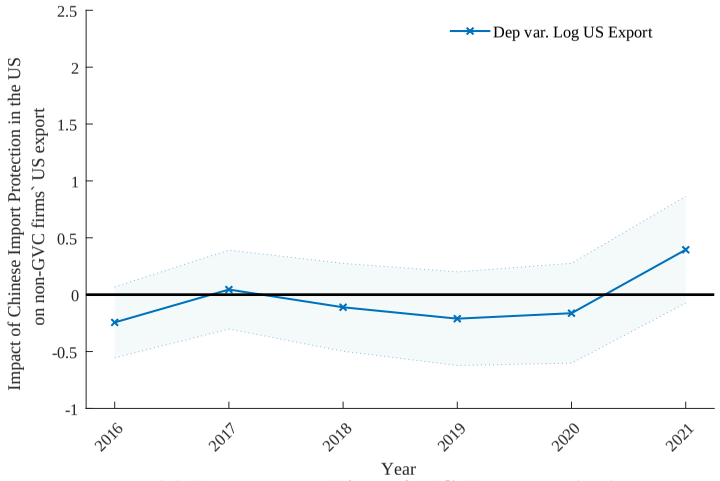
5.2.1 Impact of the US Trade Policy Change towards China

Having shown the positive effect of the change in the US trade policy towards China on Mexican firm-level exports, we now proceed with our default approach and estimate equation 9. This way, we will identify not only any possible differential impact of the trade war on GVC firms but also be able to evaluate the possible roles of pre-trends and the COVID-19 shock on these estimates.

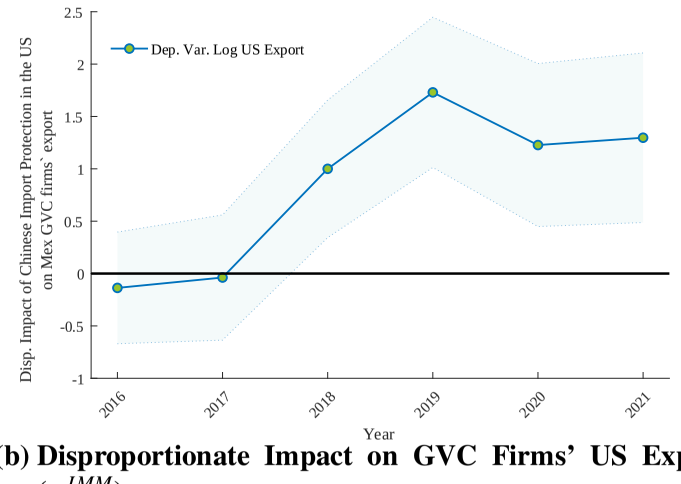
Figure 1 depicts the annual evolution of firms' export response to the US trade policy shift towards China obtained from estimating equation 9. Figure 1a and Figure 1b present respectively the DD (TM^{US-CHN}) and DDD coefficient estimates ($TM^{US-CHN} \times IMM$), along with the 95 percent confidence intervals. The dependent variable is the logarithmic value of firm's US exports. Figure 1c and Figure 1d present the same estimates with the dependent variable as the logarithm of firm's worldwide exports. The underlying coefficient estimates for Figure 1 are also presented in columns (2) and (4) of Table A.3 in the Appendix.

Let's first focus on Figure 1a. Over the post-trade war years, the treatment effect of the US Chinese import tariffs (DD) are imprecisely estimated and close to zero with the exception of 2021, showing no impact of the heightened Chinese import protection in the US on Mexican firms' exports. This result, at first, is puzzling, as it is in contrast with the significant average impact shown in Table 3. The triple difference-in-differences coefficients depicted in Figure 1b resolves this puzzle. Firms' exports to the US were not impacted by the protectionist turn in the US trade policy towards China if they are not part of GVCs (Figure 1a); at the same time, Figure 1b reveals a significant and positive impact of the rising US protectionist policies towards China on GVC firms' US exports.

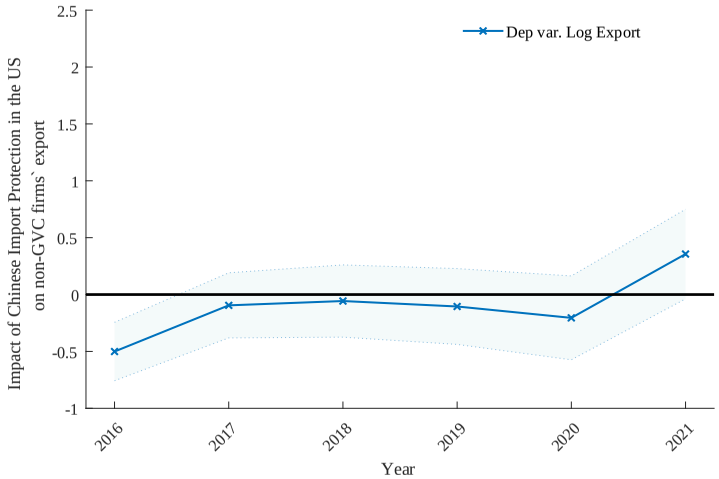
The yearly evolution of the impact shows no major pre-trends. The positive and significant effect on IMMEX firms starts in 2018 and increases in 2019 (see Figure 1b and column (2) of Table A.3). There is a decline in 2020 coinciding with the COVID-19 shock, the DDD coefficient estimate drops



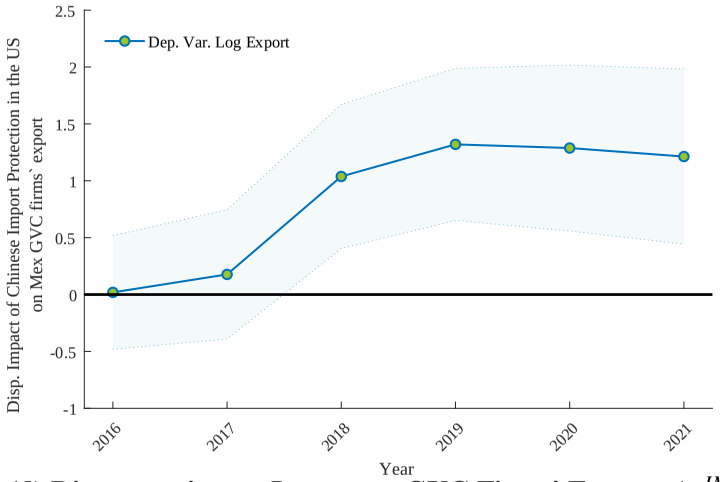
(a) Impact on Firms' US Exports (α_h)



(b) Disproportionate Impact on GVC Firms' US Exports (α_h^{IMM})



(c) Impact on Firms' Exports (α_h)



(d) Disproportionate Impact on GVC Firms' Exports (α_h^{IMM})

Figure 1: Impact of Import Protection Towards China in the US on Mexican Firms' Export

Notes: Estimation of equation 9. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The figure depicts the coefficient estimates of the regression result corresponding to column 2 (Figure 1a & 1b) and column 4 (Figure 1c & 1d) of Table A.3. The shaded area indicates the confidence interval at the 95% level. The number of observations is 123,698 in Figure 1a-1b and 159,378 in Figure 1c-1d. All regressions include firm, size-specific, and IMMEX-specific time fixed effects as well as the other controls as indicated in Table A.3. The right axis shows the coefficient values of the respective DD or DDD coefficients.

from 1.54 to 1.04 in 2020, but the overall positive effect of the US tariffs bounces back in 2021 on the IMMEX firms (0.94+0.62=1.58). The yearly evolution of the impact over time reinforces that the significant positive effect on firms' US exports is driven by the sudden shift of the US trade policy towards China.

Figure 1c & Figure 1d show the yearly evolution of the impact on firms' worldwide exports (also see column 4 of Table A.3). The results are similar, that the DD coefficients over 2018-2020 are not statistically different than zero, at the same time the DDD estimates are positive and precisely estimated over 2018-2021. As the primary export destination of Mexican firms is the US, it is not surprising to observe similar broad patterns when we focus on firms' total exports. These findings indicate that GVC firms haven't merely rerouted their exports to the US. Instead, their overall export volume has experienced a positive impact by the US protectionist turn, and the overall positive effect of the US tariffs on China on IMMEX firms' exports is largely driven by their increased exports to the US. Importantly, we find that the positive effect of the US protectionist turn to China on Mexican firms' exports predominantly attributed to GVC firms.

5.2.2 Impact of China's Retaliatory Tariffs

Figure 2 shows the results from the same regressions (columns (2) and (4) of Table A.3), this time focusing on the effect of China's retaliatory tariffs on US goods. The dependent variables are the US exports (Figures 2a & 2b) and total exports (Figures 2c & 2d). As before, the yearly DD (TX_i^{CHN-US}) coefficient estimates are depicted in Figures 2a and 2c. Figures 2b, and 2d show the annual DDD estimates ($TX_i^{CHN-US} \times IMM$).

The common treatment effects shown in Figure 2a for the US exports and in Figure 2c for the total exports are close to zero and imprecisely estimated over the post-shock years and the pre-trade-war period shows no major pre-trends. Figures 2b-2d show a disproportionate effect of China's retaliatory tariffs on IMMEX export platform firms. The results in Figure 2d show a weakly significant and negative effect over 2018-2019 in response to retaliatory tariffs of China. This disproportionate impact on GVC firms' exports dissipates over the 2020-21 period. While the pattern is more vague for US exports, the negative effect of China's retaliatory tariffs seems to be concentrated among GVC firms.

Taken together, these results establish that firms operating in the IMMEX export platform responded significantly to the US-China trade war. Given that these are on average larger firms that account for 86% of the nation-wide exports, is it possible that the difference between GVC and non-GVC firms is driven simply by the fact that GVC firms tend to be bigger? In addition to controlling for aggregate shocks that can differ between IMMEX and non-IMMEX firms, our specification (equation 9) controls for differential trends of firms of different sizes, both in terms of the number of exported goods and

in terms of overall export volume. We conducted an additional test by assigning firms located at the top quartile of the size distribution (export volume) as 'fake IMMEX' firms and estimated equation 9. We find no significant difference between fake IMMEX firms and other firms. These results are available upon request.

5.2.3 US-Mexico Tariff Escalation and Its Impact via Firms' Imports

The effects of the US-China trade war presented in Figures 1 and 2 are estimated after controlling for any potential effects of the US-Mexico tariff escalation. Figures A.1-A.2 present the yearly impact of the US-Mexico tariff escalation on firms' US and worldwide exports, respectively. These results show no major effect.

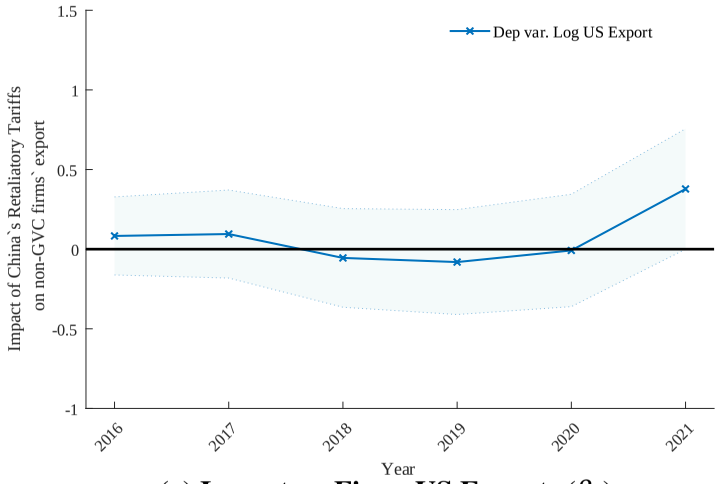
Figures A.1a-A.1b present the yearly impact of the Section 232 tariffs on Mexican firms' US exports. Mexican firms' steel and aluminium exports to the US were already dampened over 2017-18. The Section 232 tariffs also covered China together with some other countries like Canada, Russia, and Turkey. So the impact of Section 232 tariffs on Mexico may be confounded by these factors. Keeping this in mind, we see that the direct tariff impact on Mexican goods is observable on all exporters, not just on GVC firms, and we do not find any significant difference between GVC firms and others in responding to the US tariffs on Mexico (Figure A.1b). At the same time, the effect was short-lived and dissipated shortly after 2018, when the tariffs were removed.

Figures A.1c-A.1d present the effect of Mexico's retaliatory tariffs on US exports. Mexico's exporters again show differing responses to the retaliatory tariffs depending on GVC status. While non-GVC exporters seem to benefit from the temporary protection over 2018-19, the effect on GVC firms' US exports ($\mu_h + \mu_h^{IMM}$) is negligible.

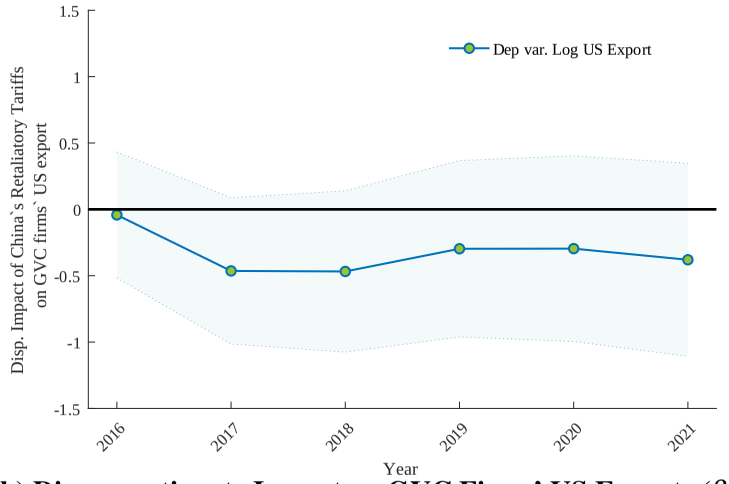
5.2.4 Impact of the US-China Trade War via Firms' Inputs

The potential effects of the US-China tariffs via firms' imports are captured by $CHNIM^{USIT}$, IC^{USRT}, IC^{USIT} in equation 9. We present the annual estimates of these controls in Figures A.3-A.5 in the Appendix.

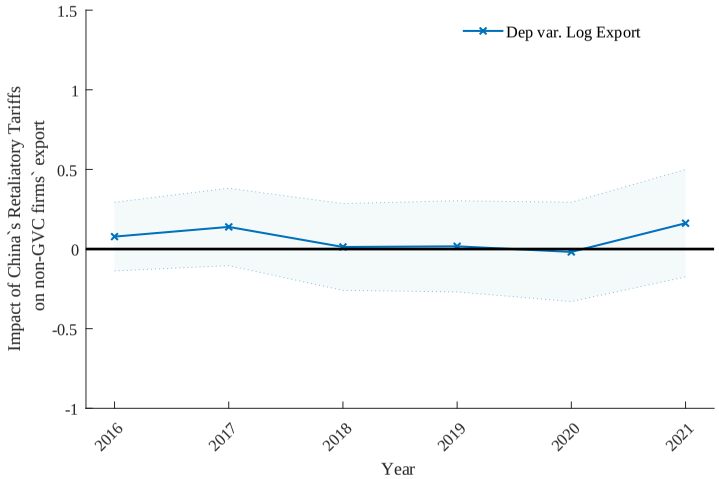
Figure A.3 presents the differential trends on firms whose imports more heavily depend on Chinese imports which will be targeted by the US trade policy after 2018. Reduced demand for the targeted Chinese goods might result in more favorable prices for Mexican exporters, benefiting their exports. However, in cases where Mexican firms operate within GVCs that cater to the US market, as in the case of IMMEX firms, sourcing decisions might require coordination at the headquarter level, or that the targeted goods may have been sourced from other MNE affiliates operating in China. With the



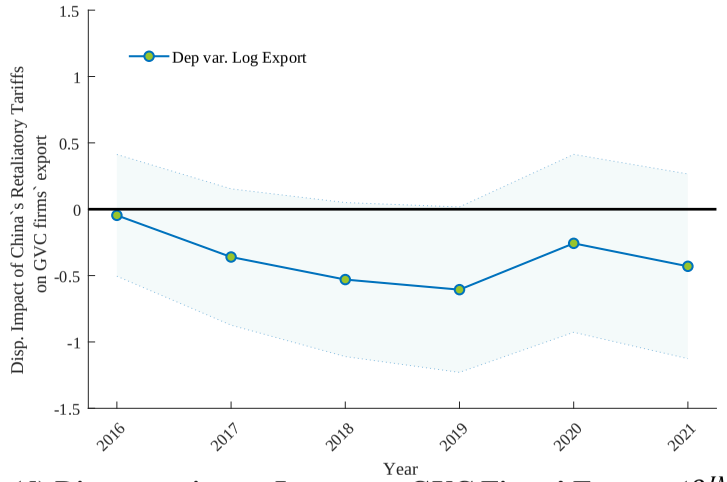
(a) Impact on Firms US Exports (β_h)



(b) Disproportionate Impact on GVC Firms' US Exports (β_h^{IMM})



(c) Impact on Firms' Exports (β_h)



(d) Disproportionate Impact on GVC Firms' Exports (β_h^{IMM})

Figure 2: Impact of China's Retaliatory Tariffs for the US on Mexican Firms' Exports

Notes: Estimation of equation 9. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The figure depicts the coefficient estimates of the regression result corresponding to column 2 (Figure 2a & 2b) and column 4 (Figure 2c & 2d) of Table A.3. The shaded area indicates the confidence interval at the 95% level. The number of observations is 123,698 (log US export) in Figure 2a-2b and 159,378 (log export) in Figure 2c-2d. All regressions include firm, size-specific, and IMMEX-specific time fixed effects as well as the other controls as indicated in Table A.3. The right axis shows the coefficient values of the respective DD (TX_i^{CHN-US}) or DDD ($TX_i^{CHN-US} \times IMM$) coefficients.

trade war, these MNE affiliates might be relocating or ceasing operations (Antras et al., 2022b).

The figure shows a slight positive effect on exports of non-GVC firms, while GVC firms' experience a negative effect. To put it differently, our findings once again highlight opposing responses to the US-China tariffs depending on firms' GVC status. The significant difference between GVC firms and other exporters starts in 2018 and continues until 2021 (Figure A.3a). These results underscore the importance of GVC links in understanding trade policy spillovers.

Consider a plastic products producer in Mexico importing polymer from the US that will be subject to US import tariff for China (IC_i^{USIT}) or China's retaliatory tariffs (IC_i^{USRT}). Figures A.4-A.5 present the yearly estimates of IC^{USRT}, and IC^{USIT} from estimation equation 9. These results show that GVC firms, reliant on US goods targeted by the US-China tariffs, do not experience a major effect on their exports.[13]

6 GVC Readjustment In Response to the US-China Trade War

We demonstrate the differential impact of the US-China trade war on Mexican exporters based on their position in global value chains (GVCs). Specifically, our analysis reveals that the effect of the US-China trade war on Mexico's export performance was primarily driven by firms involved in GVCs.

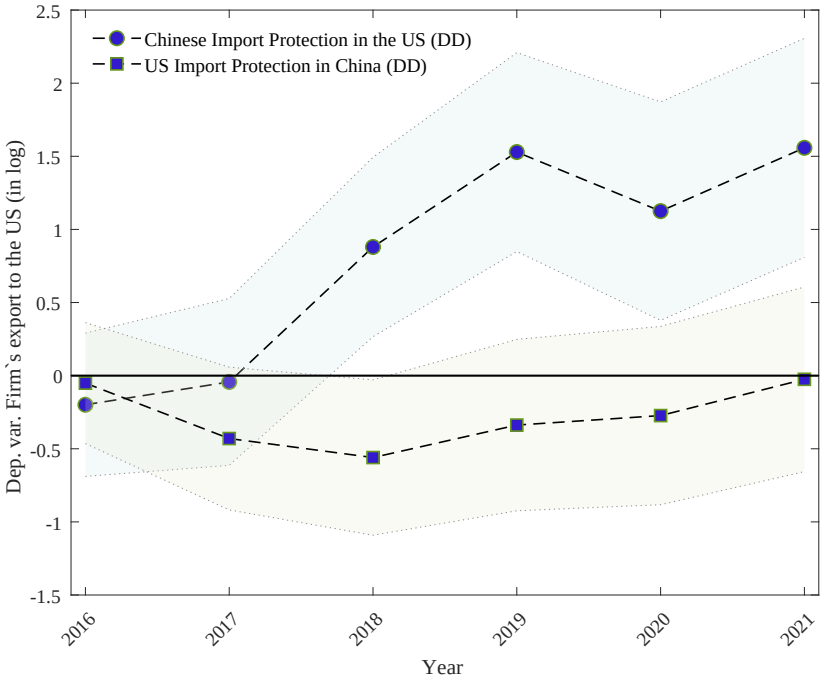
Given the prominence of IMMEX firms in shaping the impact of the US-China trade war, this section focuses specifically on these firms and estimates equation 10 exclusively for GVC firms. Doing so allows us to additionally control for industry-specific trends and explore heterogeneity across different industries as we can identify the primary industry of operations of IMMEX firms.

This section shows that both exports and exports net of total imports of GVC firms in Mexico experienced a positive impact from the heightened Chinese import protection in the US, and firms' product portfolio expanded among the targeted products.

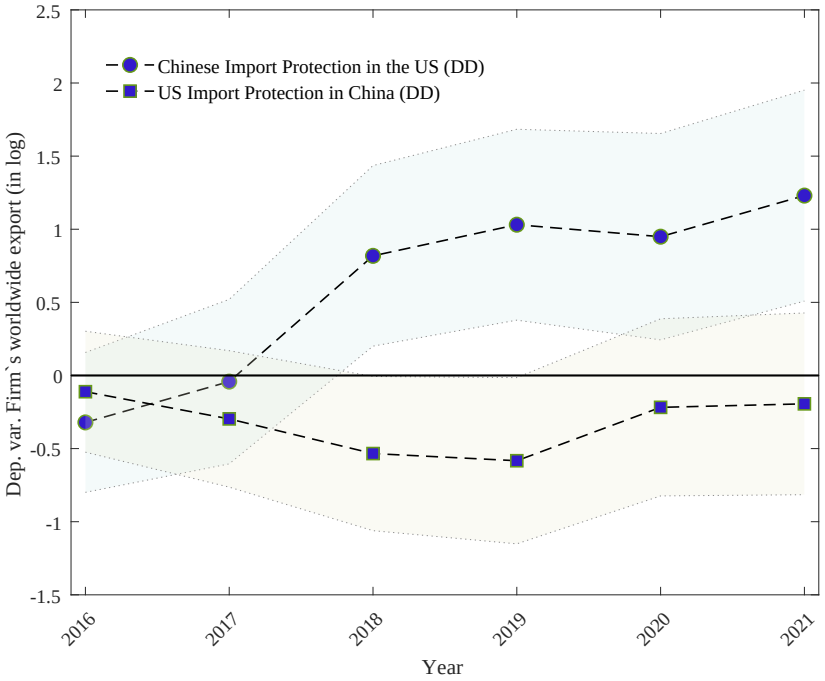
6.1 Does the Increased Chinese Import Protection in the US Cause Nearshoring?

Figure 1 in section 5 showed that increased Chinese import protection in the US disproportionately increased GVC firms' exports, despite no such effect on non-GVC exporters. We estimate equation 10 among GVC firms (firms registered under the IMMEX program as of 2016). There are close to six thousand such firms (see Table 1).

[13] Columns (1) and (3) of Table A.3 also provides results without controlling for the potential impact of US-China tariffs via firms' US imports for comparison purposes.



(a) Impact on Firms' US Exports



(b) Impact on Firms' Exports

Figure 3: The US-China Trade War and GVC Firms' Exports to the US

Notes: Estimation of equation 10 with firm, size-time, and industry-time fixed effects as well as controls for the US-Mexico tariff changes and importers from China as indicated in equation 10. The dependent variable is the natural logarithm of firm's annual export value to the US in 3a and the natural logarithm of firm's worldwide export in 3b. N=35,519 (log US export), N= 37,321 (log export). The sample consists of all IMMEX firms (as of 2016) over 2015-2021. The shaded areas indicate the confidence interval at the 95% level. The right axis shows the coefficient values of the respective DD coefficients.

Figure 3 presents the yearly DD coefficients α_h and β_h in equation 10 when the dependent variable is the log of firm export to the US (3a) and when the dependent variable is the log of total export (3b). Just to recap, α_h measures the impact of the increased Chinese import protection in the US in year h, while β_h measures the impact of China's retaliatory tariffs on firms' US exports. Note that these estimates now also control for industry-specific trends.

First, let us look at how the US import tariffs on Chinese goods affected GVC firms' exports to the US. The coefficient estimates are -0.20 and -0.04, respectively, two years and one year before the trade war started and not significantly different from zero. This indicates no important pre-trends between exposed and non-exposed GVC firms and is consistent with the current literature that finds no major pre-trends across products targeted by the tariff policy (e.g., Amiti et al., 2020; Fajgelbaum et al., 2020; Cavallo et al., 2021). In the first year of the trade war, the impact becomes 0.88 and both statistically and economically significant. To assess the economic magnitudes, we compare GVC firms at the 25th and the 75th percentile of exposure to Chinese import protection in the US (see Table A.1—the 75 percentile of exposure is 0.25, and the 25 percentile of exposure is 0.15 in the IMMEX sample). Using the 25/75 percentile exposure, the coefficients indicate a $(e^{0.88\times0.1}-1=)9\%$ increase in firm-level exports to the US in 2018. In 2019, the estimate shows a $(e^{1.53\times0.1}-1=)16.5\%$ increase in US exports. At the height of the COVID-19 pandemic in 2020, the impact decreases a bit, but it still remains significant, and in 2021, the coefficient of 1.56 shows a staggering 17% relative increase in Mexican GVC firms' exports to the US.

It is possible that firms merely divert their exports to other markets towards the US market in response to the change in US trade policy. Figure 3b shows this is not the case, and the US trade policy has a significant and positive effect on GVC firms' total exports. The coefficient estimate in 2021 is 1.23, which, together with the 25/75 percentile exposure difference, indicates a 13% relative increase in Mexican GVC firms' worldwide exports due to US import tariffs on Chinese goods.

Let's now focus on the impact of China's retaliatory tariffs (square markers in Figure 3). As some GVC firms provide distribution, storage, and other commercial and manufacturing services without changing the nature of goods, Mexican GVCs that were exporting goods that will be subject to the retaliatory tariffs may be impacted through declining demand for the US goods. We will return to this conjecture when we analyze heterogenous responses across different industries. At the same time, the full impact of the retaliatory tariffs of China can be better judged on total exports because Mexican GVCs that focus on finishing, packaging or post-production services of the products targeted by China may be directly exporting these goods from Mexico to a certain extent, instead of shipping to the US to be re-exported from there.

The results on China's retaliatory tariffs on GVC firms' total exports show no major pre-trends, with the DD coefficient estimates being -0.11 and -0.30 and statistically indistinguishable from zero in

2016 and 2017. These results show a statistically significant and negative impact of China's tariffs on Mexican GVC firms' exports in 2018 and 2019. More specifically, the coefficient estimates β_{2018} and β_{2019} are -0.53 and -0.58, respectively, and both are significant at the 5% level. Considering two Mexican exporters, one at the 75 and the other at the 25 percentile of exposure to the Chinese tariffs on the US products, the coefficient of -0.58 amounts to a ($e^{-0.58*0.13} - 1 =$) 7% differential reduction of firm-level exports. The effect dissipates after 2019. By 2021, the DD coefficient is -0.19 and not distinguishable from zero, showing a limited, short-run negative effect of the retaliatory tariffs.

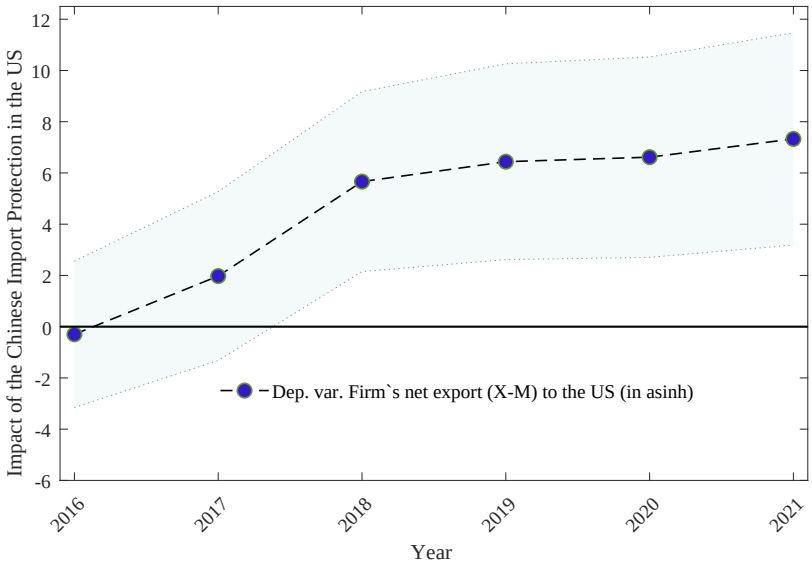
6.1.1 Firms' Net Exports

It is possible that the increased US tariffs on Chinese goods led to a similar increase in firms' imports as their exports, without significantly impacting domestic activities in Mexico. To approximate domestic value-added at the firm level, we construct a net export variable by subtracting the annual value of a firm's total imports from the value of its total exports. We also create a US-specific net export variable by subtracting the annual value of a firm's imports from the United States from the value of its US exports and estimate equation 10 after applying the inverse hyperbolic transformation (asinh) to these two net export variables. Contrary to the natural log transformation, the asinh transformation can handle zeros and negative values; hence the choice.

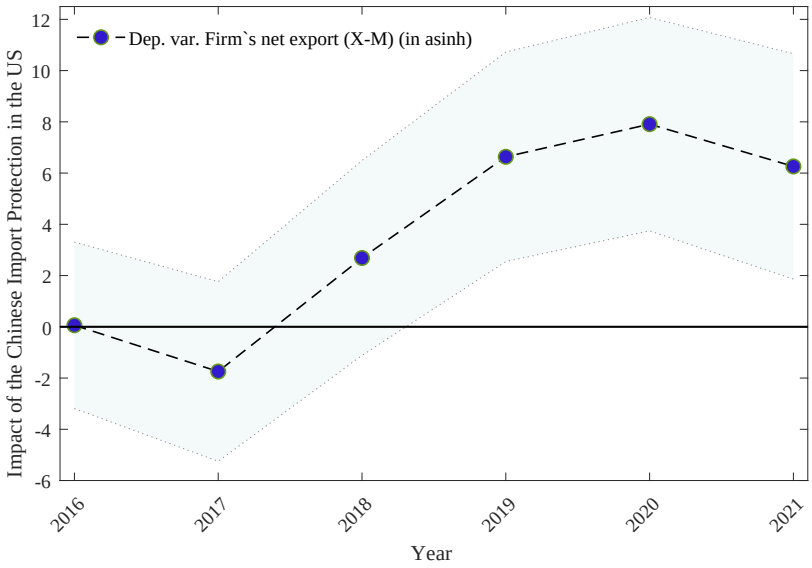
The results on the US net exports, presented in Figure 4a, show a significantly positive effect of the increased Chinese import protection in the US on Mexico-based GVCs' net exports to the US over 2018-2021. Figure 4a, together with Figure 3, provides evidence of nearshoring activities occurring in response to the change in the US trade policy towards China, highlighting the significant role of trade policy in reshaping GVCs.

Figure 4b presents the same analysis for firms' overall net exports to examine whether Mexico's value-added increased in response to the US tariffs on China. The results show a significant positive effect after 2018, suggesting a favorable impact on Mexico's overall value-added.

While the stated objective of the 2018/19 US tariffs was to stimulate American manufacturing production, Flaan and Pierce (2020) find no significant response in US domestic production to the increased tariffs on Chinese goods. The finding of increased net exports due to the heightened Chinese import protection, as presented in this paper, implies that such production response could be coming from the southern neighbor of the US via the US-Mexico production sharing program.



(a) Firms' Net Exports to the US



(b) Firms' Worldwide Net Exports

Figure 4: Impact of the rising US protectionist policy towards China on GVC Firms' Net Exports

Notes: Estimation of equation 10 with firm, size-time, and industry-time fixed effects as well as other variables as indicated in equation 10. The dependent variables are firm *i*'s exports to the US subtracted from firm *i*'s imports from the US (top) and firm *i*'s total exports subtracted from firm *i*'s total imports. Both variables are transformed via the inverse hyperbolic sine transformations. The sample consists of all IMMEX firms (as of 2016) over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 38,226. The right axis shows the coefficient values of the respective DD coefficients.

6.2 Expanding Product Portfolios of Mexican GVC Firms

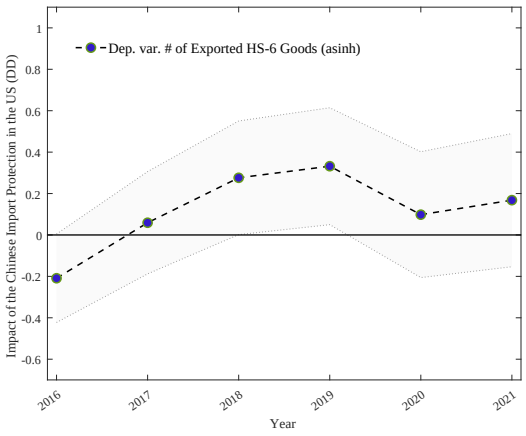
In this section we examine whether GVC firms started exporting new products, potentially substituting goods from China that are now facing higher tariffs in the US. We estimate equation 10 with the dependent variables the number of exported (HS-6 digit) goods and the number of exported goods that are subject to the 2018/19 US import tariffs for China. We then further divide the products affected by the US tariffs into intermediate and consumption goods.[14] The dependent variables are transformed by the inverse hyperbolic sine function to allow for zeros so that as we narrow down the category of products, we do not lose information and incorporate an extensive margin adjustment. The yearly estimates of TM_i^{US-CHN} are presented in Figure 5.

Figure 5a shows the yearly estimates of the effect of the Chinese import protection in the US on the total number of exported products. The results show a positive and significant effect on the number of products (HS 6-digit) over 2018 and 2019; the positive impact disappears when the COVID-19 lockdowns were affecting worldwide trade and production. While the effect resumes on the increasing trajectory again in 2021, it is not statistically significant.

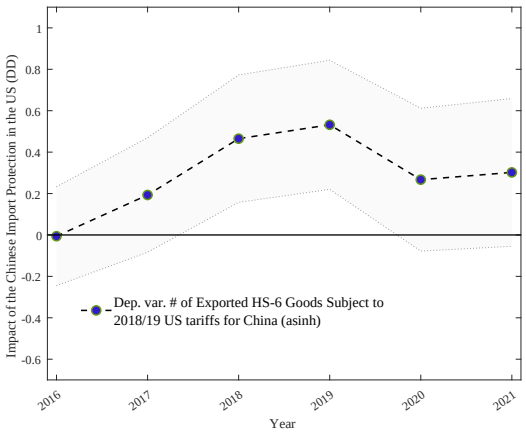
Did the expansion of GVC firms' product portfolios, resulting from protectionist policies towards China, primarily occur in the products targeted by the US tariffs on Chinese goods? To answer this question, Figure 5b depicts the evolution of the coefficient estimate for the exposure to the 2018/19 US tariffs from China, with the dependent variable being the number of goods a GVC firm exports subject to these tariffs. The results show that the increased number of exported products over 2018-2019 is driven by the targeted goods. In other words, there is evidence that GVC firms in Mexico are expanding their product portfolio to substitute for Chinese goods, now facing higher tariffs in the US market.

In Figure 5c and Figure 5d, we separately analyze intermediate and consumption products affected by the US tariffs. The results show expanding product offerings in response to the Chinese import protection in the US did not happen in intermediate (Figure 5c) but in consumption goods (Figure 5d). Focusing on the targeted consumption goods, although the significant effect diminishes in 2020 during the height of the COVID-19 shock in the US, it rebounds in 2021, suggesting a long-term development.

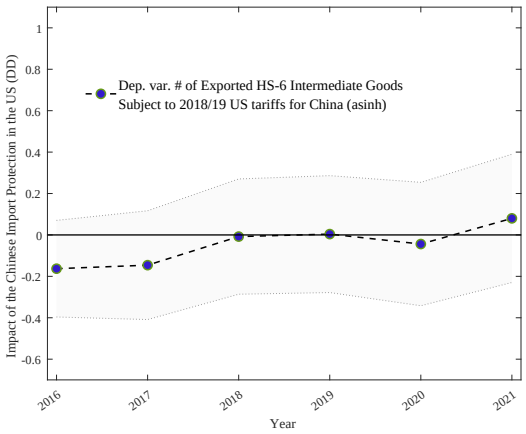
[14] We use the United Nations Conference on Trade and Development (UNCTAD)'s categorization.



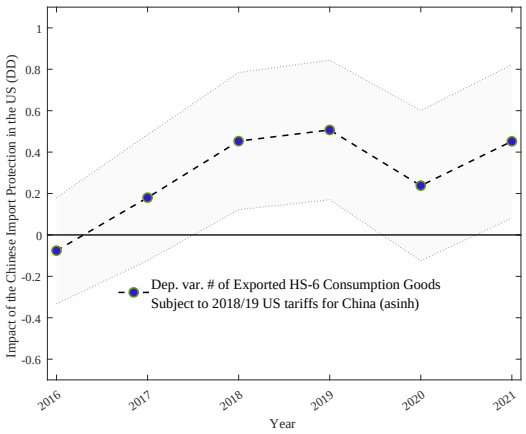
(a) Impact on the Number of Exported Products



(b) Impact on the Number of Exported Products Subject to the 2018/19 US Tariffs for China



(c) Impact on the Number of Exported Intermediate Products Subject to the 2018/19 US Tariffs for China



(d) Impact on the Number of Exported Consumption Products Subject to the 2018/19 US Tariffs for China

Figure 5: Chinese Import Protection in the US and GVC Firms' Product Offerings

Notes: Estimation of equation 10. The dependent variables are indicated in figure legends; they are in inverse hyperbolic sine transformed values. The sample consists of all IMMEX firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 37,313. All regressions include firm, size-specific, and industry-specific time fixed effects as well as the other trade policy variables as shown in 10.

7 Impact of US Protectionist Trade Policy towards China on GVC Firms' Sourcing

Mexico, like many countries, provides trade facilitation tools enabling companies to bring critical inputs duty-free. In this section, we examine if and how the sudden change in the US trade policy with respect to China affected Mexican GVC firms' sourcing. Doing so, we will also analyze potential

links between duty-free permits and the US tariffs.

Imports and exports both play a crucial role in the Global Value Chain (GVC) activities, as GVC firms specialize in specific stages of production within integrated production and service processes that span across borders. The IMMEX program is typically utilized by US companies to achieve more cost-efficient production and services as well as by foreign MNEs as an export platform for the US market. Considering the positive impact of the 2018/19 US import tariffs towards China on both exports and net exports of Mexican GVC firms, it is important to examine whether this effect is accompanied by an increase in US imports. We will also explore the effect on other sourcing locations to shed some light on GVC adjustments in response to the US trade policy. To do that, we estimate equation 10, with the dependent variable being the log value of firm's total import from the US and other regions and countries. These results are presented in Table 4.

In column (1), the dependent variable is the log value of firm's total imports from the US. The yearly estimate of the Chinese import protection exposure becomes significant in the first year of the trade war and remains statistically significant throughout 2019-2021 at around 0.75. The coefficient estimate of 0.73 in 2019, together with the 25/75 percentile exposure difference, indicates an increase in firms' US imports due to Chinese import protection of 7.6% ($e^{0.73\times0.1}-1$). While not presented, we find no significant impact of China's retaliatory tariffs on GVC firms' US imports.

Next, we present the effect on GVCs' imports from the EU-28 countries (that includes the UK), Latin American countries, China, and other important Asian countries, namely Taiwan, Thailand, Vietnam, Japan, Korea, and India, in columns (2)-(5) respectively.

The results show some anticipation effect of the US's protectionist turn on GVC firms' imports from the European countries (column 2), but otherwise no major effect. The coefficient estimate becomes weakly significant in 2017 and remains so in 2018. While the magnitude is at a similar range in 2019, it is not precisely estimated, and the effect seems to be temporary as the coefficient estimates get smaller and stay imprecisely estimated after 2019. The results in column (3) on imports from Latin American countries also show no important effects.

In column (4), we turn our attention to GVC firms' imports from China. There is a significant increase in firms' Chinese imports due to the US tariffs. The coefficient estimate for the year 2019 indicates that the intensified protectionist trade policy towards China in the US led to an 11% ($e^{1.04\times0.1}-1$) surge in Mexican GVC firms' imports from China in that year. These regressions account for differential trends among firms that import goods from China, subject to the 2018/19 US tariffs. As a result, the effect identified in column (5) must be attributed to the growing business with the US due to the change in the US tariffs.

Table 4: Increased Chinese Import Protection in the US and Mexican GVC Firms' Sourcing

Dep Var.	Imports from				
	US	Europe	LAC	China	Other Asia
	(1)	(2)	(3)	(4)	(5)
$TM_i^{US-CHN} \times$ 2016	0.263	0.331	0.337	0.312	0.180
	(0.243)	(0.386)	(0.733)	(0.391)	(0.394)
$TM_i^{US-CHN} \times$ 2017	0.345	0.756^{c}	-0.006	0.469	0.532
	(0.270)	(0.396)	(0.774)	(0.432)	(0.449)
$TM_i^{US-CHN} \times$ 2018	0.664^{b}	0.709^{c}	0.105	0.873^{c}	0.911^{c}
	(0.308)	(0.422)	(0.844)	(0.457)	(0.488)
$TM_i^{US-CHN} \times$ 2019	0.731^{b}	0.690	0.841	1.039^{b}	0.896^{c}
	(0.333)	(0.448)	(0.883)	(0.490)	(0.500)
$TM_i^{US-CHN} \times$ 2020	0.742^{b}	0.399	-0.548	1.393^{a}	1.223^{b}
	(0.377)	(0.473)	(0.901)	(0.525)	(0.517)
$TM_i^{US-CHN} \times$ 2021	0.763^{b}	0.717	-0.233	1.517^{a}	1.274^{b}
	(0.389)	(0.511)	(0.930)	(0.558)	(0.529)
China's Retaliatory Tariff Exposure × Year FEs	✓	✓	✓	✓	✓
Section 232 Tariff Exposure × Year FEs	✓	✓	✓	✓	✓
Mexico's Retaliatory Tariff Exposure × Year FEs	✓	✓	✓	✓	✓
Chinese Import Exposure ($CHNIM_i^{USIT}$) × Year FEs	✓	✓	✓	✓	✓
Firm Size × Year FEs	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Industry × Year FEs	✓	✓	✓	✓	✓
Observations	34,352	27,642	17,047	30,178	28,699
R-squared	0.898	0.859	0.802	0.855	0.865

Notes: Sample: IMMEX firms as of 2016 over 2015-2021. Estimation of equation 10 excluding the input costs controls due to potential confounding effects they can cause on firms' importing. The dependent variables are the natural logarithmic transformation of firm's import from countries/regions as given in column headings. Europe refers to the following countries: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the UK. Other Asia refers to the following set of countries: Taiwan, Thailand, Vietnam, Japan, Korea, and India. LAC refers to the Latin American Countries excluding Mexico. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% levels respectively.

Is this effect specific to China, or does it extend to other Asian countries where the US-based GVCs operate? The dependent variable in column (5) is a firm's imports from Taiwan, Thailand, Vietnam, Japan, Korea, and India. We find a robust positive impact on firms' imports from other Asian countries where GVCs are prevalent. Quantitatively the effects on imports from China and other Asian countries are similar.

To summarize, we find that Mexican GVCs that are more exposed to the Chinese import protection in the US increased their imported inputs from the US, China, Taiwan, Thailand, Vietnam, Japan, Korea,

and India. These findings provide firm-level evidence of GVC adjustment taking place in response to the US trade policy shift.

7.1 The Role of Trade Facilitation Instruments In Mexico

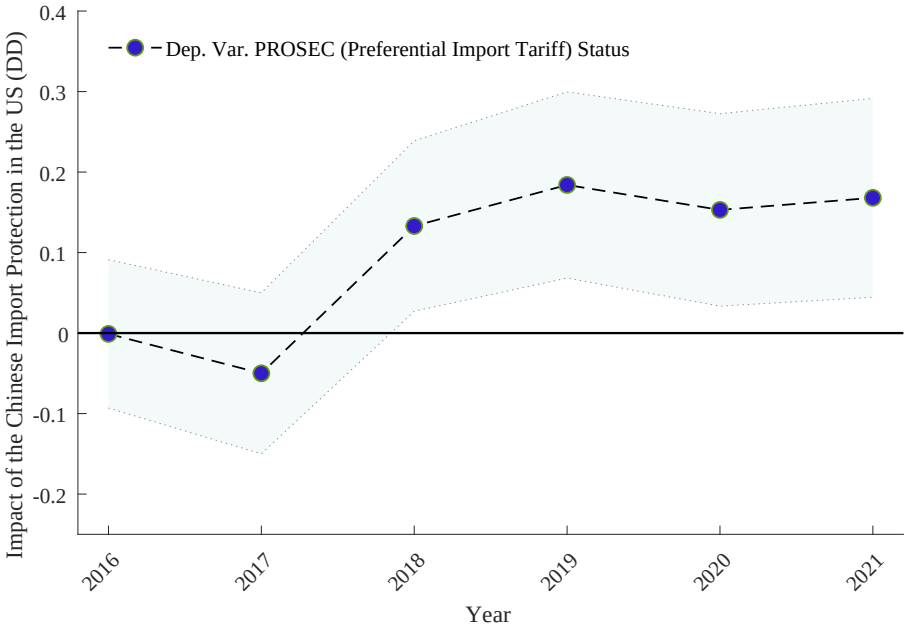
We now focus on the firm-specific preferential tariff treatments to gain further insights into supply chain relocation to Mexico. First, we study if the shift in US trade policy affects the likelihood of obtaining Eighth Rule permits that enable firms to import intermediate or capital goods with no tariffs or at significantly reduced MFN tariff rates. If an MNE opens up a new plant in Mexico or expands an existing one to incorporate a new production line, sourcing a new (non-North American) input may be needed. If so, the company will register under PROSEC (if not already registered) to obtain an Eighth Rule permit for that specific input.

Figure 6a presents the yearly results from an estimation of equation 10 among IMMEX firms where the dependent variable is a firm's PROSEC status, which takes one if the firm has any imports with Eighth Rule permits that year. The results show that heightened Chinese import protection in the US significantly increases firms' likelihood of obtaining an Eighth Rule permit. The coefficient estimate in 2019 indicates a 3.5 pp increase in the likelihood of getting *Regla Octava* permit. The dependent variable in Figure 6b is the value of imports a firm imports under said permits.[15] The results show a significant positive impact on imports treated preferentially due to the increased Chinese import protection in the US.

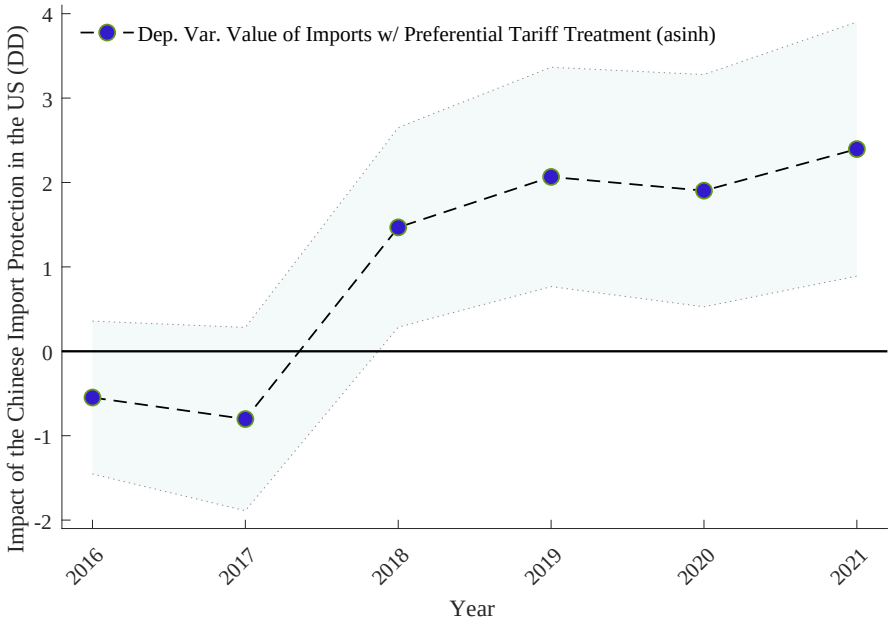
MNEs tend to co-locate sourcing activities with other affiliates or headquarters to facilitate easier monitoring, quality control, and risk management and to strengthen business relationships within the company's network (Alfaro & Charlton, 2009; Garg et al., 2023). We will next investigate from which countries and regions firms source at the preferential rates due to the shift in the US tariffs on China.

Results presented in Table 5 distinguish preferential imports depending on their source country. The first column presents the same results that are visually depicted in Figure 6b, on total imports of firms with preferential treatment (asinh). In column (2), the source country is the US. Since most of the goods from the US are already duty-free unless they are targeted by the Mexican government in retaliation for the steel and aluminum tariffs, firms do not need to utilize preferential import permits for the US goods, and accordingly, the results show no effect. Notice that the impact on firms that import US goods targeted by the Mexican government (the effect of the Mexican retaliatory tariffs) is accounted for in these regressions. We will return to the effect of the Mexican retaliatory tariffs below.

[15] In order not to lose zero-valued observations, we use the inverse hyperbolic sine transformation.



(a) GVC Firms with government permits for low tariff rates



(b) The Value of Import Under Preferential Duty Rates

Figure 6: Import Protection Against China and Preferential Duties for Mexican GVCs

Notes: Estimation of equation 10. The dependent variable in the top figure is an 0-1 indicator that takes one if firm has a Regla Octova/PROSEC license to import w/ preferential rates. The dependent variable in the bottom figure is the value of those imports that are treated w/ promotional duties in inverse hyperbolic sine transformation. The sample consists of all IMMEX firms (as of 2016) over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations in both regressions is 38,226. All regressions include firm, size-specific, and industry-specific time fixed effects. The right axis shows the coefficient values of the respective DD coefficients.

In column (3), we focus on the imports from the European countries, including the UK. We find some evidence for increased European imports under special treatment after 2018. This may be driven by the possibly increased activity of EU-originated multinationals in Mexico that serve the US market, however, total imports from Europe do not experience a major increase (column (2) of Table 4). Column (4) focuses on preferentially treated imports from Latin American countries. The coefficient is weakly significant only in 2021 and should not be over-interpreted.

In Table 4, we show that the heightened Chinese import protection in the US increases GVC firms' Chinese imports in Mexico. Do US parent companies utilize the trade facilitation instruments in Mexico to avoid the increased tariff burdens on Chinese imports? Notice that potentially confounding factors due to firms whose imports are concentrated on Chinese goods subject to the US tariffs are partialled out in these results. Indeed, we show in Figure A.3 that export performances of GVC firms are negatively affected if their imports depend on targeted goods from China. In column (5), the dependent variable is the value of Chinese imports that firm i imports at preferential rates. The DD coefficient becomes statistically significant only in 2020, which may be a temporary impact. So these results show no major indication that Mexico's trade facilitation legislature is exploited to import targeted Chinese goods to the US.

In column (6), we shift our attention to firms' preferential import from other Asian countries, excluding China. We find a clear, significant positive impact on preferentially treated imports from Taiwan, Thailand, Vietnam, Japan, Korea, and India. These countries host significant GVC activities. Our results show that the heightened protection against Chinese imports in the US not only boosts imports by Mexican GVC firms from these countries, but also encourages the utilization of firm-specific permits to import duty-free inputs from them. These findings suggest that the relocation of supply chain activities towards Mexico in response to the heightened Chinese import protection in the US is linked with Asian countries.

It is worth emphasizing that these results are obtained when additional forces associated with the trade war, such as the retaliatory tariffs, are controlled for. The full results show no significant effect of China's retaliatory tariffs, but at the same time, we find a significant and positive effect of Mexico's retaliatory tariffs on GVC firms' preferential imports. Further analysis reveals these effects are concentrated on US imports, especially over 2018 and 2019.[16] Figure A.6 presents these results. In other words, the retaliatory tariffs imposed by the Mexican government on US imports led Mexican GVCs to import more of US imports preferentially (duty-free or at a max rate of 5%). This indicates that while penalizing US imports, the Mexican government also decreased the negative effect on GVC

[16]The United States, Mexico, and Canada reached a deal to remove the Section 232 tariffs on Mexican and Canadian goods in return for the removal of retaliatory tariffs by Mexico and Canada in May 2019. While the Mexican retaliatory tariffs were removed on May 20, 2019, there were still some anti-dumping fees on certain US products, such as seamed carbon steel pipes.

firms importing these targeted US imports by allowing them to import at preferential rates.

Together, these results show an important role for trade facilitation instruments, especially in a trade war environment, to mitigate the negative effect of tariffs on domestic participation in GVCs and, at the same time, to benefit from the positive spillover effects of the third-country tariffs. The results also provide evidence for relocation of supply chain activities that are linked with Asian countries to Mexico in response to the heightened Chinese import protection in the US.

Table 5: US-China Trade War and GVC Firms' Preferential Import

Dep Var.	(1)	(2)	(3)	(4)	(5)	(6)
	Preferentially Treated Import					
	Total	USA	Europe	LAC	China	Other Asia
$TM_i^{US-CHN} \times$ 2016	-0.548	-0.185	-0.097	0.181	0.154	-0.059
	(0.462)	(0.414)	(0.349)	(0.314)	(0.354)	(0.389)
$TM_i^{US-CHN} \times$ 2017	-0.803	-0.263	-0.197	0.379	-0.229	-0.427
	(0.554)	(0.457)	(0.394)	(0.349)	(0.414)	(0.490)
$TM_i^{US-CHN} \times$ 2018	1.468^b	0.528	0.400	0.204	0.396	1.064^b
	(0.603)	(0.526)	(0.429)	(0.394)	(0.480)	(0.522)
$TM_i^{US-CHN} \times$ 2019	2.066^a	0.520	0.948^b	0.417	0.421	1.324^b
	(0.663)	(0.589)	(0.465)	(0.396)	(0.544)	(0.575)
$TM_i^{US-CHN} \times$ 2020	1.903^a	0.318	0.796	0.647	1.270^b	1.582^b
	(0.702)	(0.637)	(0.500)	(0.422)	(0.554)	(0.614)
$TM_i^{US-CHN} \times$ 2021	2.396^a	0.315	1.249^b	0.830^b	1.033	1.679^b
	(0.768)	(0.668)	(0.529)	(0.461)	(0.629)	(0.675)
China's Retaliatory Tariff Exposure × Year FEs	✓	✓	✓	✓	✓	✓
Section 232 Tariff Exposure × Year FEs	✓	✓	✓	✓	✓	✓
Mexico's Retaliatory Tariff Exposure × Year FEs	✓	✓	✓	✓	✓	✓
Chinese Import Exposure ($CHNIM_i^{USIT}$) × Year FEs	✓	✓	✓	✓	✓	✓
Firm Size × Year FEs	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Industry × Year FEs	✓	✓	✓	✓	✓	✓
Observations	38,226	38,226	38,226	38,226	38,226	38,226
R-squared	0.860	0.811	0.835	0.756	0.843	0.837

Notes: Sample: IMMEX firms as of 2016 over 2015-2021. Estimation of equation 10. The dependent variables are given in column headings, they are the inverse hyperbolic sine transformations. Europe refers to the following countries: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the UK. Other Asia refers to the following set of countries: Taiwan, Thailand, Vietnam, Japan, Korea, and India. ^{c}, ^{b} and ^{a} indicate significance at the 10%, 5% and 1% levels respectively.

8 Manufacturing GVCs and Heterogeneity in Adjustment

Although the vast majority of firms in the IMMEX program are manufacturing firms (Table A.2), IMMEX firms can operate in diverse industries, spanning from agriculture to warehousing, transportation, or professional services. In this section, we demonstrate that the positive effect of the US import tariffs against the Chinese imports is felt stronger among the manufacturing GVCs. We explore cross and within sector heterogeneity in response to the US-China trade war and show our results hold when we solely rely on variations of tariff changes across products within narrowly defined manufacturing industries.

8.1 Manufacturing Firms and Cross Industry Heterogeneity

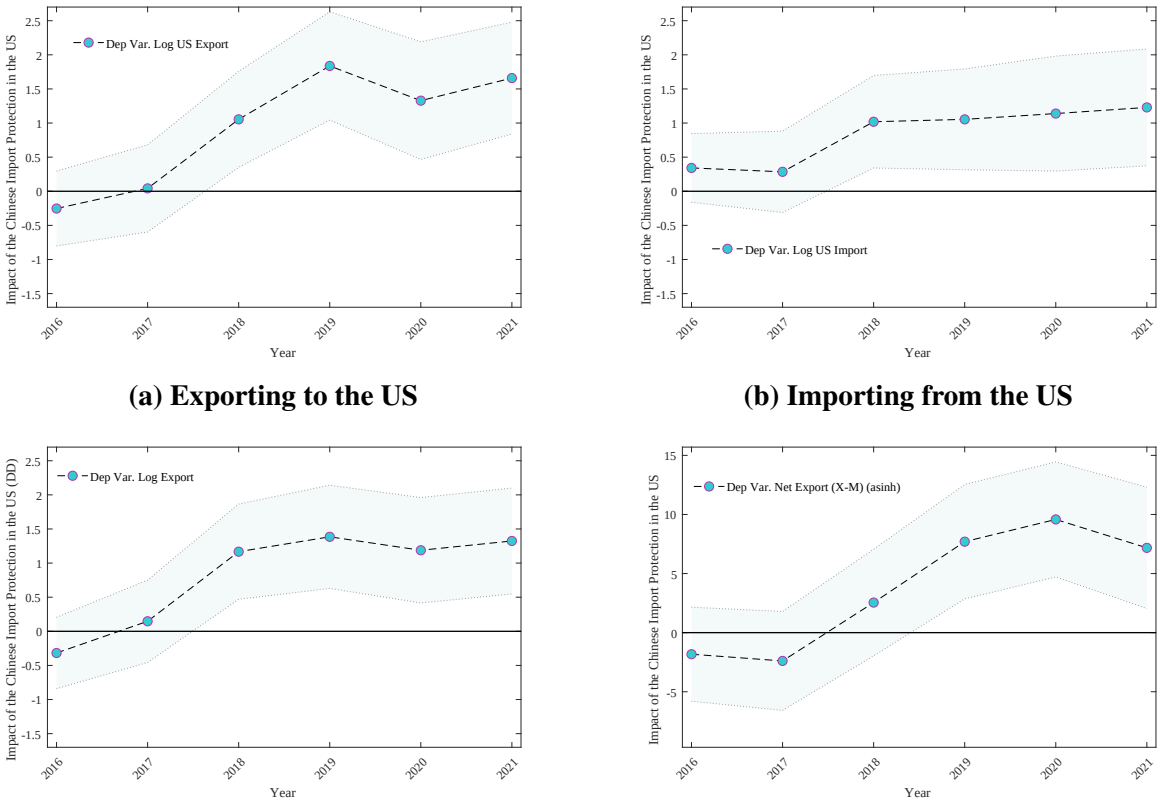
Figure 7 presents the yearly coefficient estimates for the effect of the heightened protection in the US against Chinese imports, TM^{US-CH}, on manufacturing GVCs. We estimate equation 10 with the dependent variables US exports (in log), US imports (in log), worldwide exports (in log), and worldwide exports net of worldwide imports (asinh) among manufacturing IMMEX firms.

These results show no major pretrends in any of the exports, imports or net exports variables and a robust positive effect throughout 2018-2021. The coefficient estimate for the US exports in 2019 (Figure 7a), along with the 25/75 percentile exposure difference to changes in the US tariffs, indicate a 20% ($e^{1.84\times0.1}-1$) relative increase in firms' exports to the US. This effect is larger than those we find for the whole IMMEX sample. As for the whole sample, the effect is not temporary and continues through 2021. The results on US imports (Figure 7b) also show a robust positive effect of the US import tariffs on China, indicating stronger integration between the US and Mexican manufacturing.

Figures 7c and 7d also show that worldwide exports and net exports of manufacturing GVCs in Mexico are positively affected by the protectionist shift in US trade policy towards China. The coefficient estimate of 1.4 in 2019 indicates a 15% relative increase in worldwide exports of manufacturing GVC firms.

Figure A.7 in the Appendix show the results when we additionally control for three-digit NAICS by year fixed effects and hence focus solely on variations in tariff changes across products within narrowly defined manufacturing industries. Our findings still hold. These results are consistent with the current literature that finds no major pre-trends across products targeted by the tariff policy (e.g., Amiti et al., 2020; Fajgelbaum et al., 2020; Cavallo et al., 2021).

Did the US tariffs benefit only Mexican manufacturing? Figure A.8 in the Appendix presents the heterogenous effects of the US-China trade war across three main sectors: Agriculture, Manufacturing,



(a) Exporting to the US

(b) Importing from the US

(c) Total Export

(d) Total Export Net of Total Import

Figure 7: Heightened Chinese Import Protection in the US and GVC Firms' Response in Manufacturing

Notes: Estimation of equation 10. The dependent variables are indicated in figure legends. The sample consists of all manufacturing IMMEX firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations changes between 29,946 and 27,632. All regressions include firm, size-specific year fixed effects as well as the other trade policy variables as shown in 10.

and Services. It depicts the average effect on firms' exports over the period 2018-2021, estimated separately among IMMEX firms operating within each sector. Focusing on the US tariffs (top), it shows that the impact of the 2018/19 US tariff on China is positive across all three sectors. The average effect is precisely estimated only among the manufacturing IMMEX, as the majority of IMMEX firms operate in this sector.

Figure A.8 also presents the effect of China's retaliatory tariffs, revealing a more heterogeneous pattern. Specifically, there is no significant adverse effect of China's retaliatory tariffs on manufacturing GVC firms but a significant negative effect in services that include warehousing, distribution, waste management, and other post-production services. Figure A.8 also reveals that the effect of retaliatory tariffs is statistically significant and positive among agricultural GVC firms, suggesting that US and Mexico's agricultural products are primarily substitutes. These findings support our conjecture

that the negative export effect of China's retaliatory tariffs affects GVC firms in Mexico via demand spillovers because these firms provide services to the US products that are now facing lower demand due to China's tariffs.

Exploring the heterogeneous effects of the US-China trade dispute within the manufacturing industry, Figure 8 below and Figure A.9 in the Appendix present the average effect on firms' US exports and total exports, respectively across two-digit industries. Not all manufacturing industries benefited from the US tariffs. In particular, traditionally labor-intensive industries such as textile, apparel, and footwear do not expand their business with the US (NAICS: 31), but more skill-intensive industries such as chemicals, computers, machinery, and automotive (NAICS: 32 & 33) industries do.

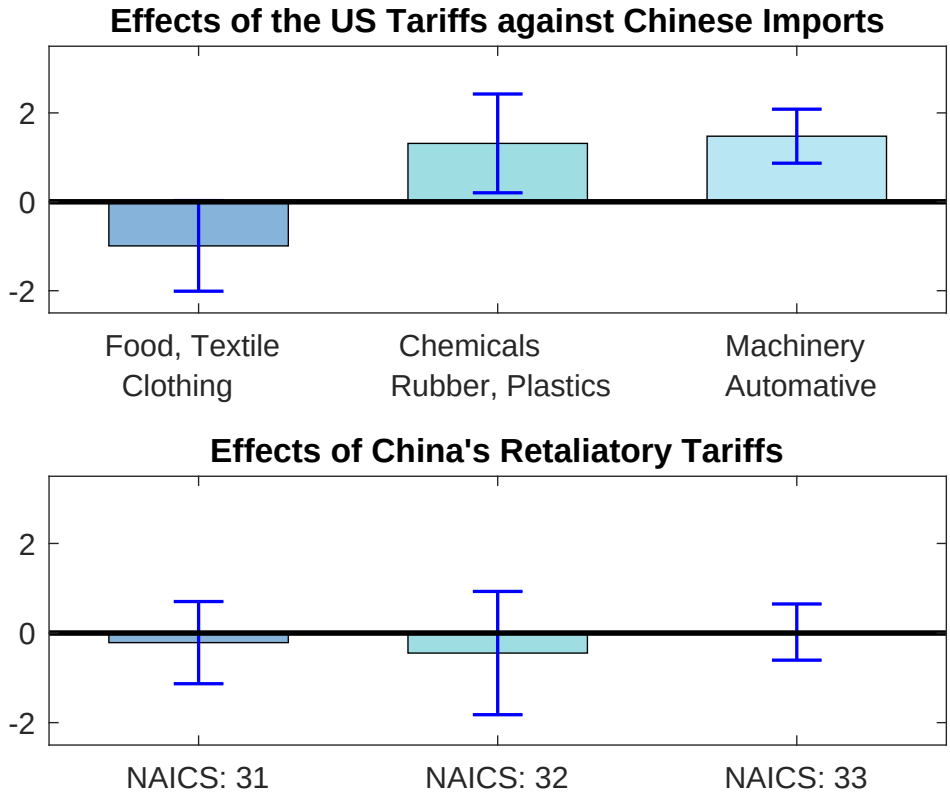


Figure 8: Average Effects on GVC Firms' US Export across Manufacturing Industries

Notes: Estimation of equation A.1 separately across IMMEX companies operated in North American Industry Classification System, NAICS=31, 32, and 33. The dependent variable in all regressions is the logarithm of firm's export to the US. All regressions include firm FEs, initial-firm-size by year FEs, and the other trade exposure variables as indicated in equation A.1. Bar heights indicate the respective coefficient values. Top figure depicts the coefficient values for the average effect over 2018-2021 of the heightened Chinese import protection in the US (TM^{US-CH}), and the bottom figure depicts the coefficient values for the average effect over 2018-2021 of China's retaliatory tariffs on the US goods (TX^{CH-US}). Robust SEs are clustered by firms, and error bars indicate 95% confidence intervals. The numbers of observations are 5,218, 4,290, and 19,537, respectively in NAICS=31, NAICS=32 and NAICS=33 regressions.

9 Concluding Remarks

After playing a key role in promoting global tariff reductions for over half a century, US trade policy took an unexpected and decisive turn in 2018 with the goal of reducing US reliance on China, which had emerged as the world's foremost manufacturing hub.[17] This shift sparked discussions in the business press regarding the potential for "nearshoring", "friendshoring", and Mexico's opportunities as an alternative to China.

To investigate the impact of the US-China trade war on Mexican firms, we employ longitudinal firm-level trade data that covers the universe of firms with international trade transaction in Mexico and construct firm-level measures of tariff exposures based on firms' pre-shock export and import portfolios at the product level. After controlling for firm fixed effects and confounding firm or industry-specific trends and utilizing the sudden turn toward protectionist policies as a natural experiment, we show that the US-China trade war had a significant effect on Mexican firms. Further, we identified all firms registered with the US-Mexico production sharing program, IMMEX, in customs data and demonstrate that these GVC participant firms were the primary channel through which the US-China trade dispute spills over to Mexico.

At the firm level, our analysis reveals that the 2018/19 US import tariffs from China had a significantly positive impact on GVC firms' exports, imports, and net exports. The positive effect on GVC firms' exports is driven by their exports to the US, while their increased imports are primarily from Asian countries and the US. Using the 25/75 percentile exposure difference to the US import tariffs on China, we find that heightened Chinese import protection caused a 20% relative increase in a typical manufacturing GVC firm's exports to the US. This positive effect was particularly pronounced in relatively skill-intensive manufacturing industries such as machinery or automotive, rather than in textile or food industries. Moreover, we provide evidence of new product introductions concentrated on consumption goods that are subject to the new tariff protection from Chinese competition in the US. The results show reorganization of supply chains in favor of Mexico in select industries. An important next step would be to explore the determinants of this heterogeneity.

The trade war not only had a positive effect on Mexico, but we also document counterbalancing negative effects. In particular, China's retaliatory tariffs had a negative, yet more transitory effect on firms' exports, particularly affecting export service GVCs. We also find evidence of a robust negative effect on GVC firms whose inputs are concentrated on targeted Chinese goods. These results highlight the role of integrated US-Mexico production processes.

[17] The decoupling of integrated production processes was an important part of the US government's intention with the change in the trade policy towards China. In fact, in August 2019, President Trump advised US firms to immediately start looking for an alternative to China (Breuninger, 2019).

Taken together, these findings underscore the transformative role of trade policy in reshaping global production and service networks and provide firm-level evidence of the nuanced occurrence of nearshoring in response to the trade war, highlighting the complex and multifaceted nature of these adjustments.

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Online Appendix:

"The US-China Trade War and Relocation of Global Value Chains to Mexico"

September 27, 2023

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Figure A.9: Average Effects of the US-China Trade War across Manufacturing Industries

A Additional Results

A.1 Summary Statistics

Table A.1: Firm-Level Measures of Exposures to the Trade War

	(1) Mean	(2) SD	(3) P25	(4) P75	(5) N
Panel A. All Exporters					
TM_i^{US-CHN}	0.167	0.097	0.089	0.250	190,801
TX_i^{CHN-US}	0.163	0.100	0.098	0.234	190,801
TM_i^{US-MEX}	0.001	0.014	0.000	0.000	190,801
TX_i^{MEX-US}	0.002	0.013	0.000	0.000	190,801
$CHNIM_i^{USIT}$	0.020	0.049	0.000	0.010	190,801
IC_i^{USIT}	0.057	0.083	0.000	0.110	190,801
IC_i^{USRT}	0.045	0.068	0.000	0.079	190,801
Panel B. IMMEX Firms					
TM_i^{US-CHN}	0.193	0.082	0.150	0.250	38,226
TX_i^{CHN-US}	0.168	0.085	0.104	0.229	38,226
TM_i^{US-MEX}	0.003	0.024	0.000	0.000	38,226
TX_i^{MEX-US}	0.004	0.019	0.000	0.000	38,226
$CHNIM_i^{USIT}$	0.025	0.044	0.000	0.028	38,226
IC_i^{USIT}	0.111	0.085	0.026	0.183	38,226
IC_i^{USRT}	0.088	0.072	0.020	0.141	38,226

Notes: See Section 4.1 for the definitions of these variables.

Table A.2: Distribution of IMMEX firms in 2016 across sectors

Agricultural and Animal Production	6.4%
Mining and Utilities	1.3%
Manufacturing	80%
Warehousing and Storage Services	5.8%
Business Services	3.8%
Repair, Maintenance, Personal and Laundry Services	1.4%
Other Services	1.4%

Notes: Data source are the IMMEX registry and customs data (COMEXT).

A.2 Supplemental Results for Section 5

We estimate a simplified, difference-in-differences version of 9 where we do not distinguish GVC firms and where we interact with the firm-level trade policy exposures with a post-shock dummy that takes one in the year 2018 and onwards. The estimation equation that underlies the results presented in Table 3 is given as follows:

$$\begin{aligned} Y_{it} = \beta_0 + \beta_1\, Post2008_t \times TM_i^{US-CHN} + \beta_2\, Post2008_t \times TX_i^{CHN-US} + \beta_3\, Post2008_t \times TM_i^{US-MEX} + \\ \beta_3\, Post2008_t \times TX_i^{MEX-US} + \beta_4\, Post2008_t \times CHNIM_i^{USIT} + \beta_5\, Post2008_t \times IC_i^{USIT} + \\ \beta_6\, Post2008_t \times IC_i^{USIT} + \beta_7\, Post2008_t \times IC_i^{USRT} + Z_{it} + \eta_i + \varepsilon_{it} \end{aligned} \tag{A.1}$$

Here, $Post2008_t$ denotes the post-shock dummy and Z_{it} includes firm-size-specific trends. In equation A.1 we explicitly write the input costs channels, $Post2008_t \times IC_i^{USIT}$, and $Post2008_t \times IC_i^{USRT}$, which are normally included in Z_{it}. Otherwise, as before Z_{it} includes initial firm size by year fixed effects.

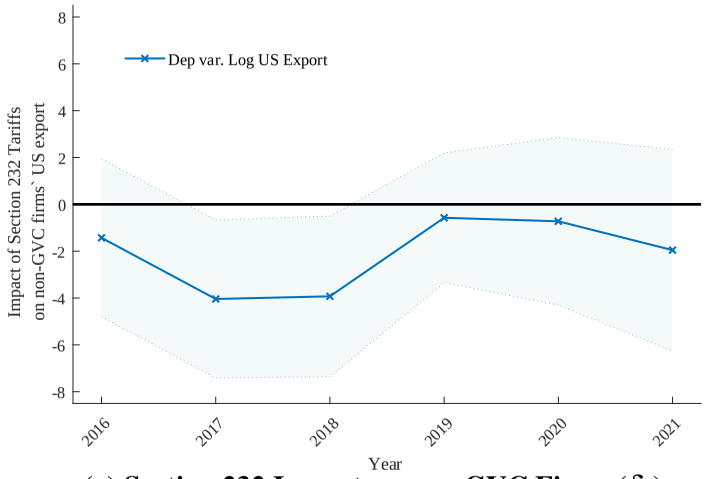
Table A.3 presents the results from estimating equation 9 among all exporting firms as of 2016 over

2015-2021.

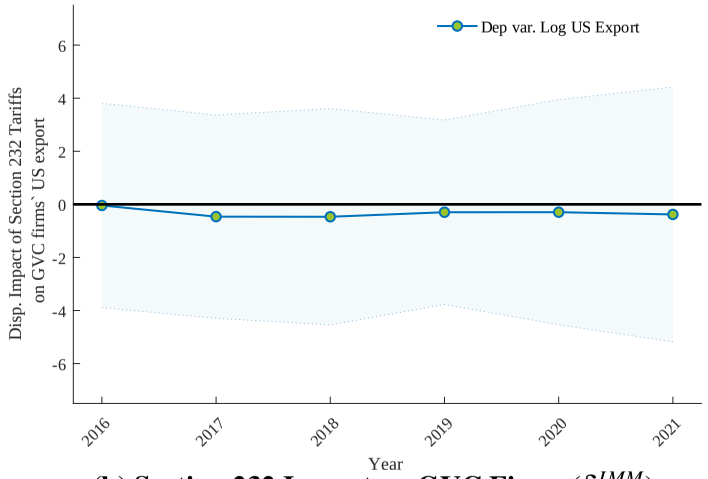
Table A.3: Increased Chinese Import Protection in the US and Mexican Firms' Export

	(1)	(2)	(3)	(4)
	Log US Export		Log Worldwide Export	
$TM_i^{US-CHN} \times$ 2016	-0.248	-0.244	-0.499^a	-0.501^a
	(0.152)	(0.159)	(0.126)	(0.131)
$TM_i^{US-CHN} \times$ 2017	0.146	0.045	-0.042	-0.095
	(0.171)	(0.177)	(0.141)	(0.146)
$TM_i^{US-CHN} \times$ 2018	0.096	-0.111	0.067	-0.057
	(0.188)	(0.197)	(0.157)	(0.162)
$TM_i^{US-CHN} \times$ 2019	-0.04	-0.211	-0.019	-0.105
	(0.200)	(0.210)	(0.164)	(0.170)
$TM_i^{US-CHN} \times$ 2020	-0.006	-0.163	-0.095	-0.205
	(0.215)	(0.224)	(0.181)	(0.188)
$TM_i^{US-CHN} \times$ 2021	0.619^a	0.395^c	0.495^b	0.356^c
	(0.228)	(0.239)	(0.193)	(0.201)
$IMM \times TM_i^{US-CHN} \times$ 2016	-0.019	-0.137	0.102	0.019
	(0.260)	(0.272)	(0.243)	(0.255)
$IMM \times TM_i^{US-CHN} \times$ 2017	-0.086	-0.038	0.171	0.177
	(0.297)	(0.305)	(0.279)	(0.290)
$IMM \times TM_i^{US-CHN} \times$ 2018	0.770^b	1.000^a	0.876^a	1.038^a
	(0.324)	(0.335)	(0.312)	(0.323)
$IMM \times TM_i^{US-CHN} \times$ 2019	1.537^a	1.730^a	1.198^a	1.320^a
	(0.355)	(0.366)	(0.328)	(0.341)
$IMM \times TM_i^{US-CHN} \times$ 2020	1.043^a	1.227^a	1.120^a	1.288^a
	(0.384)	(0.397)	(0.356)	(0.372)
$IMM \times TM_i^{US-CHN} \times$ 2021	0.940^b	1.297^a	0.955^b	1.213^a
	(0.399)	(0.413)	(0.377)	(0.393)
Chinese Retaliation Tariff Exposure $\times$ Year FEs	✓	✓	✓	✓
Section 232 Tariff Exposure $\times$ Year FEs	✓	✓	✓	✓
Mexico's Retaliatory Tariff Exposure $\times$ Year FEs	✓	✓	✓	✓
China Import Exposure ($CHNIMP_i^{USIT} \times$ Year FEs)	✓	✓	✓	✓
Input Costs Controls ($IC_i^{USIT} \times$ Year FEs)	—	✓	—	✓
Input Costs Controls ($IC_i^{USRT} \times$ Year FEs)	—	✓	—	✓
$IMM_i \times$Year FEs	✓	✓	✓	✓
Initial Firm Size $\times$ Year FEs	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Observations	123,698	123,698	159,378	159,378
R-squared	0.887	0.887	0.883	0.882

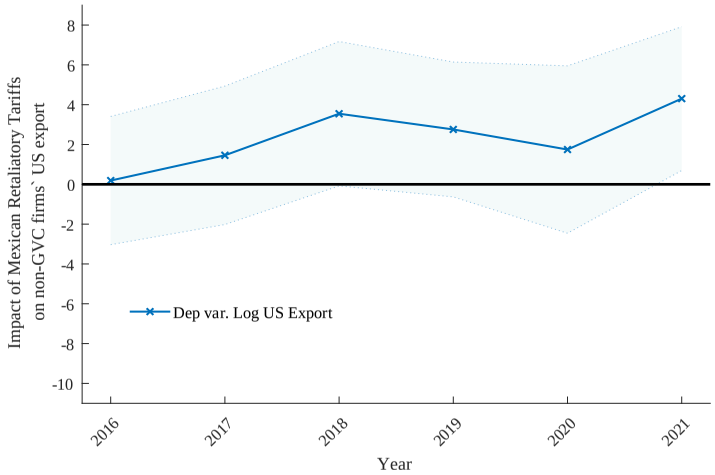
Notes: Sample: Firms with positive export as of 2016. Estimation of equation 9. The dependent variables are given in column headings. Initial Firm Size $\times$ Year FEs include firm size measured as of 2016 in terms of the number of exported goods and also based on the total export value, interacted seperately with year fixed effects. Robust standard errors are clustered at firm level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% levels respectively.



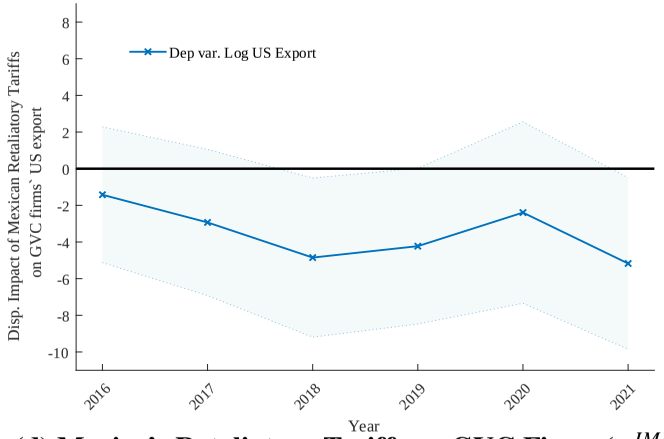
(a) Section 232 Impact on non-GVC Firms (δ_h)



(b) Section 232 Impact on GVC Firms (δ_h^{IMM})



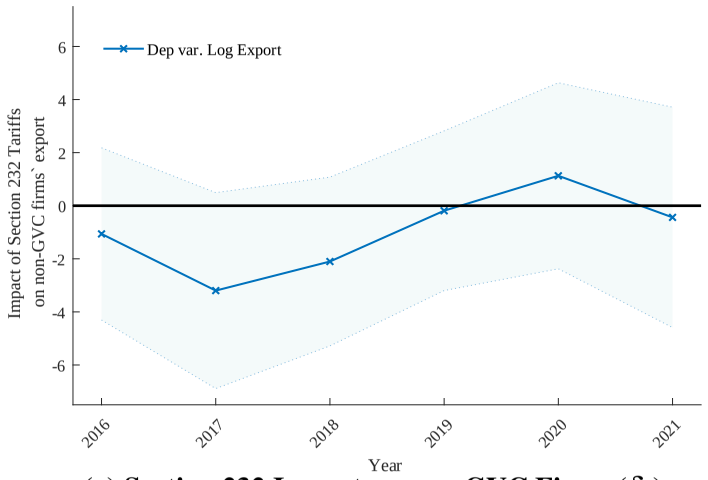
(c) Mexico's Retaliatory Tariffs on non-GVC Firms (μ_h)



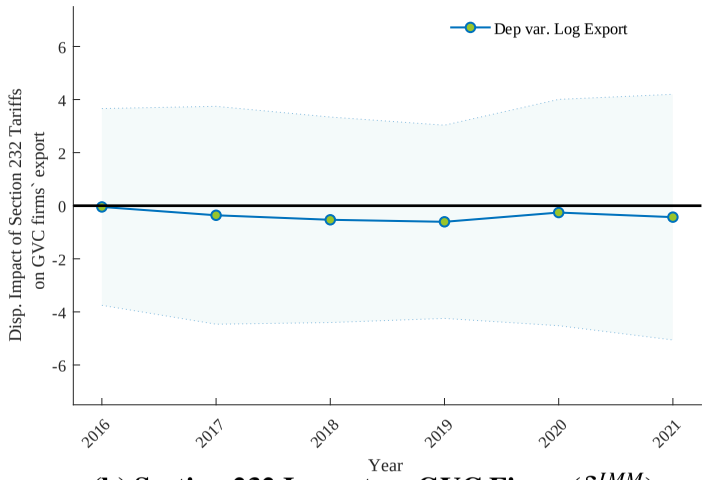
(d) Mexico's Retaliatory Tariffs on GVC Firms (μ_h^{IMM})

Figure A.1: Impact of US-Mexico Tariff Escalation on Firms' US Export

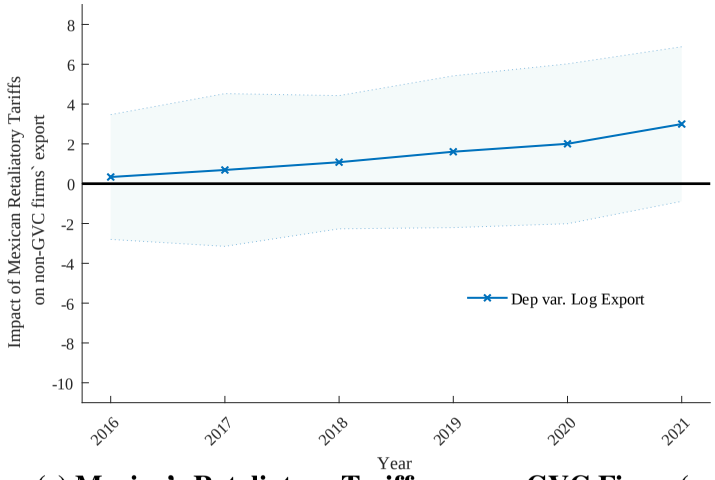
Notes: Estimation of equation 9. The dependent variable is the natural logarithm of firm's annual export value to the US. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 123,698. All regressions include firm, size-specific, and IMMEX-specific time fixed effects. The right axis shows the coefficient values of the respective DD or DDD coefficients.



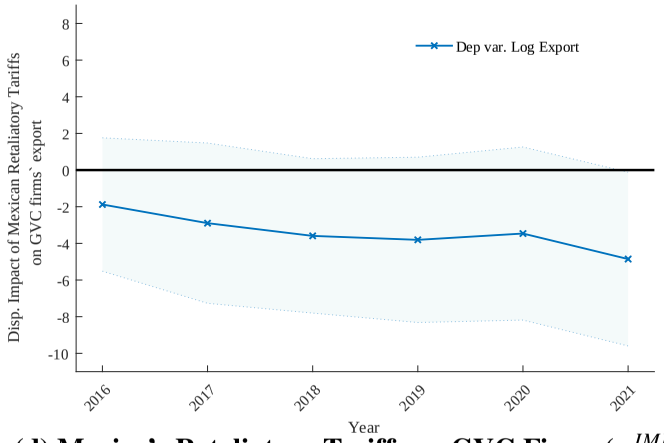
(a) Section 232 Impact on non-GVC Firms (δ_h)



(b) Section 232 Impact on GVC Firms (δ_h^{IMM})



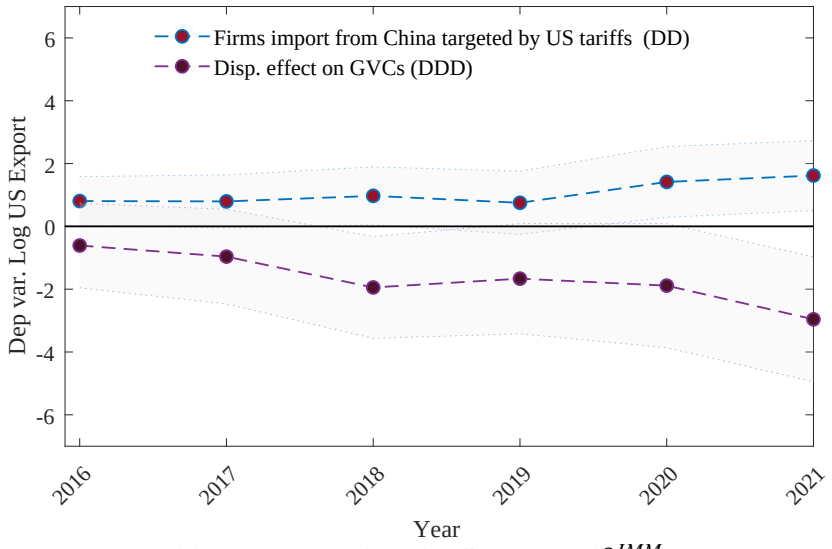
(c) Mexico's Retaliatory Tariffs on non-GVC Firms (μ_h)



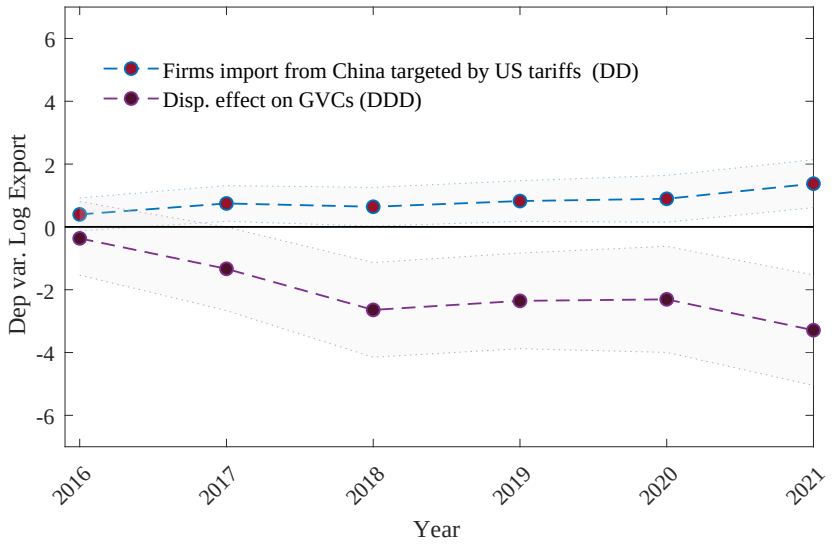
(d) Mexico's Retaliatory Tariffs on GVC Firms (μ_h^{IMM})

Figure A.2: Impact of US-Mexico Tariff Escalation on Firms' Export

Notes: Estimation of equation 9. The dependent variable is the natural logarithm of firm's annual export value. The figure present the yearly coefficient estimates corresponding to column (2) of Table A.3. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 159,378. All regressions include firm, size-specific, and IMMEX-specific time fixed effects. The right axis shows the coefficient values of the respective DD or DDD coefficients.



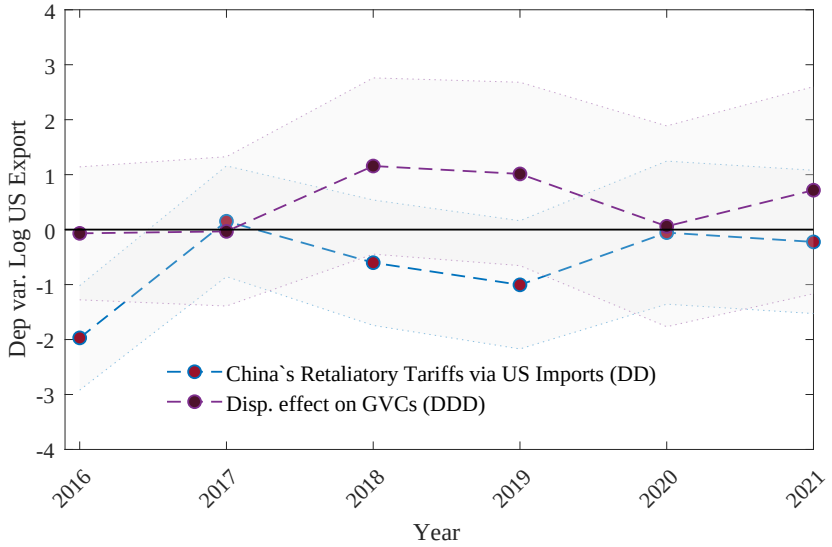
(a) Impact on Firms' US Exports (β_h^{IMM})



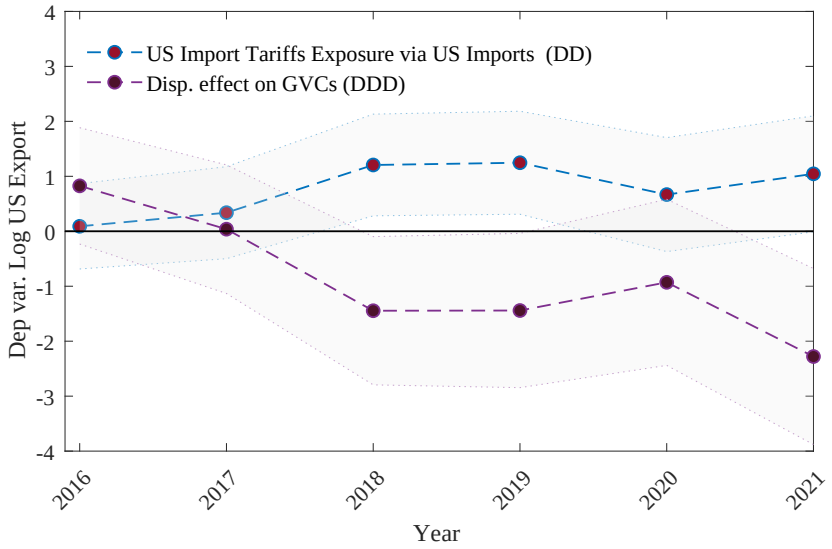
(b) Impact on Firms' Exports (β_h)

Figure A.3: Importing US tariffs imposed goods from China

Notes: Estimation of equation 9. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The figure depicts the DD and DDD coefficient estimates ($CHNIM_i^{USIT}$) of the regression result corresponding to column 2 (Figure A.3a) and column 4 (Figure A.3b) of Table A.3. The shaded area indicates the confidence interval at the 95% level. The number of observations is 123,698 in Figure 2a and 159,378 in Figure 2b. All regressions include firm, size-specific, and IMMEX-specific time fixed effects as well as the other controls as indicated in Table A.3. The right axis shows the coefficient values of the respective DD or DDD coefficients.



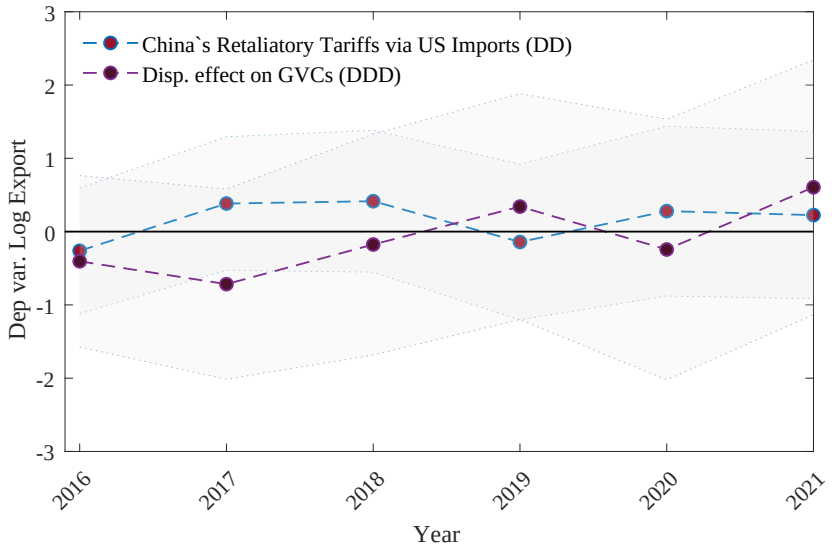
(a) Differential Trends on Firms whose US imports are targeted by China's retaliatory tariffs (IC_i^{USRT})



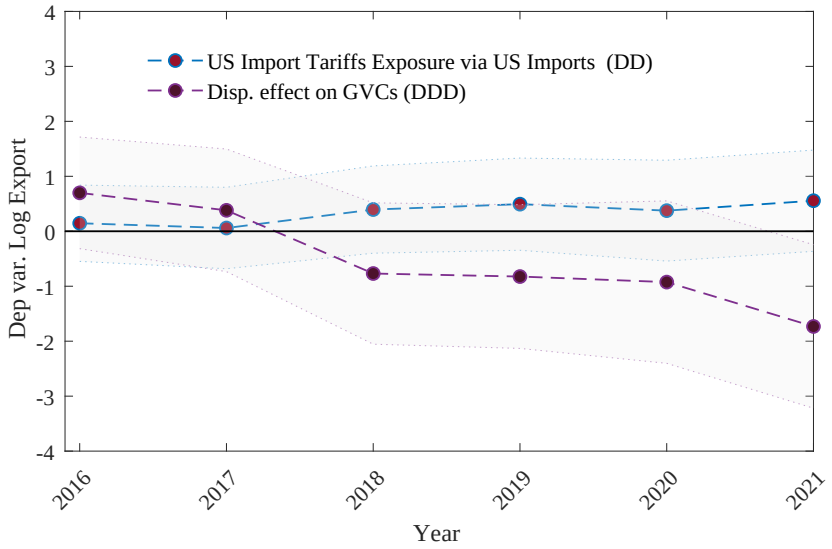
(b) Differential Trends on Firms whose US imports are targeted by the US import tariffs (IC_i^{USIT})

Figure A.4: Input Channels I —Dep. Var. Firm's Exports to the US

Notes: Estimation of equation 9. The dependent variable is the natural logarithm of firm's annual export to the US. Figures A.4a A.4b present the yearly IC_i^{USRT}, and IC_i^{USIT} coefficient estimates corresponding to column (2) of Table A.3 respectively. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 123,698. All regressions include firm, size-specific, and IMMEX-specific time fixed effects. The right axis shows the coefficient values of the respective DD or DDD coefficients.



(a) Differential Trends on Firms whose US imports are targeted by China's retaliatory tariffs (IC_i^{USRT})



(b) Differential Trends on Firms whose US imports are targeted by the US import tariffs (IC_i^{USIT})

Figure A.5: Input Channels II —Dep. Var. Firm's Exports

Notes: Estimation of equation 9. The dependent variable is the natural logarithm of firm's annual export value. Figures A.5a A.5b present the yearly IC_i^{USRT}, and IC_i^{USIT} coefficient estimates corresponding to column (4) of Table A.3 respectively. The sample consists of all exporting firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations is 159,378. All regressions include firm, size-specific, and IMMEX-specific time fixed effects. The right axis shows the coefficient values of the respective DD or DDD coefficients.

A.3 Supplemental Results for Section 6

Figure A.6 depicts the yearly coefficient estimates for exposure to China's retaliatory tariffs on GVC firms' import from the US under the special HS heading '98' (Regla Octava).

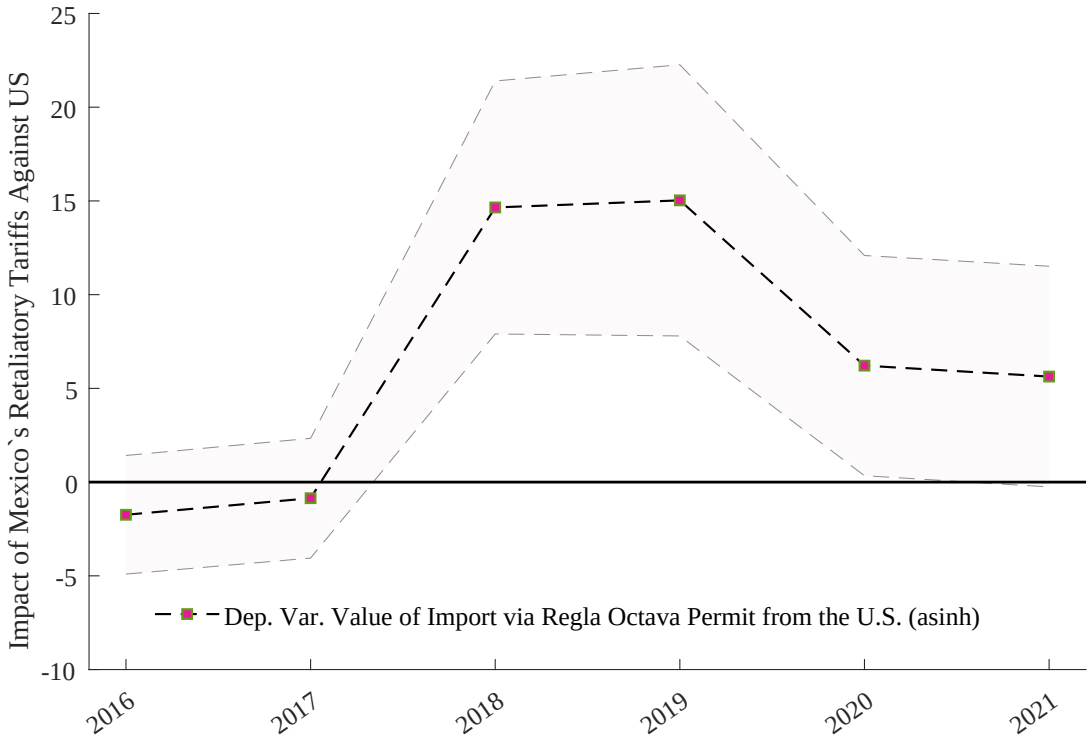


Figure A.6: Impact of Mexico's Retaliatory Tariffs on GVC Firms' Preferential Import from the US

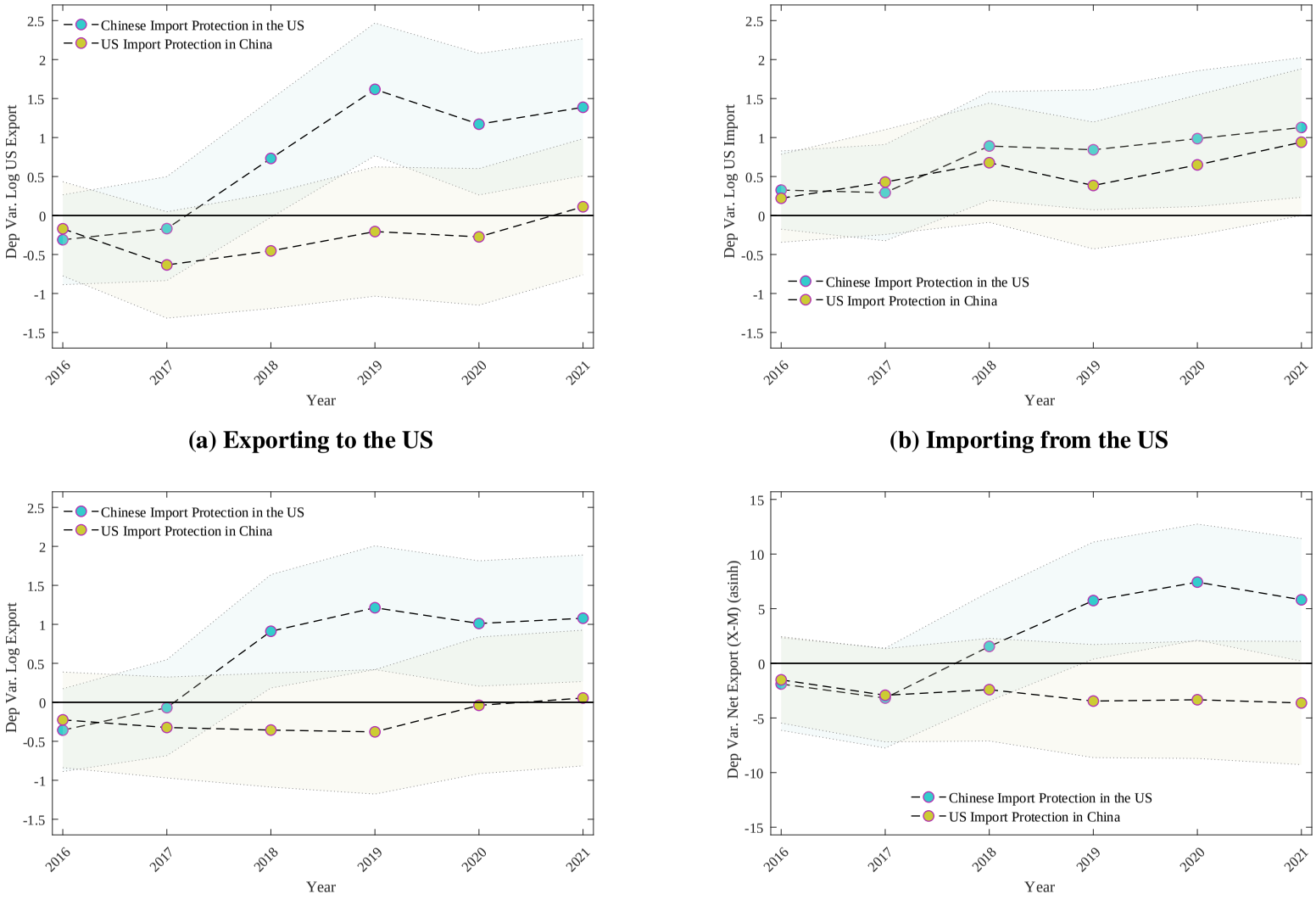
Notes: Estimation of equation 10 on the IMMEX sample over 2015-2021. The dependent variable is a firm's import from the U.S under special heading '98'. It is transformed using the inverse hyperbolic sine function. The shaded area indicate the confidence interval at the 95% level. The number of observations is 38,226. The right axis shows the coefficient values of the respective DD coefficients.

Table A.4 presents results from estimating equation 10 on various firms' outcomes when we additionally control for municipality-by-year fixed effects to understand a potentially confounding role of local labor market shocks driven by labor shortages and COVID closures. The results are robust to such potential shocks.

Table A.4: Robustness Check with Municipality-Specific Aggregate Shocks: The Effect of the US-China Trade War on GVC Firms

VARIABLES	(1) Exports (Log)	(2) US Exports (Log)	(3) Imports from US (Log)	(4) Imports from China (Log)	(5) Imports from Other Asia (Log)	(6) Net Exports (X-M) (asinh)
$TM_i^{US-CHN} \times$ 2016	-0.103	-0.005	0.009	0.494	0.538	1.379
	(0.270)	(0.287)	(0.270)	(0.456)	(0.434)	(2.006)
$TWM_i^{US-CHN} \times$ 2017	0.111	0.171	-0.023	0.380	0.347	-0.064
	(0.320)	(0.335)	(0.318)	(0.495)	(0.483)	(2.118)
$TWM_i^{US-CHN} \times$ 2018	1.004^a	1.043^a	0.299	0.666	1.003^c	4.669^b
	(0.353)	(0.350)	(0.341)	(0.508)	(0.529)	(2.288)
$TWM_i^{US-CHN} \times$ 2019	1.198^a	1.554^a	0.226	1.005^c	0.940^c	8.747^a
	(0.362)	(0.381)	(0.368)	(0.558)	(0.552)	(2.481)
$TWM_i^{US-CHN} \times$ 2020	1.106^a	1.115^a	0.539	1.411^b	1.290^b	7.373^a
	(0.396)	(0.415)	(0.427)	(0.584)	(0.573)	(2.530)
$TWM_i^{US-CHN} \times$ 2021	1.197^a	1.519^a	0.630	1.581^b	1.561^a	5.058^c
	(0.398)	(0.424)	(0.446)	(0.624)	(0.569)	(2.653)
$TX_i^{CHN-US} \times$ 2016	-0.177	-0.224	0.173	-0.099	-0.055	-1.124
	(0.262)	(0.250)	(0.262)	(0.429)	(0.426)	(1.712)
$TX_i^{CHN-US} \times$ 2017	-0.124	-0.353	0.459	0.115	-0.361	-0.928
	(0.294)	(0.298)	(0.321)	(0.494)	(0.448)	(1.835)
$TX_i^{CHN-US} \times$ 2018	-0.409	-0.388	0.454	-0.526	-0.464	-1.630
	(0.327)	(0.323)	(0.323)	(0.536)	(0.488)	(1.994)
$TX_i^{CHN-US} \times$ 2019	-0.587^c	-0.284	0.044	-0.610	-0.831	-4.504^b
	(0.346)	(0.351)	(0.349)	(0.613)	(0.507)	(2.188)
$TX_i^{CHN-US} \times$ 2020	-0.138	-0.215	0.247	-0.572	-0.878	-3.363
	(0.375)	(0.363)	(0.406)	(0.619)	(0.539)	(2.281)
$TX_i^{CHN-US} \times$ 2021	0.003	0.206	0.749^c	-0.787	-0.797	-3.063
	(0.373)	(0.377)	(0.415)	(0.663)	(0.566)	(2.401)
Section 232 Tariff Exposure $\times$ Year FEs	✓	✓	✓	✓	✓	✓
Mex. Retaliatory Tariff Exp. $\times$ Year FEs	✓	✓	✓	✓	✓	✓
$IC_i^{USIT} \times$Year FEs	✓	✓	✓	✓	✓	✓
$IC_i^{USRT} \times$Year FEs	✓	✓	✓	✓	✓	✓
Initial-Firm-Size $\times$ Year FEs	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Industry $\times$ Year FEs	✓	✓	✓	✓	✓	✓
Municipality $\times$ Year FEs	✓	✓	✓	✓	✓	✓
Observations	36,370	34,604	33,492	29,396	27,922	37,523
R-squared	0.896	0.896	0.905	0.864	0.876	0.804

Notes: Sample: IMMEX firms as of 2016 over 2015-2021. Estimation of equation 10 with additional municipality by year FEs. The dependent variables are given in column headings. Other Asia consists of the following countries: Taiwan, Thailand, Vietnam, Japan, Korea, and India. ^{c}, ^{b} and ^{a} indicate significance at the 10%, 5% and 1% levels respectively.



(a) Exporting to the US

(b) Importing from the US

(c) Total Export

(d) Net Export

Figure A.7: Robustness with 3-digit NAICS by Year FEs: Effects of the US-China trade war on Manufacturing GVC Firms in Mexico

Notes: Estimation of equation 10 with additional 3-digit NAICS by Year FEs. The dependent variables are written as y-axis labels. The sample consists of manufacturing IMMEX firms in Mexico as of 2016 over 2015-2021. The shaded area indicates the confidence interval at the 95% level. The number of observations changes between 29,946 and 27,632.

Figure A.8 shows the average effect on GVC firms' export over 2018-2021 across different sectors.

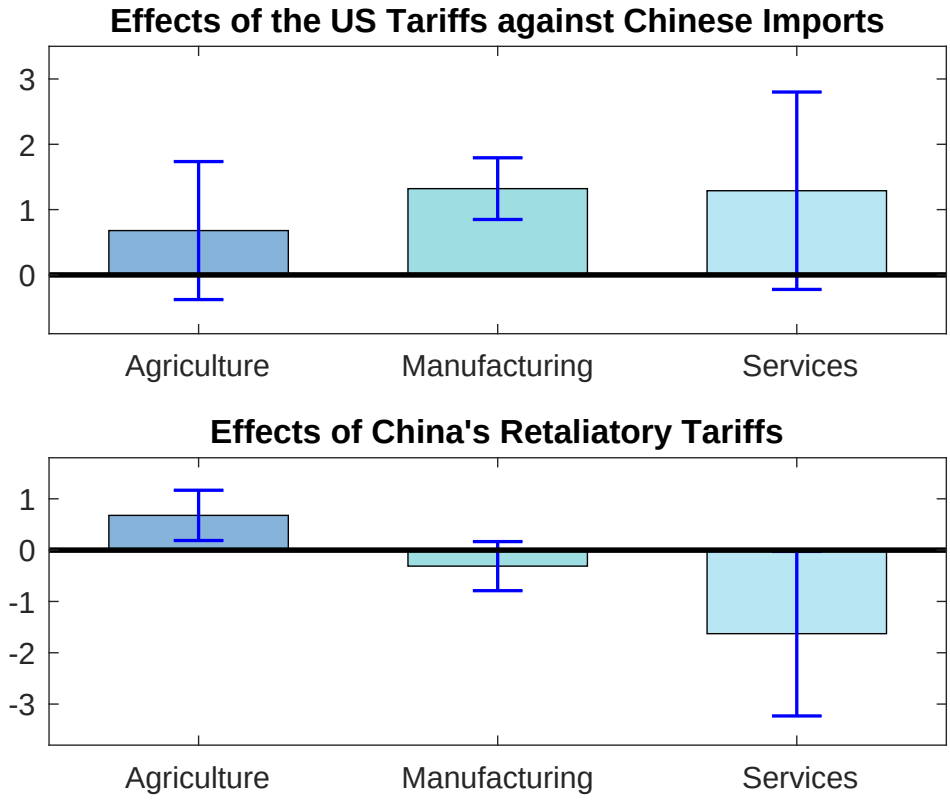


Figure A.8: Average Effects of the US-China Trade War across Sectors on GVC Firms' Exports

Notes: Estimation of equation A.1 separately across Agricultural, Manufacturing, and Services IMMEX companies. The dependent variable in all regressions is the logarithm of firm's export. All regressions include firm FEs, initial-firm-size by year FEs, and the other trade exposure variables as indicated in equation A.1. Bar heights indicate the respective coefficient values. Top figure depicts the coefficient values for the average effect over 2018-2021 of the heightened Chinese import protection in the US (TM^{US-CH}), and the bottom figure depicts the coefficient values for the average effect over 2018-2021 of China's retaliatory tariffs on the US goods (TX^{CH-US}). Robust SEs are clustered by firms and error bars indicate 95% confidence intervals. The numbers of observations are 2,309, 29,438, and 4,154 respectively in Agriculture, Manufacturing and Services regressions.

B Data Construction

We employ confidential transaction-level customs data, called COMEXT, that covers all export and import transactions of Mexican firms. The database is hosted by the secure data servers in the Econlab of Banco de Mexico. The values in the customs data are reported in free on board (FOB). The products are reported at the TIGIE classification which closely matches with the HS classification at the six-

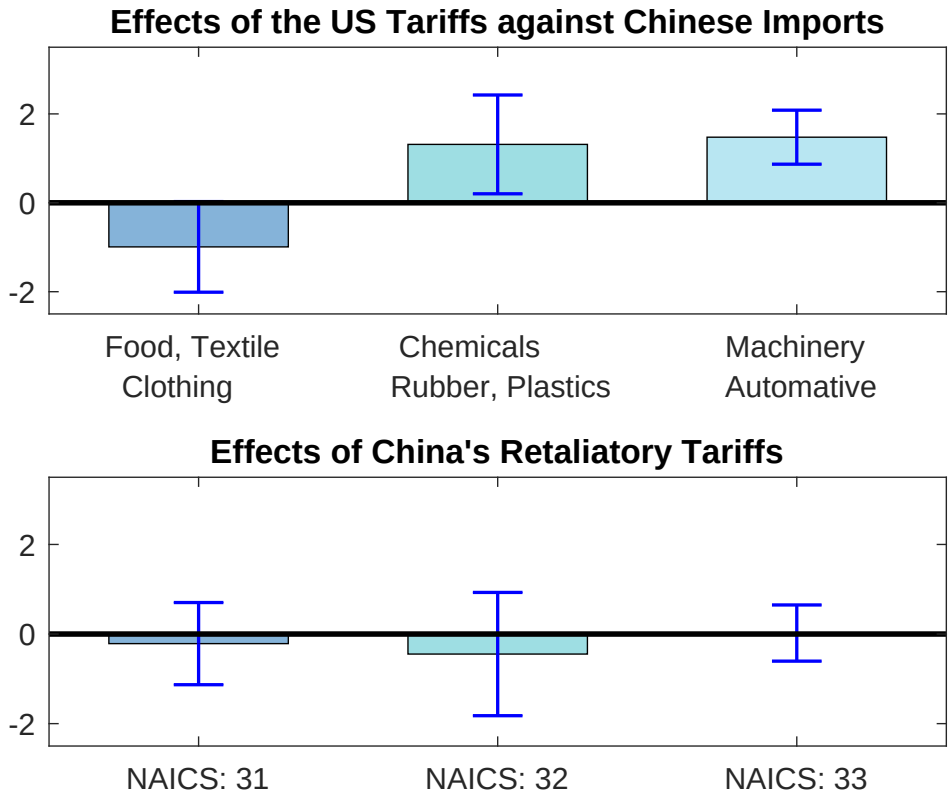


Figure A.9: Average Effects of the US-China Trade War across Manufacturing Industries on GVC Firms' Export

Notes: Estimation of equation A.1 separately across IMMEX companies operated in NAICS=31, 32, and 33. The dependent variable in all regressions is the logarithm of firm's export. All regressions include firm FEs, initial firm-size by year FEs, and the other trade exposure variables as indicated in equation A.1. Bar heights indicate the respective coefficient values. The top figure depicts the coefficient values for the average effect over 2018-2021 of the heightened Chinese import protection in the US (TM^{US-CH}), and the bottom figure depicts the coefficient values for the average effect over 2018-2021 of China's retaliatory tariffs on the US goods (TX^{CH-US}). Robust SEs are clustered by firms and error bars indicate 95% confidence intervals. The numbers of observations are 5,446, 4,539, and 20,234 respectively in NAICS=31, NAICS=32, and NAICS=33 regressions.

digit. We use the correspondence tables provided by Banco de Mexico to map TIGIE to HS.

We link the confidential transaction-level customs data with the six-digit products and country pairs subject to newly imposed import and export tariffs as part of the 2018/19 trade war. We use the datasets of tariff changes on US imports and exports in 2018 and 2019 as constructed by Fajgelbaum et al. 2020 and Fajgelbaum et al. 2021. Import tariff changes are reported at the Country-Month-HS-10 digit. We use the share of each HS-10 digit good in total US HS-6 digit import in the pre-trade war year, 2017, to collapse the data into the HS-6 digit level. Similarly, we collapsed retaliatory tariff

changes imposed on the US which are reported at the HS-8 digit level based on the US exports in the pre-trade war year. Based on the firms' HS-6 digit level import and export across different destinations as of 2016, we then identify affected firms and construct our firm-level measures of the trade war as described in Section 4.

C Legislative Environment for GVC participant firms: IMMEX

C.1 IMMEX Registry

The Secretariat of Economy (Secretaría de Economía) publishes monthly directories of firms that are registered under the IMMEX programs. IMMEX firms are required to submit annual reports of activity to the Secretariat of Economy and also sustain a minimum export amount (of 500,000 USD annually) to keep their IMMEX status. Failure to submit their annual operations report would allow the Ministry of Economy to suspend the IMMEX status of a firm and initiate a cancellation procedure which can result in eventual cancelation. The failure to meet the annual exports sales threshold would also lead to the cancellation of the IMMEX status.

We obtain the monthly directories that contain firms' names, addresses, as well as their tax identifiers, Registro Federal de Contibuyentes (RFC) from the Ministry of Economy (Secretaría de Economía).[18] The IMMEX registry has been updated by the government officials five to eight times per year between 2012 and 2015. Since 2016, they have been updated monthly. We use the unique tax identifiers of firms together with their names and addresses to identify IMMEX firms in COMEXT. Researchers are only permitted to work with customs data after the real tax id of firms are re-constructed, due to the sensitivity of this information that allows one to potentially identify a single firm. As a result, this merge has been completed on behalf of us by Banco de Mexico's Econlab personnel who can observe the raw data. Between 2012-2021, there were total of 14,519 firms registered in the IMMEX directories and 13,965 of them were identified (96%) in the COMEXT data.

C.2 Background Information: The Creation of IMMEX

The Program for Temporary Imports to Promote Exports (PITEX) was created in 1990 to provide a platform for Mexican domestic operations to better compete with maquiladoras. Plants that invoiced

[18] RFC is a unique registration number issued by Mexico's tax collection agency, SAT.

10 percent or more of their sales as exports could bring in raw materials duty-free but would have to re-export them as finished goods within a fixed time frame. Plants with 30 percent or more of sales as exports were qualified to bring in duty-free machinery and equipment. Essentially, Mexican plants under PITEX were receiving maquiladora-like benefits (Cañas and Gilmer, 2007).

The full implementation of NAFTA decreased the difference between the Maquiladora and the PITEX programs by removing domestic sales limitation on Maquiladoras and allowing for 100% foreign ownership. And, in 2007, the Ministry of Economy decided to merge the maquiladora and PITEX programs into a new program, called Maquiladora Manufacturing Industry and Export Services, or IMMEX Decree.

In Mexico companies are subject to both a 28 percent corporate income taxes net of expenses and a 16 percent value-added taxes on domestic purchases of inputs and imports. If maquiladoras certify that they function purely as a maquiladora for a foreign company with all the inventories owned by a foreign company then instead of paying 28 percent corporate income tax, they pay 3 percent income or asset tax, whichever is greater. Maquiladoras are also altogether exempt from the value-added tax on purchases (domestic or imports). Since the establishment of IMMEX, PITEX firms were also granted value-added tax exemption, yet the corporate tax differences still persists between foreign maquiladoras and PITEX firms.

With NAFTA, duty-free input was extended to other companies as long as the goods qualify the minimum North American content. But IMMEX firms are still granted additional benefits with respect to importing inputs, machinery and equipment to be used in the production. If importing from non-NAFTA/USMCA countries, IMMEX firms can delay duties until they re-export the final product that contains the import. They pay lower customs processing fees. They are exempt from duties altogether on imports as long as the final products go to outside the North American destination. If the final products go to the US, which is likely the case, or Canada, then IMMEX firms can benefit from some additional trade facilitation instruments, such as Regla Octava and can pay lower (preferential) duties on the non-North American content of their export.

PROSEC Firms and the Eighth Rule (Regla Octava) PROSEC is the Spanish acronym for *Programa de Promoción Sectorial* /Sectorial Promotion Program. The program establishes that authorized companies that manufacture goods for a particular sector can import certain, pre-specified goods to be used in their production using preferential tariff rates, regardless of whether the goods to be produced are for export or the domestic market. Unlike the IMMEX Program, which permits companies to carry out temporary imports with specific benefits in paying duties and value-added tax, the PROSEC Program's benefits only concern duties (not value-added taxes) regardless of the type of imports, whether temporary or not. PROSEC has the following 23 "sectoral programs":

- Food and Sugar
- Coffee
- Chocolates, confectionery and the like
- Mining and metallurgy
- Chemicals
- Pharmaceutical products, medicines, and medical equipment
- Photography
- Rubber and plastic articles
- Leather and hides and skins
- Wood
- Paper and paper board
- Textiles and clothing
- Footwear
- Iron and steel
- Agricultural machinery
- Electricity
- Electronics
- Automobiles and spare parts
- Transportation, except the automotive and spare parts sectors

- Toys and sports articles
- Furniture
- Miscellaneous industries
- Capital goods

Some inputs within each of the twenty-three sectors were specified under PROSEC, and companies registered under this program can import these pre-specified inputs at preferential rates ranging from 0 to 10 percent.

What is the Eighth Rule (Regla Octava)?

The "eighth rule" consists of a license issued by the Ministry of Economy that allows a company that has an authorized PROSEC program to use tariff items from Mexico's HS (TIGIE) heading 98 "special operations." The authorized companies may import machinery, equipment, materials, inputs, parts, and components at preferential tariff rates per the Ministry of Economy authorization. Companies that seek to benefit from the Eighth Rule must have their " manufacturing company certificate" that consists of its PROSEC registration. In other words, the company must have its PROSEC registration in order to access the preferential tariffs of the Eighth Rule.

This permit allows for the import of all types of goods to be used in a specific production project via a single tariff code that is exempted from the payment of import duties. We identify firms that import under the Eighth Rule based on the customs data as we see if firms import any goods under the heading of "special operations". As any firm with the Eighth Rule permit has to have a PROSEC registration, this way we also identify PROSEC firms. We should note that our PROSEC identification does not capture a PROSEC firm if that firm does not utilize the Eighth Rule. IMMEX firms benefit from the Eighth Rule for their non-NAFTA/USMCA import contents when they are exporting to NAFTA countries.

Appendix Bibliography

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