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From Final Goods to Inputs: The Protectionist Effect of Rules of Origin[†]

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Recent decades have witnessed a surge of trade in intermediate goods and a proliferation of free trade agreements (FTAs). FTAs use rules of origin (RoO) to distinguish goods originating from member countries from those originating from third countries. We focus on the North American Free Trade Agreement (NAFTA), the world's largest FTA, and construct a unique dataset that allows us to map the input-output linkages in its RoO. Exploiting cross-product and cross-country variation in treatment over time, we show that NAFTA RoO led to a sizable reduction in imports of intermediate goods from third countries relative to NAFTA partners. (*JEL* F13, F15, F23, L14, O19)

Recent decades have witnessed the rapid emergence of global value chains. Increasingly, production processes are fragmented across countries, and firms source their inputs from suppliers around the world. As a result, trade in intermediate goods now accounts for as much as two-thirds of international trade (Johnson and Noguera 2012a).

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These developments have motivated recent studies of firms' sourcing decisions (e.g., Antràs, Fort, and Tintelnot 2017).[1] These studies abstract from the role of government policies. In particular, they do not take into account a second important trend that has characterized recent decades: the proliferation of regional trade agreements.[2] This trend can help to explain why global value chains are actually regional in nature (Baldwin 2013). Regional trade agreements allow substantial trade liberalization among members, without the need to reciprocate to other GATT/WTO contracting parties.[3] Around 90 percent of regional agreements are free trade agreements (FTAs) and partial scope agreements, with customs unions accounting for the remaining 10 percent.

FTAs can clearly distort sourcing decisions through preferential tariffs: inputs imported from FTA partners face lower tariffs than inputs imported from third countries. This channel has been well documented in studies of the trade and welfare effects of regional agreements. For example, Caliendo and Parro (2015) examine the impact of preferential tariff changes among members of the North American Free Trade Agreement (NAFTA). They find little evidence of trade diversion and conclude that "the rest of the world was hardly affected by NAFTA's tariff reductions" (p. 25). However, these studies neglect a second key channel through which FTAs can also distort trade in intermediates: preferential rules of origin (RoO). FTAs employ these rules to distinguish goods originating from member countries from those originating from third countries. In principle, RoO are meant to prevent trade deflection, i.e., to ensure that goods being exported at preferential rates from one FTA partner to another truly originate from the area and are not simply assembled from components originating from third countries. In practice, they also prevent final good producers from choosing the most efficient input suppliers around the world, in order to avoid losing origin status and the tariff preference it confers. In this paper, we show that preferential RoO compound the trade-diversion effect of preferential tariffs, further deterring imports of intermediate goods from non-member countries.

The increasing fragmentation of production processes across countries makes it difficult to define the origin of a good. Between the "conception" of a product and its "delivery" to the final consumer, a wide range of activities are involved (e.g., manufacturing, assembly, packaging, and transport), which might involve intermediate goods imported from different countries. FTAs often define origin based on tariff classification shifts, i.e., changes in the Harmonized System (HS) product classification codes (at the chapter, heading, or subheading level) with respect to its inputs. RoO based on changes in tariff classification imply that, for a

[1] Antràs, Fort, and Tintelnot (2017) analyze the margins of global sourcing. In their model, firms determine from which countries to source inputs. A firm can add one country to the set of countries from which it is able to import, but this requires incurring a market-specific fixed cost. As a result, relatively unproductive firms opt out of importing from countries that are not particularly attractive sources of inputs. A related study by Blaum, Lelarge, and Peters (forthcoming) uses a multi-country quantitative model to study the effect of imported inputs on firm-level and aggregate productivity.

[2] As of June 20, 2017, 279 RTAs were in force. These correspond to 445 notifications from WTO members, counting goods, services, and accessions separately (WTO Secretariat).

[3] Regional trade agreements constitute an exception to Most Favored Nation (MFN) principle stipulated by Article I of the GATT, according to which a country should grant equal treatment to all imported goods, irrespective of their origin. Preferential agreements are allowed under Article XXIV of the GATT (or under the Enabling Clause for trade agreement involving developing countries).

final good to be eligible for preferential tariff treatment, the production or sourcing of some of its inputs must take place within the FTA.[4]

Rules of origin constrain sourcing decisions. A final good producer faced with RoO restrictions has two options. It can comply with the rules, in which case it can export to the FTA partners at preferential tariff rates, but must source certain inputs within the FTA. Or it can decide not to comply with the rules, in which case it can source its inputs from any supplier around the world, but faces MFN tariffs when exporting to the FTA partners. The benefits of complying with RoO are larger when the preferential margin, the difference between the MFN tariff and the preferential tariff applied by the FTA partners to the final good, is larger. RoO have thus a "cascade effect," shifting protection from final goods to intermediate inputs.[5] The presence of RoO implies that the tariffs on final goods are part of the implicit cost of importing intermediate goods. The effective rate of protection on these goods can thus be much higher than that implied by the level of input tariffs.

Several theoretical studies have emphasized that RoO can give rise to trade diversion in intermediate goods (e.g., Grossman 1981; Falvey and Reed 1998). On the empirical front, however, direct evidence of this effect has been lacking, due to the legal complexity of the rules. As stressed by Cadot et al. (2006, p. 150), while the "theoretical analysis of rules of origin has made considerable strides... their empirical analysis is still in its infancy." To the best of our knowledge, this is the first paper to study the impact of RoO on trade in intermediate goods.

To carry out our analysis, we focus on NAFTA, the world's largest FTA, linking 444 million people producing $17 trillion worth of goods and services.[6] The focus on NAFTA is due to the specific features of its RoO. First, the rules contained in NAFTA are written at a disaggregated level, with specific rules for each product. Second, they are mostly defined in terms of changes of tariff classification, which are in some instances combined with valued added rules.[7] These features allow us to construct a unique dataset, which maps the input-output linkages embedded in NAFTA RoO. For every final good, we can trace all the inputs that are subject to RoO requirements. Similarly, we can link every intermediate good to the final goods that impose RoO restrictions on its sourcing.

To capture the effect of RoO, we construct different treatment variables. For each intermediate good, we first consider all final goods that have RoO restricting the sourcing of that particular input. We next exclude rules associated with final goods with zero preference margin. These rules should have no impact on sourcing decisions, given that final good producers have nothing to gain by complying with

[4] For example, the RoO contained in NAFTA stipulate that watches (heading 91.02 in the HS classification) must undergo change of HS chapter, i.e., non-originating inputs must not fall under HS chapter 91. This rule implies that watches can only be traded duty free among NAFTA members if the watch movements (HS 91.08), watch straps (HS 91.13), and watch cases (HS 91.12) used to produce them are sourced from producers located within the FTA.

[5] Going back to the example above, the higher the MFN tariff applied by NAFTA members on imports of the final good (watches), the stronger the incentives to comply with RoO, and thus the greater the potential for trade diversion in intermediates (watch movements, straps, and cases).

[6] http://www.trade.gov/mas/ian/tradeagreements/fta/tg_ian_002425.asp.

[7] Alongside tariff classification shift rules, FTAs may contain value added rules (requiring that the last production process has created a certain percentage of value added content) or technical tests (which set out certain production activities that may or may not confer originating status).

them. We then further exclude flexible rules, i.e., instances in which final good producers can qualify for origin by meeting a value added requirement.

We investigate the impact of NAFTA RoO on imports of intermediate goods from non-member countries. Like other trade policies, RoO can be influenced by lobbying pressure.[8] If policymakers manipulate RoO to protect domestic producers, we would expect them to set stricter rules in sectors characterized by a stronger increase in import competition. Crucially, this type of endogeneity would make it harder to find evidence for the trade-diverting effect of RoO.

We focus our analysis on Mexico, for which NAFTA RoO were to a large extent inherited from those included in CUSFTA negotiated years earlier between the United States and Canada (around 90 percent of the NAFTA rules were already present in CUSFTA). To the extent that some of the modifications introduced during the NAFTA negotiations reflected pressure by Mexican import-competing producers, our estimates should be biased downward.

To study the impact of NAFTA RoO, we estimate triple-difference regressions, exploiting variation in treatment across both products and countries over time. This approach allows us to account for product-level and country-level trends in Mexican imports, which might be correlated with the RoO variables. In particular, we examine changes in the growth rate of Mexican imports between 1991 and 2003 (before and after the entry into force of NAFTA). We compare changes in imports of "treated" and "non-treated" goods, depending on whether they were subject to NAFTA sourcing restrictions (and on the extent of these restrictions). We also use cross-country variation in treatment, exploiting the fact that imports from third countries were subject to RoO restrictions, while imports from NAFTA partners were not.

Our results show that NAFTA RoO on final goods reduced the growth rate of Mexican imports of intermediates from third countries relative to NAFTA partners. As expected, the size of the effect depends on the extent to which Mexican producers had incentives to comply with them (i.e., the size of the preference margin and the importance of NAFTA export markets) and whether the sourcing restrictions were strict or flexible (i.e., whether change in tariff classification rules were combined with alternative value added rules). The results are robust to using alternative methodologies to construct the dependent and control variables, using different samples of goods and countries, and instrumenting NAFTA RoO with those contained in CUSFTA.

In terms of magnitude, our estimates imply that RoO decreased the growth rate of imports of affected goods from third countries relative to NAFTA partners by around 48 log points on average (representing around 45 percent of the actual change in imports of treated goods). Comparing the effect of different treatment variables, we find that trade-diversion was driven by rules that are both relevant (i.e., final good producers have something to gain by complying with them) and strict (i.e., origin can only be obtained if the restricted inputs are sourced within NAFTA).

[8] As pointed out by Chase (2008), RoO are highly susceptible to industry capture, for various reasons. First, negotiators need not set a single standard: rules can vary across products, allowing trade negotiators to devise carefully crafted measures that please domestic producers. Second, RoO are obscure and highly technical measures. If trade negotiators lack the necessary technical background, they are likely to rely on industry representatives for advice on how to draft them.

The rest of the paper is organized as follows. Section I reviews the related literature. In Section II, we present a brief overview of the history of NAFTA. In Section III, we describe the data and variables used in our empirical analysis. Section IV presents our empirical results. The last section concludes.

I. Related Literature

As mentioned above, there is a relatively vast theoretical literature on the impact of rules of origins. Early studies have been concerned with content protection, investigating the effects of host government requirements that foreign firms use a certain proportion (measured by quantity or value) of host country inputs for their output to be sold in the host market (e.g., Grossman 1981; Dixit and Grossman 1982; Vousden 1987). More recent studies focus directly on the effects of preferential rules of origin in FTAs. Krishna and Krueger (1995) stress the potential hidden protectionism of RoO, showing that they can induce a switch in the sourcing from low-cost non-regional to high-cost regional inputs in order for final good producers to take advantage of the preferential rates. Falvey and Reed (1998) analyze the impact of RoO on final good production and sourcing decision under different scenarios. They conclude that RoO distort resource allocation if final good producers can obtain preferential benefits by modifying their input mix in order to satisfy RoO requirements. Ju and Krishna (2005) study firms' incentives to comply with RoO. They describe a three-country model with heterogeneous firms. They show that two regimes can arise, depending on the level of the intraregional intermediate good price: a homogeneous regime (in which all final good producers conform to RoO requirements/do not conform to RoO requirements) and a heterogeneous regime (in which some final good producers conform to RoO requirements but others do not).

The empirical literature on RoO is limited, due to the legal complexity of the rules, which makes measurement difficult. Several papers examine the impact of RoO on trade flows (e.g., Carrère and de Melo 2006). To capture the restrictiveness of RoO, most of these studies use synthetic indices like the one constructed by Estevadeordal (2000), which do not allow to capture vertical linkages between goods.[9] To the best of our knowledge, this is the first paper to map input-output linkages in preferential RoO and examine the impact of these sourcing restrictions on trade in intermediates.[10]

A few studies focus on the political economy determinants of RoO. Cadot et al. (2006) examine the impact of lobbying by US intermediate good producers on rules of origin in upstream sectors. In the spirit of Grossman and Helpman (1995), Duttagupta and Panagariya (2007) show that trade-diverting RoO can help to make FTA politically acceptable. Other studies focus on the interests of downstream producers. Chase (2008) argues that some final good producers

[9] The index constructed by Estevadeordal measures the restrictiveness of preferential rules of origin from 1 (least restrictive) to 7 (most restrictive). Its construction is based on the assumption that a change in classification rule is less restrictive than a value added rule, which in turn is less restrictive than a technical requirement.

[10] Bombarda and Gamberoni (2013) distinguish between intermediate and final goods, but focus on cumulation rules (defining the geographic area from which inputs can be sourced and still be considered as originating in a FTA).

will want lenient rules of origin to accommodate foreign sourcing of inputs, while others might prefer tough rules to block foreign entrants. These studies suggest that the stringency of rules of origins in a given sector may be systematically linked to the trade policy interests of leading producers in that sector. This raises concerns about the endogeneity of RoO. We address these concerns in two ways. First, we focus on Mexico, exploiting the fact that NAFTA RoO were largely inherited from those contained in the FTA signed in 1988 between the United States and Canada. Second, we employ a triple-difference approach, which allows us to account for product-level trends.

Our work builds on the literature that examines the impact of preferential trade agreements. In particular, it is related to recent studies that assess the effects of NAFTA on trade and welfare. Kehoe and Ruhl (2013) focus on changes in trade patterns driven by countries starting to export goods that they had not exported before. They find that the extensive margin is a crucial factor in explaining the increase in trade after trade liberalizations. On average, it accounts for 9.9 percent of the growth in trade for the NAFTA country pairs. Caliendo and Parro (2015) build on Eaton and Kortum (2002) to develop a tractable model of tariff policy evaluation, which allows to decompose and quantify the differential role of intermediate goods and sectoral linkages. They find that the welfare effects of NAFTA were heterogeneous across members (Mexico's welfare increased by 1.31 percent, US's welfare increased by 0.08 percent, and Canada's welfare declined by 0.06 percent) and that the trade created between members was larger than the trade diverted from third countries. These studies abstract from the role of preferential RoO. Our analysis shows that, when accounting for these sourcing restrictions, the trade-diversion effect of NAFTA was large.

Our analysis also contributes to the literature on third-country effects of discriminatory trade policies. Winters and Chang (2000) examine the impact of preferential trade agreements on members' and excluded countries' export prices using the Spanish entry into the EC as a case study. Chang and Winters (2002) show that the creation of MERCOSUR led to significant declines in the prices of non-members' exports to the bloc. Bown and Crowley (2007) examine whether a country's use of an import-restricting trade policy distorts a second country's exports to third markets. Bown and Crowley (2006) study the impact of US antidumping duties on Japanese exports to the United States and the European Union.

Finally, our paper is related to recent work motivated by the emergence of global value chains. Several papers use input-output tables to calculate the domestic value added of exports (e.g., Johnson and Noguera 2012a; Koopman, Wang, and Wei 2014). Focusing on China, Kee and Tang (2016) find that the domestic value added ratio of its exports increased by more than 10 percent over 2000–2006. This was the result of firms substituting domestic inputs for imported inputs, due to an expansion of domestic input variety triggered by decreasing tariffs and increasing foreign direct investment (FDI). Related contributions use input-output tables to measure the distance of an input relative to final demand (Antràs et al. 2012; Antràs and Chor 2013) or to construct an industry-pair specific measure of upstreamness (Alfaro et al. forthcoming). Some studies combine input-output tables with information on the production activities of firms operating in many countries and industries to study vertical integration choices (e.g., Alfaro et al. 2016).

II. Brief History of NAFTA

The North American Free Trade Agreement (NAFTA) superseded the Canada-United States Free Trade Agreement (CUSFTA), which was signed in 1988 by Canada and the United States to eliminate tariffs and other trade restrictions over a ten-year period. In 1990, Mexico approached the United States with the idea of forming a free trade agreement. Mexico's main motivation in pursuing an FTA with the United States was to stabilize the Mexican economy and promote economic development by attracting foreign direct investment (Villarreal 2010).[11] Canada joined the negotiations the following year, with the goal of creating one free trade area in North America.

NAFTA was signed in 1992 by Canada, Mexico, and the United States and entered into force on January 1, 1994. NAFTA rules of origin were applied as soon as the agreement took effect in January 1994. By contrast, only approximately 50 percent of the internal tariffs were abolished in 1994; most of the remaining tariffs were phased out during the following 5 to 10 years.

As the smaller members, Mexico and Canada have less diversified trade partners than the United States and rely more on NAFTA for their exports and imports. For example, in 2011, 52.59 percent of Mexican imports and 81.72 percent of Mexican exports took place within NAFTA, while the corresponding shares for the United States were 25.83 percent and 32.32 percent.

In our empirical analysis, we examine the impact of NAFTA RoO on final goods on Mexican imports of intermediates from third countries. As mentioned in the introduction, NAFTA RoO can be taken as exogenous from the point of view of Mexico. There are two main reasons for this. First, the rules contained in NAFTA were largely inherited from those contained in the Canada-US Free Trade Agreement. Second, to the extent that RoO were modified during the NAFTA negotiations, Mexico had little power to affect such changes. As in the CUSFTA negotiations, the predominant role was played by the United States, by far the largest FTA member: in some sectors, US negotiators pushed for stricter rules, under the pressure of producers that were subject to strong import competition.[12] In other sectors, the United States pushed for more lenient rules, under the pressure of firms that were highly dependent on multinational supply chains.[13] During the NAFTA negotiations, the interests of the United States often prevailed over those of its smaller trading partners. For example, Mexico pushed without success for less stringent rules of origin

[11] During the 1980s, Mexico was marked by inflation and economic stagnation. The 1982 debt crisis, in which the Mexican government was unable to meet its foreign debt obligations, was a primary cause of the economic problems the country faced in the early to mid-1980s. Much of the government's efforts in addressing the challenges were placed on privatizing state industries and moving toward trade liberalization. In the late 1980s and early into the 1990s, the Mexican government implemented a series of measures to restructure the economy, including steps toward unilateral trade liberalization and accession to the General Agreement on Tariffs and Trade (GATT) in 1986.

[12] For example, this was the case of the automobile industry, in which US producers were concerned about competition from Japanese and European companies with plants in North America; and the textile industry, in which the US producers wanted to ensure that the Mexican apparel industry would use US (rather than Chinese) textiles for NAFTA production (Puccio 2013).

[13] This was the case of IBM, which pushed to allow for lenient rules on inputs sourcing in the computer industry.

in the car and textile industries, to remain an attractive location for assembly operations of European, Japanese, and other East-Asian companies.[14]

III. Data and Variables

This section describes the data we use and the construction of the key variables. We start by describing our new dataset on NAFTA RoO, and the treatment variables we construct to examine the impact of these sourcing restrictions on trade in intermediates. We then move to the description of the other trade data and variables used in our empirical analysis. The definition of all the variables used in our empirical analysis, as well as the sources used to construct them, can be found in Table A1 in the Appendix.

A. *NAFTA Rules of Origins*

The rules of origin contained in Annex 401 of NAFTA determine the conditions under which goods imported from the member countries are eligible to receive preferential tariff treatment.

As mentioned in the introduction, two features of NAFTA RoO make them appealing for our purposes. First, they are written at a very disaggregated level, with specific rules applying to each product (defined using the HS classification at the four- or six-digit level). Second, they are mostly defined in terms of tariff classification changes, which impose sourcing restrictions on a set of inputs (at the two-, four-, or six-digit level of the HS classification). In NAFTA, value added (VA) rules are only used in combination with change of classification rules.[15] This is not the case for other FTAs, in which VA rules are predominant (e.g., free trade agreements between the European Union and third countries). In the case of value added rules, different input mixes can achieve the same value added, making it harder to identify the restricted inputs.

As an example, consider a textile apparel falling under HS heading 6203.42 (men's or boys' trousers, made of cotton). NAFTA rules of origin for this product require the following:

> *Change[s] to subheadings 6203.41 through 6203.49 from any other chapter, except from headings 5106 through 5113, 5204 through 5212, 5307 through 5308 or 5310 through 5311, chapter 54, or heading 5508 through 5516, 5801 through 5802 or 6001 through 6002, provided that the*

[14] Since 1965, Mexico had implemented the maquiladora program, permitting the establishment of foreign-owned subsidiary plants in Mexico for the assembly, processing, and finishing of duty free foreign materials and components into products for export. The maquiladora program allowed the duty free importation of all machinery, equipment, raw materials, replacement parts, and tools used by a foreign firm in the assembly/processing operation. Following the introduction of NAFTA RoO, Mexico had to modify its maquiladora program, terminating its duty drawback policy for exports under NAFTA.

[15] In some cases, VA rules are written as an alternative to change of classification rules, i.e., producers are given the choice between complying with the tariff shift required by a change of classification rule or with a value added requirement. In other cases, VA are complementary to change of classification rules, i.e., producers have to comply with both requirements (for more details, see Puccio 2013).

good is both cut and sewn or otherwise assembled in the territory of one or more of the NAFTA parties.

We can divide the rule into two parts. The first part ("A change to subheadings 6203.41 through 6203.49 from any other chapter") is the main rule applying to final goods in the range between 6203.41 and 6203.49 (which includes men's or boys' trousers) and requires an HS chapter change, i.e., any non-originating input must be sourced outside the chapter of the final good. In other words, any input falling within chapter 62 must be sourced within NAFTA for the trousers to obtain origin status. The second part (from "except from headings 5106 through 5113" until the end) imposes additional requirements: any input falling into the listed tariff items must also be sourced within NAFTA, even though these products don't fall under the same chapter as the trousers.[16]

In this example, there is no VA alternative rule of origin applying to HS 6203.42. This implies that producers of trousers will have to source *all the restricted inputs* within NAFTA if they want to qualify for origin. If they import from outside the FTA any of the restricted inputs, no matter the value of the imports, they are denied origin and have to face MFN tariffs instead of preferential tariffs when exporting to NAFTA partners. For example, in 2001 a Mexican producer of trousers did not obtain origin because he had imported one of the restricted fabrics (cotton yarn, falling under heading 5205) from the Philippines. To comply with NAFTA RoO, the Mexican producer should have sourced this fabric within the FTA.[17] As a result, the Mexican producer had to face MFN tariffs of 9.2 percent and 17.5 percent when exporting to the United States and Canada respectively (instead of preferential tariffs of 0 percent for both countries).

Customs officials in the United States, Canada, and Mexico use the NAFTA Certificate of Origin to establish if the goods imported from their NAFTA partners receive MFN or reduced duties. The Certificate must be completed by the exporter and sent to the importer (see online Appendix Figure I for the English version). While this document does not have to accompany the shipment, the importer must have a copy in its possession before claiming the NAFTA tariff preference at customs. In the absence of the Certificate, MFN tariff rates are applied.

NAFTA RoO are very difficult to bypass. In order to obtain origin status, producers must obtain from their suppliers all the relevant information to show that production of their final good satisfies the rules set out in Annex 401. In case of verification, producers must have all the record keeping in line with the requirements of NAFTA and be able to prove the origin of all their intermediate inputs. Failure to submit the Certificate of origin and the supporting documentation upon request results in the importing NAFTA partner denying preferential tariff treatment. Material false statements, acts or omissions, or failure to maintain and provide records, may result in civil or criminal penalties, including penalties for fraud and negligence.

[16] In general, additional requirements can be divided into two categories: those written at the Harmonized Schedule level, i.e., at the chapter, heading, or subheading level and those written at the national schedule level, i.e., at the eight-digit level and, for the United States, at the eight- or ten-digit level. Those requirements written at the Harmonized Schedule level apply to all partners, while those written at the national level apply only to goods exported to that partner.

[17] Details of this ruling (HQ 562266) and other rulings issued by the US Department for Customs and Border Protection can be found in the Customs Rulings and Border Protection Online Search System (rulings.cbp.gov).

Avoiding NAFTA RoO is also hard because the rules contained in Annex 401 are such that, when there are rules that restrict the sourcing of some inputs necessary to produce a particular final good, there are also rules on the restricted inputs. Consider again the example of the Mexican producer of trousers who was denied origin because he had imported cotton yarn, one of the restricted inputs, from the Philippines. To obtain origin, the Mexican producer of trousers might be tempted to import fabrics similar to cotton yarn from third countries and claim origin after making minor modifications. However, cotton yarn is itself subject to a change of chapter rule plus additional requirements, which means that the sourcing of those other fabrics would be restricted too. The correlation between RoO on final goods and RoO on the restricted inputs is 0.98.[18]

Our goal is to examine the impact of RoO on final goods on trade in intermediates. To this purpose, we have constructed a dataset that codifies all the change of tariff classification requirements (main rule and additional requirements) contained in Annex 401.[19] We have also coded whether rules on change in tariff classification are combined with alternative or complementary VA rules. In total, our dataset contains more than 700,000 input-output pairs defining rules of origin. This dataset allows us to link each final good to all the intermediate inputs that must be sourced within NAFTA for the final good to obtain origin. Similarly, we can link each intermediate good to all the final goods that impose restrictions on its sourcing.

Using this dataset, we define the dummy variable $RoO_{i,j}$, which is equal to 1 if there is a RoO on final good i that restricts the sourcing of intermediate good j. Figure 1 provides a graphical representation of the sourcing restrictions contained in Annex 401, by plotting all the dummy variables $RoO_{i,j}$. Outputs i are on the horizontal axis, whereas inputs j are on the vertical axis. Almost all intermediate goods have rules of origin associated to several outputs and most of them with outputs that fall into the same sector category. As shown in Figure 2, in many cases, there are hundreds or even thousands of RoO within each of the dots in Figure 1.

Rules of origin should only affect sourcing decisions when they apply to vertically related goods, i.e., if the restricted good j is actually used as an input in the production of final good i. To verify this, we have matched the data on NAFTA RoO with the direct requirements input-output tables provided by the Bureau of Economic Analysis (BEA).[20]

To capture the impact of NAFTA RoO on imports of intermediate good j, we count the number of sourcing restrictions that apply to this good, i.e., $RoO_j = \sum_i RoO_{i,j}$. This approach is justified by the way in which NAFTA RoO are written. The fact that the origin of products is defined in terms of detailed change of tariff classification rules implies that *all* restricted inputs must be sourced within NAFTA to obtain origin. In turn, this implies that the impact of RoO should not depend on the

[18] This number is computed by correlating the number of RoO on a final good i with the average number of RoO across the restricted inputs j used to produce good i.

[19] Trade flows are expressed at the six-digit HS level. We have converted all RoO to six digits, expanding those written at the two- or four-digit level and dropping rules written at the national eight- or ten-digit levels.

[20] In particular, we use the direct requirement matrix provided in the 1997 Benchmark Input-Output Accounts. In contrast to earlier versions, this table is constructed based on an industry classification similar to NAIC97. We match industries from this classification to HS6 products by using the concordance table provided by the BEA. See Section A of the online Appendix for more details.

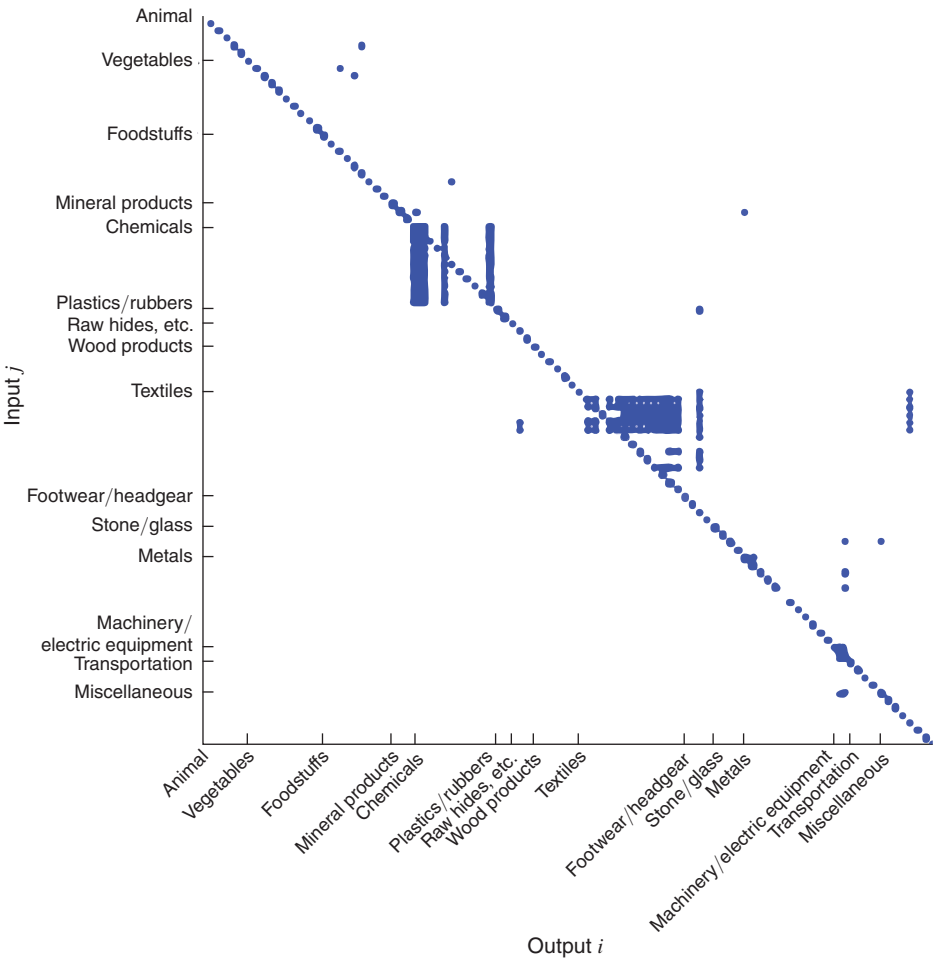


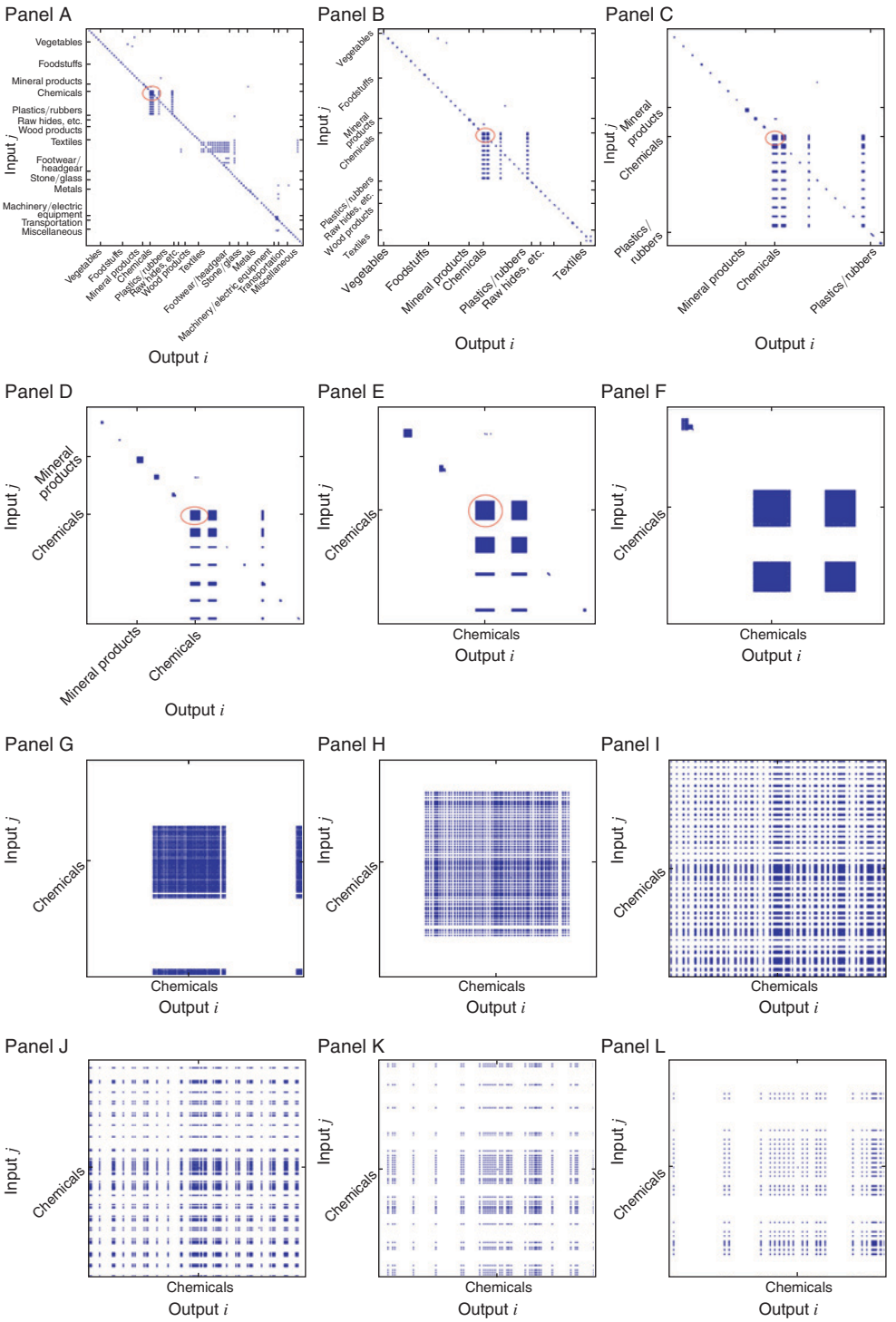
FIGURE 1. NAFTA RULES OF ORIGIN (RoO_{ij})

Notes: This figure provides a graphical representation of NAFTA rules of origin. Outputs i are on the horizontal axis and inputs j are on the vertical axis. Each dot corresponds to $RoO_{ij} = 1$, i.e., a rule on final good i that imposes sourcing restrictions on intermediate good j.

importance of the restricted inputs in the production of the final good. In robustness checks, we weight each $RoO_{i,j}$ dummy by the requirement coefficient $dr_{i,j}$.[21]

We construct three different versions of the RoO treatment variable. Treatment RoO_j^1 includes all rules on final goods i restricting the sourcing of j; RoO_j^2 excludes rules that Mexican producers have no incentives to comply with, given that the preference margin on their final good is 0. Our preferred treatment, RoO_j^3, further excludes rules that do not impose strict sourcing restrictions, i.e., instances in which final good producers can obtain origin status by complying with alternative VA rules.

[21] Instead of using simple count measures, we could construct the treatment variables as shares, taking into account the number of industries that use j as an input. However, this normalization would be redundant in our empirical analysis: our approach allows us to control for time-invariant product characteristics (at the HS6 level); the number of industries that use j as an input is thus already accounted for (at least to the extent that technology is not varying during our sample period).



(*Continued*)

FIGURE 2. NAFTA ROO: ZOOMING INTO FIGURE 1

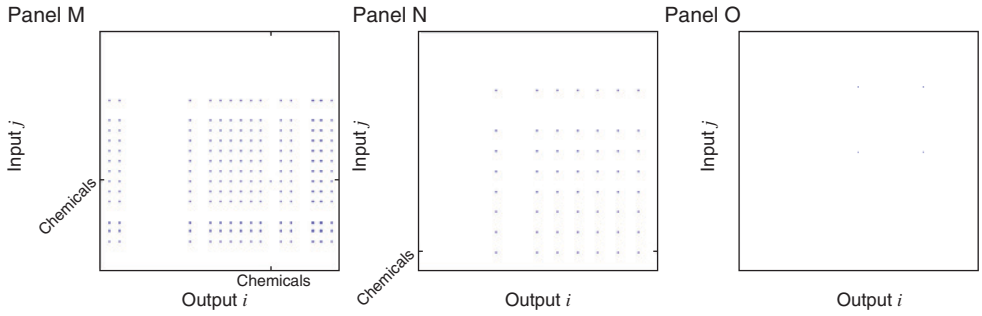


FIGURE 2. NAFTA ROO: ZOOMING INTO FIGURE 1 (*Continued*)

Table 1 provides descriptive statistics of these variables. For each sector, we report the mean, standard deviation, minimum, and maximum of the number of RoO_j^x, as well as the percentage of final goods subject to different types of rules. Notice that most intermediate goods are subject to some sourcing restrictions (i.e., the variable RoO_j^1 is positive for close to 100 percent of the goods in each sector). Chemicals and textiles are the sectors with the highest prevalence of RoO when considering all rules (panel A). When we exclude final goods with zero preference margin from our measure (panel B), the total number of rules decreases by around 132,000. When we exclude instances in which producers can obtain origin by complying with alternative value added rules, the total number of rules decreases further (panel C). This drop is mainly driven by chemicals, for which the average number of restrictions falls from 449.82 to 2.00 when considering only strict rules. Table V in the online Appendix provides similar statistics on the RoO that apply to final goods *i*.

To get a sense of how often RoO apply to vertically related goods, we randomly match each IO six-digit commodity with one of the associated HS six-digit goods in the concordance table provided by the BEA. Each randomization generates an input-output table expressed in HS6 codes.[22] Using the input-output tables thus constructed, we verify whether RoO on a good *i* impose restrictions on goods *j* that are actually inputs in the production of *i*. For each converted input-output table and each rule RoO_{ij}, we check whether *i* and *j* are vertically related, i.e., whether the direct requirement coefficient dr_{ij} is positive.

We can apply this procedure to different types of RoO, depending on how broadly they are defined in Annex 401. Not surprisingly, we find that change of tariff classification rules that are written at a more disaggregated level are more likely to apply to goods that are actually inputs in the production of the final good. On average, rules written at the chapter level (HS2) apply to vertically related goods in around 50 percent of the cases. For rules written at the heading level (HS4), the number increases to 68 percent. The highest percentage is found for rules written at the subheading (HS6) level (96 percent).

[22] We repeat the procedure 1,000 times, to make sure that our results are stable across randomizations. The input-output tables constructed using this procedure do not contain all goods and thus cannot be used in our empirical analysis. See Section A in the online Appendix for details on how we construct the input-output tables used in our regressions.

TABLE 1—DESCRIPTIVE STATISTICS ON NAFTA ROO

	Panel A. RoO_j^1				Panel B. RoO_j^2				Panel C. RoO_j^3			
HS	Mean	Min	Max	%	Mean	Min	Max	%	Mean	Min	Max	%
01–05: animal products	57.69	15.00	87.00	100.00	18.11	5.00	24.00	100.00	18.11	5.00	24.00	100.00
06–15: vegetables	40.15	0.00	57.00	99.37	23.65	0.00	43.00	99.37	23.65	0.00	43.00	99.37
16–24: foodstuffs	23.73	0.00	44.00	99.44	18.60	0.00	37.00	99.44	18.60	0.00	37.00	99.44
25–27: mineral products	54.36	0.00	74.00	98.82	13.64	0.00	32.00	98.82	13.64	0.00	32.00	98.82
28–38: chemicals	559.02	0.00	591.00	99.73	449.82	0.00	483.00	99.73	2.00	0.00	33.00	48.74
39–40: plastics/rubbers	21.04	1	61	100	12.90	0	36	97.88	10.90	0	30	86.77
41–43: raw hides, skins, leathers	21.39	9.00	34.00	100.00	18.82	4.00	30.00	100.00	18.82	4.00	30.00	100.00
44–49: wood products	39.04	0.00	93.00	99.11	28.26	0.00	77.00	81.33	28.26	0.00	77.00	81.33
50–63: textiles	280.21	4.00	722.00	100.00	276.66	1.00	715.00	100.00	276.66	1.00	715.00	100.00
64–67: footwear/headgear	17.02	2	29	100	16.51	1	29	100	16.51	1	29	100
68–71: stone/glass	37.38	0.00	57.00	99.47	27.57	0.00	52.00	99.47	27.57	0.00	52.00	99.47
72–83: metals	40.30	0.00	96.00	93.97	33.53	0.00	81.00	92.41	33.32	0.00	81.00	92.41
84–85: machinery/electrical	8.79	0	65	99.08	5.10	0	63	82.68	4.54	0	58	79.27
86–89: transportation	9.54	1.00	22.00	100.00	8.30	0.00	20.00	90.91	5.62	0.00	20.00	90.91
90–97: miscellaneous	20.00	0.00	44.00	99.48	15.63	0.00	41.00	99.48	14.02	0.00	41.00	99.48
All sector categories	148.89	0.00	722.00	98.92	124.87	0.00	715.00	95.13	57.25	0.00	715.00	86.54
Total number of RoO	746,393				625,967				287,016			

Notes: The table provides descriptive statistics of our treatment variables. For each sector, we report the mean, minimum, and maximum of the number of sourcing restrictions imposed on intermediate goods in those sectors, as well as the percentage of intermediate goods subject to sourcing restrictions. In this table, RoO_j^x is the number (in levels) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which *Preference Margin NAFTA*$_i = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules.

In our empirical analysis, we will include all rules contained in Annex 401 of NAFTA, using input-output coefficients to exclude rules that do not apply to vertically related goods.

B. *Other Trade Data and Variables*

In our empirical analysis, we will study the effects of NAFTA RoO on changes in Mexican imports from third countries relative to imports from NAFTA partners. The source of the trade data is the World Integrated Trade Solution (WITS). We choose 1991 as the start year of our analysis, because this is the latest year before NAFTA came into force for which WITS provides data on Mexican imports. We choose 2003 as end year to allow enough time for producers to learn about NAFTA sourcing restrictions and adjust their decisions accordingly.[23]

[23] NAFTA RoO were slightly modified after 2003 (e.g., to add rules on new goods). Before that date, there were only minor technical changes (e.g., to make the rules compatible with changes in the harmonized classification). Our results are robust to using alternative start and end years.

Table 2—Descriptive Statistics on Imports and Tariffs

HS code	Description	Panel A. Mexican imports from non-NAFTA countries 1991	Panel A. Mexican imports from non-NAFTA countries 2003	Panel B. Mexican imports from NAFTA partners 1991	Panel B. Mexican imports from NAFTA partners 2003	Panel C. Tariffs applied by Mexico MFN 1991	Panel C. Tariffs applied by Mexico MFN 2003	Panel C. Tariffs applied by Mexico NAFTA 2003	Panel D. Tariffs applied by NAFTA partners MFN 2003	Panel D. Tariffs applied by NAFTA partners NAFTA 2003
01–05	Animal products	105.02	396.71	974.83	2,300.02	13.92	32.70	1.23	2.12	0.23
06–15	Vegetables	163.75	245.05	1,470.59	4,893.73	12.47	18.22	0.00	3.35	0.02
16–24	Foodstuffs	81.75	133.05	630.23	2,241.19	17.07	25.85	0.11	8.74	0.52
25–27	Mineral products	122.20	718.77	1,295.18	4,932.58	9.34	11.68	0.00	0.45	0.00
28–38	Chemicals	166.60	1,194.19	1,844.43	7,416.82	11.21	12.57	0.01	2.68	0.00
39–40	Plastic/rubbers	164.09	1,365.55	1,364.73	11,502.20	13.47	16.31	0.00	3.72	0.00
41–43	Raw hides,skins, leathers	22.96	222.96	183.43	796.17	13.05	20.82	0.00	3.95	0.00
44–49	Wood products	39.23	359.86	1,291.55	4,276.96	11.81	15.71	0.00	0.66	0.00
50–63	Textiles	325.97	1,468.05	662.75	6,778.14	16.79	24.47	0.00	10.22	0.00
64–67	Footwear/headgear	82.54	260.93	72.10	60.28	19.17	29.85	0.00	9.29	0.48
68–71	Stone/glass	39.36	525.59	244.87	1,492.56	15.66	18.47	0.00	2.86	0.15
72–83	Metals	192.87	1,585.28	2,045.47	9,408.64	12.66	16.83	0.00	2.01	0.00
84–85	Machinery/electrical	1,224.05	21,999.54	6,540.45	36,770.64	13.62	13.26	0.00	1.56	0.00
86–89	Transportation	135.93	1,444.67	1,230.50	11,583.13	14.29	18.38	0.00	4.28	0.00
90–97	Miscellaneous	324.51	1,839.54	1,361.38	5,104.76	15.06	18.44	0.00	2.76	0.00

Notes: Panel A reports descriptive statistics on the value of Mexican imports from non-NAFTA countries (in millions of US$), excluding countries which during our sample period had free trade agreements or partial scope trade agreements with Mexico. Panel B reports descriptive statistics on the value of Mexican imports from NAFTA partners (in millions of US$). Panel C reports descriptive statistics of the average MFN tariffs applied by Mexico in 1991 and 2003, as well as the preferential tariffs applied by Mexico in 2003 on imports from its NAFTA partners. Panel D reports descriptive statistics of the average MFN and NAFTA preferential tariffs applied by the United States and Canada. All tariffs are expressed in percentage terms.

The list of countries included in our analysis can be found in Table IV in the online Appendix. In our benchmark regressions, we include all GATT/WTO members that had no free trade agreement with Mexico during our sample period (given that we have no data on the RoO contained in these agreements). In robustness checks, we show that our results continue to hold if we consider different samples of countries.

Panel A of Table 2 reports descriptive statistics on Mexican imports from non-NAFTA countries. In general, Mexican imports from third countries increased significantly between 1991 and 2003. For the average product (at the HS6 level) and country of origin, the increase was 227.05 percent.

Panel B of Table 2 reports the corresponding descriptive statistics on Mexican imports from NAFTA partners. For the average product (at the HS6 level), Mexican imports from the United States and Canada increased by 118.02 percent between 1991 and 2003.[24] In our empirical analysis, we will use the data from panel A to construct the dependent variable for our regressions, $\Delta Imports_{j,\,non\text{-}NAFTAo} - \Delta Imports_{j,\,NAFTA}$, which captures product-level changes in Mexican imports from third countries relative to imports from NAFTA partners.

[24] In terms of levels, Mexican imports from NAFTA partners far exceeded imports from third countries in 2003. The only exception are footwear/headgear products. This is mostly due to the increase in imports from China, following its accession to the WTO in 2001.

Descriptive statistics on Mexican MFN and preferential tariffs can be found in panel C.[25] Between 1991 and 2003, MFN tariffs applied by Mexico fell in some sectors and increased in others.[26] During the same period, Mexico eliminated most tariffs on imports from NAFTA partners. Based on this information, we define the variable $\Delta Preferential\ Tariff_{j,o} = \Delta Tariff_{j,o} - \Delta Tariff_{j,NAFTA}$.[27] This variable captures the extent to which, following the implementation of NAFTA, Mexico lowered tariffs on imports from the United States and Canada more than tariffs on imports from third countries. The larger is $\Delta Preferential\ Tariff_{j,o}$, the larger is the increase in protection faced by producers of good j from third country o, relative to US and Canadian producers of the same good.[28]

Panel D of Table 2 reports average MFN and NAFTA preferential tariffs applied by the United States and Canada in 2003. NAFTA RoO should only divert Mexican imports of intermediate goods from third countries if the difference between these tariffs is large enough to compensate for the costs of complying with RoO (i.e., the costs adjusting sourcing decisions, as well the administrative costs of obtaining the certification). To capture the gains of complying with a particular rule $RoO_{i,j}$, we use the information in panel D to construct the variable $Preference\ Margin\ NAFTA_i$, which is the average between the preference margins of the United States and Canada for good i.[29] Notice that, unlike the variables $\Delta Imports_{j,non\text{-}NAFTAo} - \Delta Imports_{j,NAFTA}$ and $\Delta Preferential\ Tariff_j$, the variable $Preference\ Margin\ NAFTA_i$ is not expressed as a difference between 1991 and 2003 values. This is because the impact of NAFTA RoO should only depend on the preferential margin enjoyed by Mexican producers of i when exporting to the United States and Canada *after* the implementation of NAFTA.[30] We also construct the variable $Average\ Margin\ NAFTA_j$, which is the average of $Preference\ Margin\ NAFTA_i$ across all final goods i that have RoO imposing sourcing restrictions on j.

Previous studies suggest that tariff preferences may not be used unless export volumes are large enough to result in substantial duty savings. To proxy for the importance of NAFTA export markets for Mexican final good producers, we use the variable $Exports\ NAFTA_j$, which is the log of total Mexican exports to the United States and Canada, across all final goods i imposing restrictions on j.

[25] As mentioned above, prior to NAFTA, Mexico had a duty drawback scheme, which allowed the refund, waiver, or reduction of customs duties owed on imported goods, on condition that the goods are subsequently exported (footnote 14). Data on the duty drawbacks granted are not available, so we use data on MFN applied tariffs to capture Mexican import protection in 1991.

[26] On average, applied Mexican MFN tariffs increased by around 14 percent between 1991 and 2003. Upon accessing the GATT in 1986, Mexico bound 100 percent of its tariff lines, agreeing on the maximum tariff rates it could apply to other GATT members. Like most developing countries, Mexico had a big "tariff overhang," i.e., a significant gap between its bound and applied MFN tariffs. Following the Uruguay Round of multilateral trade negotiations, Mexico reduced the level of its tariff bindings (Blackhurst, Enders, and Francois 1996).

[27] Data on the preferential tariffs applied by Mexico to its NAFTA partners are not available in WITS for 2003, so we use the first next year available (2004). These tariffs were zero for 99.1 percent of the products.

[28] In our benchmark regressions, the tariff preference variable does not vary by origin ($\Delta Preferential\ Tariff_j$). This is because the countries in our main sample did not have preferential agreements with Mexico. The tariff variable is instead defined at the product-country level ($\Delta Preferential\ Tariff_{j,o}$) in the robustness checks in which we include countries that negotiated a free trade agreement with Mexico.

[29] We first average the preference margin across destination countries (United States and Canada), for each final good i. We then take the average across final goods.

[30] Thus, the effect of a RoO on final good i on imports of restricted input j does not depend on whether the United States and Canada granted GSP preferences to Mexican producers of i before NAFTA.

To avoid endogeneity concerns, we use data on pre-NAFTA (1991) Mexican exports to construct this measure.

IV. Empirical Analysis

To obtain origin status, and thus benefit from lower tariffs when exporting to the United States and Canada, Mexican final good producers may have substituted inputs produced by third-country suppliers with inputs produced by NAFTA suppliers.

The goal of our analysis is to verify whether NAFTA RoO gave rise to this trade diversion in intermediate goods. Going back to the example mentioned in Section IIIA, we want to verify whether NAFTA sourcing restrictions on HS 6203.42 (men's or boys' trousers, made of cotton) had a detrimental effect on the evolution of Mexican imports of the fabrics used to produce trousers to which these restrictions apply.

A. *Empirical Methodology*

The standard approach to study the effect of preferential trade agreements is to use a difference-in-differences approach. Based on this approach, we would compare changes in Mexican imports of "treated" goods (which became subject to RoO sourcing restrictions when NAFTA entered into force) to changes in "non-treated" goods (which were not subject to sourcing restrictions), by running the following regression:

$$(1) \quad \Delta Imports_{j,\,non\text{-}NAFTAo} = \alpha + \beta_1 RoO_j^x + \beta_2 \Delta Preferential\ Tariff_{j,o} + \delta_{k(j)} + \delta_o + \epsilon_{j,o}.$$

The dependent variable, $\Delta Imports_{j,\,non\text{-}NAFTAo}$, is the log change in Mexican imports of HS6-digit good j from non-NAFTA country o between 1991 and 2003. The key regressor of interest is RoO_j^x, which captures the effect of the introduction of NAFTA RoO on final goods i imposing sourcing restrictions on intermediate j. The variable $\Delta Preferential\ Tariff_{j,o}$ captures the role of preferential tariff reductions and is defined as the difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and from NAFTA partners between 1991 and 2003. Finally, $\delta_{k(j)}$ and δ_o are industry and country-of-origin fixed effects, which account for sector-level and country-level trends in Mexican imports.

Using a difference-in-differences approach would remove any potential bias resulting from unobservable and time-invariant product characteristics. However, it would not allow us to control for product-level trends: given that the RoO treatment variables are defined at the HS6 level, it is not possible to include in (1) fixed effects defined at the same level of aggregation. This raises the concern that the results of the difference-in-differences regressions might be driven by omitted variables correlated with the RoO variables, resulting in biased estimates.

To deal with this concern, we employ a triple-difference methodology, exploiting both cross-product and cross-country variation in treatment over time. In particular, we compare the effect of NAFTA RoO on the growth rate of Mexican imports of

intermediate goods from "treated" countries (outside NAFTA) and "non-treated" countries (NAFTA partners). We estimate the following regression:

$$(2)\quad \Delta Imports_{j,\,non\text{-}NAFTAo} - \Delta Imports_{j,\,NAFTA} = \alpha_0 + \alpha_1 RoO_j^x + \alpha_2\, \Delta Preferential\ Tariff_j + \delta_o + \epsilon_{j,\,NAFTAo,\,NAFTA},$$

which can be written as the difference between the following two equations:

$$(3)\quad \Delta Imports_{j,\,non\text{-}NAFTAo} = \beta_0 + \beta_1 RoO_j^x + \beta_2 \Delta Preferential\ Tariff_j + X_j + \delta_o + \epsilon_{j,\,non\text{-}NAFTAo},$$

$$(4)\quad \Delta Imports_{j,\,NAFTA} = \gamma_0 + \gamma_1 RoO_j^x + \gamma_2\, \Delta Preferential\ Tariff_j + X_j + \epsilon_{j,\,NAFTA},$$

where $\Delta Imports_{j,\,NAFTA}$ is the log change in Mexican imports of good j from the United States and Canada between 1991 and 2003. The dependent variable in (2) is thus the difference between the growth rate of Mexican imports of good j from third countries and the corresponding growth rate of imports from NAFTA partners.[31] Under the assumption that product-level trends are the same for imports from non-NAFTA and NAFTA countries, X_j cancels out in equation (2), allowing us to deal with omitted variable concerns. In all specifications, we cluster standard errors at two digits, to allow for correlation in the error terms at a broad level of sectoral aggregation.

RoO might have affected imports of intermediate goods from non-NAFTA countries through two channels: (i) they may have led final good producers to switch from non-NAFTA to NAFTA suppliers (substitution effect); and (ii) they may have depressed demand for restricted inputs, by raising the cost of producing the output (level effect).

Using a difference-in-differences approach would not allow us to disentangle these effects. By contrast, the triple-difference methodology accounts for product-level trends in Mexican imports, including changes in demand for intermediates. The RoO coefficients in (2) should thus isolate the substitution effect of NAFTA RoO. These sourcing restrictions should have had a detrimental impact only on Mexican imports of j from non-NAFTA countries. We thus expect the coefficient α_1 to be negative and significant.

B. *Main Results*

We start by estimating model (2) using all the rules contained in Annex 401 of NAFTA. As discussed in Section III, we consider three versions of the treatment variable RoO_j^x. In the first treatment ($x = 1$), we include all dummies RoO_{ij}, i.e., all rules on final goods i imposing sourcing restrictions on good j. The second

[31] To account for the effects of RoO on the extensive margin of trade, in our benchmark regressions, we construct these growth rates using observations corresponding to zero imports at the start or end year. In this case, the dependent variable is defined as the difference between $\log(1 + Imports_{j,\,non\text{-}NAFTAo,\,2003}) - \log(1 + Imports_{j,\,non\text{-}NAFTAo,\,1991})$ and $\log(1 + Imports_{j,\,NAFTA,\,2003}) - \log(1 + Imports_{j,\,NAFTA,\,1991})$. Notice that our dependent variable never actually takes value 0. This would only happen if the growth rates were exactly the same for member and non-member countries, which never happens in our data.

TABLE 3—NAFTA RoO AND CHANGE IN MEXICAN IMPORTS, TRIPLE-DIFFERENCE RESULTS
(*All Rules*)

	(1)	(2)	(3)
RoO_j^1	−0.114		
	(0.054)		
RoO_j^2		−0.117	
		(0.052)	
RoO_j^3			−0.161
			(0.047)
$\Delta Preferential\ Tariff_j$	−0.279	−0.254	−0.150
	(0.151)	(0.149)	(0.138)
Country of origin FE	Yes	Yes	Yes
Observations	28,053	28,053	28,053
R^2	0.150	0.150	0.153

Notes: This table shows the results of the estimation of equation (2). The dependent variable is $\Delta Imports_{j,non-NAFTA_o} - \Delta Imports_{j,NAFTA}$, the difference between the log change in Mexican imports of good j (at the HS6 level) from non-NAFTA country o between 1991 and 2003 and the corresponding change of imports from NAFTA partners. It includes goods for which Mexican imports were positive in 1991 and/or 2003. RoO_j^x is the number (in logs) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which *Preference Margin NAFTA*$_i = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_j$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA countries and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Standard errors in parentheses clustered by industry (at the HS2 level).

treatment ($x = 2$) distinguishes the rules depending on the preference margin on the final good. This measure excludes rules on final goods i for which the variable *Preference Margin NAFTA*$_i$ is equal to 0, which producers have no incentives to comply with. The last treatment ($x = 3$) also takes into account value added rules. This is our preferred treatment, which includes only rules RoO_{ij} for which the preference margin on the final good is positive and for which there are no alternative value added rules.

The results are reported in Table 3. The coefficients of the RoO variables are always negative and significant, indicating that NAFTA RoO had a detrimental impact on imports of treated goods from third countries relative to NAFTA partners. The largest coefficient is found for our preferred treatment variable (RoO_j^3), which captures rules that are relevant (producers have incentives to comply with them, given that the preference margin on the final good is positive) and strict (there is no alternative VA rule). However, as discussed below, the coefficients reported in this table cannot be used to directly compare the effects of different type of rules, depending on whether or not they are relevant and on whether they are strict or flexible. This is because the treatment variables are nested, i.e., RoO_j^1 contains RoO_j^2, which contains RoO_j^3.

Notice that the coefficient of the tariff variable is not always significant at conventional levels. We would expect $\Delta Preferential\ Tariff_j$ to have negative effect on Mexican imports from third countries and a positive effect on Mexican imports from NAFTA partners. Indeed, the coefficient of this variable is always negative and

significant when running regression (3),[32] while it is always positive and significant when running (4). These two effects work in opposite directions when we estimate the triple-difference regression (2).

RoO should only affect sourcing decisions if they apply to vertically related goods, i.e., if the restricted good j is actually an input in the production of final good i. In Table 3, we have included all rules contained in NAFTA. Our next step is to exclude rules RoO_j that do not apply to vertically related goods. To this purpose, we verify whether good j is an input in the production of final good i, exploiting information contained in the Input-Output (IO) Direct Requirement Table 1997 provided by the BEA.[33]

Table 4 reports the results we obtain when we estimate (2) using information from input-output tables to exclude rules that not apply to vertically related goods (i.e., RoO_{ij} for which the direct requirement coefficient dr_{ij} is 0). In line with the results reported in Table 3, the coefficients of the RoO treatment variables are always negative and significant, confirming that NAFTA rules of origin on final goods decreased Mexican imports of restricted intermediates from non-NAFTA countries.

As mentioned before, the treatment variables used in Tables 3 and 4 are nested, i.e., RoO_j^1 contains RoO_j^2, which contains RoO_j^3. As a result, we cannot directly compare the effect of different types of rules, depending on whether producers have incentives to comply with them and whether they are strict or flexible. To do so, we define these mutually exclusive treatment variables:

- *RoO Placebo*$_j$: This variable is constructed as the difference between RoO_j^1 and RoO_j^2 and thus captures rules $RoO_{i,j}$ that are irrelevant (producers have no incentives to comply with them, because the preference margin on good i is 0).
- *RoO Flexible*$_j$: This variable is constructed as the difference between RoO_j^2 and RoO_j^3 and thus captures rules $RoO_{i,j}$ that are relevant (the preference margin on good i is positive) but flexible (producers can obtain origin by complying with an alternative VA rule).
- *RoO Strict*$_j$: this variable is equal to RoO_j^3 and thus captures rules $RoO_{i,j}$ that are both relevant (the preference margin on good i is positive) and strict (there is no alternative VA rule).

In Table 5 we report the results of triple-difference regressions in which we include these treatment variables together. In column 1, we include all rules, independently on vertical linkages. In column 2, we exclude rules that do not apply to vertically related goods. In this specification, the variables

[32] See Conconi et al. (2016). In this earlier version of our paper, we also estimated (3) including separately the two components of $\Delta Preferential\ Tariff_j$, i.e., $\Delta Tariff_j$ and $\Delta Tariff_{j,NAFTA}$. As expected, the estimated coefficient was negative and significant for the former and positive and significant for the latter.

[33] As explained in Section A of the online Appendix, this table is based on a different product classification (similar to NAICS-97), which is less disaggregated than our trade data (there are 458 products in the IO classification, versus 5,112 in the HS six-digit classification). We use the BEA concordance table to generate an input-output table based on the HS six-digit classification. We can then restrict the analysis to rules RoO_{ij} for which $dr_{i,j} > 0$. The procedure to exclude rules that do not apply to vertically related goods suffers from measurement error, because the mapping between IO and HS6 products is not one-to-one: in the BEA concordance table, each IO six-digit good is associated on average to 14 HS six-digit goods; there are also a few instances in which a HS-6 good is associated to more than one IO good. Moreover, some IO products are present in the input-output tables, but not in the concordance table.

TABLE 4—NAFTA RoO AND CHANGE IN MEXICAN IMPORTS, TRIPLE-DIFFERENCE RESULTS: EXCLUDING RULES FOR WHICH $dr_{i,j} = 0$

	(1)	(2)	(3)
RoO_j^1	−0.116		
	(0.051)		
RoO_j^2		−0.120	
		(0.049)	
RoO_j^3			−0.170
			(0.045)
$\Delta Preferential\ Tariff_j$	−0.276	−0.254	−0.151
	(0.152)	(0.150)	(0.140)
Country of origin fixed effects	Yes	Yes	Yes
Observations	28,053	28,053	28,053
R^2	0.151	0.151	0.155

Notes: This table shows the results of the estimation of equation (2). The dependent variable is $\Delta Imports_{j,non-NAFTAo} - \Delta Imports_{j,NAFTA}$, the difference between the log change in Mexican imports of good j (at the HS6 level) from non-NAFTA country o between 1991 and 2003 and the corresponding change of imports from NAFTA partners. It includes goods for which Mexican imports were positive in 1991 and/or 2003. The variable RoO_j^x is the number (in logs) of rules $RoO_{i,j}$, excluding those for which $dr_{i,j} = 0$. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which $Preference\ Margin\ NAFTA_i = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_j$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA countries and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Standard errors in parentheses clustered by industry (at the HS2 level).

$RoO\ Flexible_j$ and $RoO\ Strict_j$ capture rules $RoO_{i,j}$ that are relevant according to two criteria: (i) producers have something to gain from complying with them ($Preference\ Margin\ NAFTA_i > 0$); and (ii) the restricted good j is actually an input in the production of good i ($dr_{i,j} > 0$).

As expected, irrelevant rules had no effect on Mexican imports (the coefficient of $RoO\ Placebo_j$ is never significant). We also find no effect for sourcing restrictions that are relevant but flexible (the coefficient of $RoO\ Flexible_j$ is never significant). This is not surprising: a rule $RoO_{i,j}$ is unlikely to change sourcing decisions on intermediate j when producers of good i can qualify for origin by complying with an alternative VA rule. By contrast, rules that are both relevant and strict distorted sourcing decisions, giving rise to trade diversion (the coefficient of $RoO\ Strict_j$ is always negative and significant and the 1 percent level).

The results of Table 5 show that NAFTA sourcing restrictions led to a significant decrease in the growth rate of Mexican imports of intermediate goods from third countries relative to NAFTA partners. This effect is driven by rules that are both relevant (final good producers had incentives to comply with them) and strict (producers could only obtain the certificate of origin by sourcing the restricted intermediate from suppliers within NAFTA).

How large was the trade-diversion effect of NAFTA RoO? To answer this question, we focus on rules that are both relevant and strict. In Table 6 we report the magnitude of the effects of these rules based on the estimated coefficients of RoO_j^3 in Tables 3 and 4. The results in column 1 indicate that NAFTA sourcing restrictions decreased the growth rate of Mexican imports of intermediates from third countries relative

Table 5—NAFTA RoO and Change in Mexican Imports, Triple-Difference Results: Comparison between Different Types of Rules

	(1)	(2)
$RoO\ Placebo_j\ (RoO_j^1 - RoO_j^2)$	−0.019	−0.004
	(0.043)	(0.039)
$RoO\ Flexible_j\ (RoO_j^2 - RoO_j^3)$	0.002	−0.005
	(0.041)	(0.042)
$RoO\ Strict_j\ (RoO_j^3)$	−0.164	−0.171
	(0.047)	(0.044)
$\Delta Preferential\ Tariff_j$	−0.157	−0.153
	(0.138)	(0.140)
Country of origin fixed effects	Yes	Yes
Observations	28,053	28,053
R^2	0.153	0.155

Notes: The dependent variable is $\Delta Imports_{j,non-NAFTAo} - \Delta Imports_{j,NAFTA}$, the difference between the log change in Mexican imports of good j (at the HS6 level) from non-NAFTA country o between 1991 and 2003 and the corresponding change of imports from NAFTA partners. It includes goods for which Mexican imports were positive in 1991 and/or 2003. In column 1, the RoO variables are constructed using information on all rules, while in column 2, they exclude rules $RoO_{i,j}$ for which $dr_{i,j} = 0$. The variable $RoO\ Placebo_j$ is the number (in logs) of rules $RoO_{i,j}$ for which $Preference\ Margin\ NAFTA_i = 0$. The variable $RoO\ Flexible_j$ is the number (in logs) of rules $RoO_{i,j}$ for which $Preference\ Margin\ NAFTA_i > 0$ and $No\ VA_{ij} = 0$. The variable $RoO\ Strict_j$ is the number (in logs) of rules $RoO_{i,j}$ for which $Preference\ Margin\ NAFTA_i > 0$ and $No\ VA_{ij} = 1$. $\Delta Preferential\ Tariff_j$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA countries and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Industry fixed effects defined at four digits. Standard errors in parentheses clustered by industry (at the HS2 level).

to NAFTA partners by 48.364 log points.[34] This number is obtained by multiplying the estimated coefficient of RoO_j^3 by the average of this variable for treated goods $\times 100$ $(-0.161 \times 3.004 \times 100 = -48.364)$. This represents 44.209 percent of the average actual change in imports of treated goods $\left(\frac{-0.161 \times 3.004 \times 100}{1.094} = -44.209\right)$. This is equivalent to saying that, had the variable RoO_j^3 been 0, Mexican imports of these goods from third countries relative to NAFTA partners would have been 44.209 percent higher. The estimates reported in column 2 of Table 6 imply that NAFTA sourcing restrictions decreased the growth rate of imports of intermediates from third countries relative to NAFTA partners by 48.314 log points on average. This represents 45.280 percent of the actual change in imports.

The results of Table 6 should be considered as an underestimate of the long-term effects of NAFTA RoO on Mexican imports. This is because there is evidence that in 2003 some Mexican producers had still to fully understand and adjust to NAFTA sourcing restrictions.[35]

Although the estimated coefficients of $\Delta Preferential\ Tariff_j$ are not always significant at conventional levels, they imply an effect that is similar in size to that of

[34] Given that the coefficients in Table 6 are expressed in log points, they are an approximation of the effects of RoO in percentage points. A reduction of 48 log points corresponds to a reduction of around 38 percentage points.

[35] As mentioned before, many firms payed the administrative and legal costs to comply with these restrictions, but failed to obtain origin status (see footnote 17).

TABLE 6—QUANTIFICATION OF THE EFFECT OF ROO

	(1)	(2)
$\hat{\beta}_1$	−0.161	−0.170
Mean RoO_j^3	3.004	2.842
$\Delta Imports_j$	1.094	1.067
Effect of RoO_j^3 (in log points)	−48.364	−48.314
Effect of RoO_j^3 (as percent of $\Delta Imports_j$)	44.209	45.280

Notes: This table shows that magnitude of the effects of NAFTA RoO on Mexican imports from non-NAFTA countries relative to Mexican imports from NAFTA partners. $\hat{\beta}_1$ is the estimated coefficient of RoO_j^3 in the triple-difference regressions. Columns 1 and 2 report the estimates from column 3 of Tables 3 and 4, respectively. *Mean* RoO_j^3 is the average of RoO_j^3 across treated goods. $\Delta Imports_{j,o}$ is the average log change in imports across treated goods. The effect of RoO_j^3 (in log points) is computed by multiplying $\hat{\beta}_1$ by $RoO_j^3 \times 100$. The effect of RoO_j^3 (as percent of $\Delta Imports$) is computed by dividing the absolute value of the effect of RoO_j^3 by $\Delta Imports_{j,o}$.

RoO. Based on the coefficients reported in column 3 of Tables 3 and 4, preferential reductions in tariffs reduced the growth rate of Mexican imports of treated intermediate goods from third countries relative to NAFTA partners by 43.935 and 42.899 log points, respectively. The numbers are obtained by multiplying the estimated coefficients of $\Delta Preferential\ Tariff_j$ by the average of this variable for treated goods $\times 100$ ($-0.150 \times 2.929 \times 100$ and $-0.151 \times 2.841 \times 100$). These effects represent around 41 percent and 40 percent of the actual change in imports of treated goods.

We next focus on intermediate goods that were subject to relevant and strict sourcing restrictions (i.e., j goods for which the variable $RoO_{ij}^3 > 0$) and exploit variation in the intensity of the treatment. The negative impact of NAFTA RoO should be larger when Mexican final good producers had stronger incentives to comply with them. The larger the difference between the MFN and preferential tariffs applied by the United States and Canada on their final goods, the stronger the incentives to source the restricted inputs within NAFTA. The effect of RoO on Mexican imports of intermediates from non-member countries should thus be increasing in the variable *Average Margin* $NAFTA_j$. This is the average of *Preference Margin* $NAFTA_i$ across all goods i imposing restrictions on j, based on the MFN and preferential tariffs applied by the United States and Canada in 2003.

The effect of NAFTA RoO should also have been more detrimental for sourcing restrictions that apply to final goods for which the United States and Canada represent more important export markets. To see this, consider the example of two Mexican producers, selling different final goods. Before NAFTA, both producers imported some inputs from third countries (e.g., Germany or Japan). Exports of the first producer were mostly destined for the North American market, while the second producer exported more to the rest of the world. Following the entry into force of NAFTA, the two producers can export their goods to the United States and Canada at preferential rates, but only if they stop importing certain inputs from third countries. NAFTA RoO should have a stronger impact on the sourcing decisions of the first producer, who stands to gain more from complying with them. The impact of RoO on Mexican imports of intermediate goods j should thus depend on the importance of NAFTA export markets for Mexican producers of final goods i.

This is proxied by the variable *Exports NAFTA*$_j$, the total volume of pre-NAFTA (1991) Mexican exports to the United States and Canada, summing across all goods *i* that impose sourcing restrictions on *j*.

To verify whether the impact of NAFTA sourcing restrictions depends on the incentives of final good producers to comply with them, in Table 7 we include in regression (2) interactions between RoO_{ij}^3 and the variables *Average Margin NAFTA*$_j$ and *Exports NAFTA*$_j$ (first separately, and then together). The coefficients of the interactions terms are always negative, though they are not significant at conventional levels.[36]

The results of Table 7 confirm that the negative impact of NAFTA sourcing restrictions on Mexican imports of intermediate good *j* is larger when Mexican final good producers have more to gain from obtaining origin status, i.e., when the preference margin is larger and when NAFTA partners represent more important export markets. We can compute the effect of rules of origins for different levels of *Average Margin NAFTA*$_j$ and *Exports NAFTA*$_j$. For example, the estimates in column 1 imply a RoO coefficient of −0.293 (significant at the 1 percent level) for goods falling in the ninetieth percentile of the distribution of *Average Margin NAFTA*$_j$. This coefficient, together with the fact that the average of RoO_j^3 for these goods was 4.85, indicates that NAFTA sourcing restrictions reduced the growth rate of imports from non-members relative to members by 142 log points. Column 2 implies a coefficient of −0.328 (significant at the 1 percent level) for goods in the ninetieth percentile of the distribution of *Exports NAFTA*$_j$. Given that the average of RoO_j^3 for these goods was 4.78, this corresponds to a 159 log points reduction in the growth rate of imports from third countries relative to NAFTA partners.

C. *Robustness Checks*

We have performed a series of additional estimations to verify the robustness of our triple-difference results. In the interest of space, the results of all these estimations are reported in online Appendix Section B.

Construction of the Dependent Variable.—In our triple-difference regressions, the dependent variable is the difference between the growth rate of Mexican imports from third countries and the corresponding growth rate from NAFTA partners. To construct this variable, we have included observations corresponding to zero imports, i.e., instances in which Mexico imported a good *j* from a given country *o* only in 1991 *or* 2003.[37] We can thus account for the effects of RoO on the extensive margin of trade, allowing for the possibility that NAFTA sourcing restrictions led Mexican producers to stop importing restricted intermediates from third countries and/or to start importing them from its NAFTA partners.

In Tables 3 and 4, the dependent variable is defined as the difference between the log change in Mexican imports of good *j* (at the HS6 level) from non-NAFTA

[36] It should be stressed that in these regressions we only exploit variation in the intensive margin of the preference margin. This is because the treatment variable RoO_j^3 excludes all rules $RoO_{i,j}$ for which *Preference Margin NAFTA*$_i$ is 0.

[37] We never include observations corresponding to goods that Mexico did not import from a given country *o* neither in 1991 nor in 2003.

TABLE 7—NAFTA RoO AND CHANGE IN MEXICAN IMPORTS, TRIPLE-DIFFERENCE RESULTS

	(1)	(2)	(3)
$RoO_j^3 \times Average\ Margin\ NAFTA_j$	−0.103		−0.073
	(0.067)		(0.073)
$RoO_j^3 \times Exports\ NAFTA_j$		−0.017	−0.011
		(0.028)	(0.029)
RoO_j^3	−0.026	−0.125	−0.053
	(0.095)	(0.353)	(0.287)
$Average\ Margin\ NAFTA_j$	0.274		0.253
	(0.224)		(0.250)
$Exports\ NAFTA_j$		0.123	0.105
		(0.036)	(0.043)
$\Delta Preferential\ Tariff_j$	−0.108	−0.123	−0.128
	(0.136)	(0.149)	(0.141)
Country of origin fixed effects	Yes	Yes	Yes
Observations	25,031	25,031	25,031
R^2	0.155	0.157	0.157

Notes: The dependent variable is $\Delta Imports_{j,\,non\text{-}NAFTAo} - \Delta Imports_{j,NAFTA}$, the difference between the log change in Mexican imports of good j (at the HS6 level) from non-NAFTA country o between 1991 and 2003 and the corresponding change of imports from NAFTA partners. It includes goods for which Mexican imports were positive in 1991 and/or 2003. RoO_j^3 is the number (in logs) of final goods i that have a RoO (written at the HS6 level) restricting the sourcing of good j, excluding those with $Preference\ Margin\ NAFTA_i = 0$ and with alternative VA rules. The variable $Average\ Margin\ NAFTA_j$ is the average of $Preference\ Margin\ NAFTA_i$ across all goods i imposing restrictions on j, constructed based on the MFN and preferential tariffs applied by the United States and Canada in 2003. The variable $Exports\ NAFTA_j$ is the log of the sum of Mexican exports to the United States and Canada in 1991, across final goods i that have RoO restrictions on j. $\Delta Preferential\ Tariff_j$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA countries and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Industry fixed effects defined at three digits. Standard errors in parentheses clustered by industry (at the HS2 level).

country o between 1991 and 2003 and the corresponding log change of imports from NAFTA partners. As mentioned before, our dependent variable never takes value 0. This would only be the case if the growth rates of Mexican imports from third countries coincided with the growth rates of Mexican imports from NAFTA partners, which never happens in our data.

We have experimented with three alternative ways to construct the dependent variable, which we discuss below. First, online Appendix Tables VI–VII show that the results of our triple-difference estimations continue to hold if we collapse the trade data at the product level. In these specifications, the dependent variable is constructed aggregating imports across third countries and NAFTA partners, and hence does not take into account zero imports.[38]

Second, online Appendix Tables VIII–IX reproduce Tables 3 and 4 when we construct the dependent variable using only observations corresponding to goods j

[38] When collapsing the dependent variable at the product level, the growth rate of Mexican imports of good j from third countries is constructed by summing up all Mexican imports of j across non-NAFTA countries for 1991 and 2003, and computing the log difference between these two values. Similarly, the growth rates of Mexican imports of good j from NAFTA partners is constructed by summing up all Mexican imports of j across the United States and Canada for 1991 and 2003, and computing the log difference of these two values.

that Mexico imported from third country o and NAFTA partners in both 1991 and 2003. In line with our benchmark regressions, the coefficients of the RoO treatment variables are always negative and highly significant.

Finally, we have verified that our results are robust to using the inverse hyperbolic sine transformation to construct the growth rates of Mexican imports from third countries and NAFTA partners. Unlike the log transformation, the inverse hyperbolic sine is defined at 0 (Burbidge, Magee, and Robb 1988; MacKinnon and Magee 1990). The results of online Appendix Tables X–XI confirm that NAFTA RoO reduced the growth rate of Mexican imports of intermediates from third countries relative to NAFTA partners.

Construction of Treatment Variables.—The effect of RoO on imports of intermediates may vary across final goods. Consider, for example, two rules applying to final goods i and i', both imposing sourcing restrictions on intermediate good j. Suppose that j is a more important input in the production of the first final good $\left(\text{i.e., } dr_{i,j} > dr_{i',j}\right)$. The effect of $RoO_{i,j}$ may be larger than the effect of $RoO_{i',j}$, if the costs of switching to NAFTA suppliers is lower for i producers (which could be the case if final good producers face fixed costs of searching for new suppliers). The opposite may be true if the switching costs are higher for i producers (which could be the case if higher IO coefficients proxy for higher quality inputs).[39]

To allow for these heterogeneous effects, we have modified our treatment variables, weighting each rule RoO_{ij} by the direct requirement coefficient $dr_{i,j}$.[40]

Online Appendix Table XII reproduces our triple-difference regressions when we use these alternative regressors. Once again, we find that the coefficients of all RoO variables are negative and significant, confirming that NAFTA RoO reduced the growth rates of Mexican imports of treated intermediates from non-NAFTA countries relative to NAFTA partners.

Countries Included in the Sample.—In our analysis so far, we have excluded countries with which Mexico negotiated other FTAs during our sample period. This is because we have no data on the RoO contained in these agreements, which should have affected the evolution of Mexican imports from FTA partners. Online Appendix Tables XIII–XIV show that our results on the trade-diverting effects of NAFTA RoO are robust to including these countries.[41]

[39] The effect of RoO may also vary across different inputs. For example, RoO that apply to final good i may restrict the sourcing of two different intermediate goods, j and j'. Suppose that j is a more important input in the production of i $\left(\text{i.e., } dr_{i,j} > dr_{i,j'}\right)$. We would then expect Mexican imports of j to exceed imports of j' both pre- and post-NAFTA. This type of heterogeneity is already accounted for in our empirical analysis: our dependent variable is expressed in percentage changes (log differences), so we already control for differences in the level of j and j' imports.

[40] In these regressions, the treatment variables are constructed by weighting each rule $RoO_{i,j}$ by $dr_{i,j}$, the requirement of input j to produce \$1 of output i: $RoO_j^1 = \log\left(1+\sum_i RoO_{i,j} \times dr_{i,j}\right)$; $RoO_j^2 = \log\left(1+\sum_i RoO_{i,j} \times dr_{i,j} \times Margin_i\right)$; $RoO_j^3 = \log\left(1+\sum_i RoO_{i,j} \times dr_{i,j} \times Margin_i \times No\ VA_{ij}\right)$.

[41] In these robustness checks, the sample includes the countries denoted by a * in Table IV in the online Appendix. These are EU members, Chile and Israel, with which Mexico had a FTA in force in 2003, and for which WITS provides data on the tariffs applied by Mexico to its FTA partners, allowing us to construct the variable

Our main sample includes countries that were not members of the GATT/WTO in 1991 and/or 2003. WITS provides no information on the tariff applied by Mexico to imports from these countries, so we have used data on Mexican MFN tariffs to construct the variable $\Delta Preferential\ Tariff_j$. In online Appendix Tables XV–XVI we show that the results of our triple-difference regressions are unaffected when excluding these countries.[42]

Instrumenting NAFTA Rules with CUSFTA Rules.—As mentioned in the introduction, if policymakers manipulate RoO to protect domestic producers, we would expect them to set stricter rules in sectors characterized by a stronger increase in import competition. This type of endogeneity would work against us, making it harder to identify the trade-diverting effect of RoO.

The advantage of focusing on Mexico is that NAFTA RoO were to a large extent inherited from those contained in CUSFTA. Still, it might be the case that some of the modifications introduced during the NAFTA negotiations reflected pressure by import-competing producers. This should not be a serious concern for our results, given that the triple-difference approach allows us to control for product-level trends.

Nevertheless, we have verified that our results are robust to using CUSFTA RoO as an instrument for NAFTA RoO.[43] The rules contained in the two agreements are highly correlated, which makes the instrument very strong: the correlation between the treatment variables is 0.97 for RoO_j^1 and RoO_j^2, and 0.98 for RoO_j^3.[44] Online Appendix Tables XVII–XVIII show that the results of triple-difference regressions are robust to using the rules contained in CUSFTA as an instrument for NAFTA rules.

V. Conclusions

Recent decades have witnessed a proliferation of free trade agreements (FTAs). Rules of origin (RoO) are a key element in the functioning of these agreements: they determine the conditions that a product must satisfy to be considered as originating from the member countries and receive preferential tariff treatment.

Theoretical studies have long pointed out that RoO can give rise to trade diversion in intermediate goods (e.g., Grossman 1981; Falvey and Reed 1998). The distortive effect of these sourcing restrictions is also emphasized in recent surveys. For example, in a study by the International Trade Centre (2015) based on large-scale surveys of

$\Delta Preferential\ Tariff_{j,o}$. Information on the different types of preferential trade agreements negotiated by Mexico can be found at http://fas.org/sgp/crs/row/R40784.pdf.

[42] In these regressions, the sample excludes the countries denoted by a • in Table IV in the online Appendix.

[43] Our discussion in Section II suggests that CUSFTA RoO might be correlated with trends in US imports before the agreement was signed. If these trends were strongly correlated with their counterpart for Mexico, CUSFTA rules would not be a valid instrument. We have verified that this is not the case, using information from the Center for International Data. The digital version of these data, elaborated by Feenstra (1996), contains detailed information about the quantity and value of imports at the product level (based on SITC rev. 4 codes), disaggregated by country of origin (see cid.econ.ucdavis.edu). Using these data, we have constructed the variables $\Delta Imports_j^{US}$ and $\Delta Imports_j^{Mex}$, which respectively measure the log change in US and Mexican imports of good j between 1980 and 1987, the year before the signature of CUSFTA. When we run a regression of $\Delta Imports_j^{Mex}$ against $\Delta Imports_j^{US}$ we find a statistically significant positive coefficient of 0.006, which implies a negligible relationship between the two variables. See also Figure II in the online Appendix.

[44] We have performed the Hausman test by including as a regressor the residuals of the first stage in the ordinary least squares (OLS) regression. Endogeneity of the instrument is rejected at the 1 percent level in all cases.

companies in developing countries, RoO emerge as the most problematic non-tariff measure faced by manufacturing firms.

However, systematic empirical evidence about the impact of RoO on trade in intermediates has been lacking, due to their legal complexity, which makes measurement difficult. In this paper, we have overcome this difficulty by focusing on NAFTA, the world's largest FTA, and constructing a unique dataset, which codifies the input-output linkages embedded in the RoO contained in this agreement. For each final good, we can trace all the intermediate goods that are subject to sourcing restrictions; similarly, for every intermediate good, we can trace all the final goods that impose restrictions on its sourcing.

To identify the trade-diverting effects of RoO, we follow a triple-difference approach, exploiting both cross-product and cross-country variation in treatment over time. Our results show that NAFTA RoO had a detrimental impact on imports of treated goods from non-member countries. Our estimates indicate that RoO decreased the growth rate of imports from third countries relative to NAFTA partners by around 48 log points on average, which represents around 45 percent of the actual change in imports of treated goods. This is equivalent to saying that, in the absence of RoO, Mexican imports of these goods from third countries relative to NAFTA partners would have been 45 percent higher. As expected, the magnitude of the effects increases when final goods producers have stronger incentives to comply with the rules.

Our analysis shows that accounting for the role of preferential RoO is key to understanding the implications of trade agreements. Our findings can help to explain why global value chains are actually regional in nature, with most trade in intermediates goods concentrated within "Factory North America," "Factory Europe," and "Factory Asia" (Baldwin 2013; Johnson and Noguera 2012b).

An important avenue of future research is to quantify the impact of FTAs on aggregate productivity and welfare, through their effect on firms' sourcing decisions. To this purpose, we could include preferential tariffs and RoO in a model of global sourcing as in Antràs, Fort, and Tintelnot (2017) or in a framework that accounts for input-output linkages as in Caliendo and Parro (2015). On the empirical front, we would need to combine our data on NAFTA RoO and tariffs with Mexican firm-level trade data before and after the entry into force of NAFTA. Collecting Mexican firm-level data would also allow us to study the trade creation effects of NAFTA RoO and verify whether imports of intermediates from third countries were displaced by inputs produced domestically (possibly by subsidiaries of multinationals located in Mexico) or imported from the United States and Canada. It would also be interesting to study whether NAFTA sourcing restrictions led foreign suppliers to relocate within the FTA. Identifying this "RoO-jumping" effect would require disaggregated data on Mexican inward FDI.

It is well known that input tariffs are low compared to tariffs on final goods (e.g., Miroudot, Lanz, and Ragoussis 2009). Our results show that, when accounting for the sourcing restrictions embedded in preferential trade agreements, the effective rate of protection on these goods is much higher. Our analysis suggests that many FTAs, including NAFTA, violate multilateral trade rules. Paragraph 5(b) of Article XXIV of the GATT states that "the duties and other regulations of commerce maintained in each of the constituent territories and applicable at the formation of such free-trade area… shall not be higher or more restrictive than the corresponding duties and other regula-

tions of commerce existing in the same constituent territories prior to the formation of the free trade area." Our findings show that preferential RoO in FTAs can violate this rule, by substantially increasing the level of protection faced by non-members.

Appendix

Table A1—Definitions and Sources of Main Variables

Variable	Source	Definition
Panel A		
RoO_j^1	Annex-401	$\log(1+\sum_i RoO_{i,j})$
RoO_j^2	Annex-401	$\log(1+\sum_i RoO_{i,j}\times Margin_i)$
RoO_j^3	Annex-401	$\log(1+\sum_i RoO_{i,j}\times Margin_i\times NoVA_{ij})$
$RoO\ Placebo_j$	Annex-401	$RoO_j^1 - RoO_j^2$
$RoO\ Flexible_j$	Annex-401	$RoO_j^2 - RoO_j^3$
$RoO\ Strict_j$	Annex-401	Same as RoO_j^3
$\Delta Imports_{j,\,non\text{-}NAFTAo}$	WITS	$\log(1+Imports_{j,\,non\text{-}NAFTAo,\,2003}) - \log(1+Imports_{j,\,non\text{-}NAFTAo,\,1991})$
$\Delta Imports_{j,\,NAFTA}$	WITS	$\log(1+Imports_{j,\,NAFTA,\,2003}) - \log(1+Imports_{j,\,NAFTA,\,1991})$
$\Delta Preferential\ Tariff_j$	WITS	$\Delta Tariff_j - \Delta Tariff\ NAFTA_j$
$Average\ Margin\ NAFTA_j$	WITS	Average of $Preference\ Margin\ NAFTA_i$ across all goods i imposing restrictions on j
$Exports\ NAFTA_j$	WITS	$\log(1+\sum_i Exports\ NAFTA_i)$ across all goods i imposting restrictions on j
Panel B		
$RoO_{i,j}$	Annex-401	Dummy variable equal to 1 if good i has a RoO restricting the sourcing of good j
$No\ VA_{i,j}$	Annex-401	Dummy variable equal to 1 if rule $RoO_{i,j}$ has no value added alternative
$Imports_{j,\,non\text{-}NAFTAo,\,t}$	WITS	Value of Mexican imports of good j from third country o in year t
$Imports_{j,\,NAFTA,\,t}$	WITS	Value of Mexican imports of good j from NAFTA partners in year t
$Tariff_{j,\,t}$	WITS	MFN tariff applied by Mexico on imports of good j in year t
$Tariff\ NAFTA_{j,\,t}$	WITS	Preferential tariff applied by Mexico on imports of good j from the United States and Canada in year t
$\Delta Tariff_j$	WITS	$\log(1+Tariff_{j,\,2003}) - \log(1+Tariff_{j,\,1991})$
$\Delta Tariff\ NAFTA_j$	WITS	$\log(1+Tariff\ NAFTA_{j,\,2003}) - \log(1+Tariff_{j,\,1991})$
$Tariff_i^{US}$	WITS	MFN tariff applied by the United States to imports of good i in 2003
$Tariff\ NAFTA_i^{US}$	WITS	Preferential tariff applied by the United States to Mexican imports of good i in 2003
$Pref.\ Margin_i^{US}$	WITS	$\log(1+Tariff_{i,\,t}^{US}) - \log(1+Preference\ Tariff_i^{US})$
$Tariff_i^{CA}$	WITS	MFN tariff applied by Canada to imports of good i in 2003
$Tariff\ NAFTA_i^{CA}$	WITS	Preferential tariff applied by Canada to Mexican imports of good i in 2003
$Pref.\ Margin_i^{CA}$	WITS	$\log(1+Tariff_i^{CA}) - \log(1+Pref.\ Tariff_i^{CA})$
$Preference\ Margin\ NAFTA_i$	WITS	Average between $Pref.\ Margin_i^{US}$ and $Pref.\ Margin_i^{CA}$
$Margin_i$	WITS	Dummy variable equal to 1 if $Preference\ Margin\ NAFTA_i > 0$
$Exports\ NAFTA_i$	WITS	Mexican exports of good i to the United States and Canada in 1991

Note: The table provides the definition and sources of all the variables used in our regressions (panel A), and in the construction of such variables (panel B).

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