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FROM FINAL GOODS TO INPUTS: THE PROTECTIONIST EFFECT OF RULES OF ORIGIN[†]

Abstract

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. In this paper, we show that the sourcing restrictions embedded in RoO greatly distort trade in intermediaries. 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. Using a difference-in-differences approach, we find that RoO on final goods reduced imports of intermediate goods from third countries by around 30 percentage points. Even if external tariffs are unchanged, FTAs may thus violate multilateral trade rules, by substantially increasing the level of protection faced by non-members.

JEL Classification: F23 and F53
Keywords: input-output linkages, rules of origin and trade agreements

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1 Introduction

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, 2012).

These developments have motivated a recent studies of firms' sourcing decisions (e.g. Antràs *et al.*, 2014).[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] These agreements allow substantial trade liberalization among members, without the need to reciprocate to other GATT/WTO contracting parties.[3] Around 90% of regional agreements are free trade agreements (FTAs) and partial scope agreements, with customs unions accounting for the remaining 10%.

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 (e.g. Caliendo and Parro, 2015). However, FTAs can also distort trade in intermediaries through a second less transparent channel: preferential rules of origin (RoOs). 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 prevent final good producers from choosing the most efficient input suppliers around the world, for fear of 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.

[1] Antràs *et al.* (2014) 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. Related studies by Blaum *et al.* (2013) and Ramanarayanan (2014) use multi-country quantitative models to study the effect of imported inputs on firm-level and aggregate productivity.

[2] As of 1 December 2015, 619 notifications of regional trade agreements had been received by the GATT/WTO. Of these, 413 were in force (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).

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, transport), which might involve intermediate goods imported from different countries. FTAs often define origin based on tariff classification shifts: a product earns origin — and thus preferential tariff treatment — if it has a different Harmonised System (HS) classification than its imported inputs thus complying with a shift at a specified HS level (different chapter level, different heading level or different subheading level). RoO based on change in tariff classification imply that, for a 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 what 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), 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 intermediaries.

[4] For example, the RoO contained in the North American Free Trade Agreement (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 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 intermediaries (watch movements, straps, and cases cases).

To carry out our analysis, we focus on NAFTA, the world's largest FTA, linking 450 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 the NAFTA agreement are written at a disaggregated level, with specific rules for each product (defined at the heading or sub-heading level of the Harmonized Schedule). Second, they are mostly defined in terms of change of tariff classification, with few instances in which these rules are 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 impose sourcing restrictions on 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 no incentives to comply with them. We then further exclude flexible rules, i.e. instances in which final good producers can obtain origin by meeting a value added requirement. We also experiment with weighting the rules by the importance of the input-output linkages.

We investigate the impact of NAFTA RoO on imports of intermediate goods from non-member countries. The literature on the political economy of RoO suggests that powerful industry lobbies may shape the way FTA members draft the rules (e.g. Cadot *et al.*, 2006; Chase, 2008). To deal with concerns about the endogeneity of NAFTA RoO, we focus our analysis on Mexico rather than Canada or the United States. We argue that, from the point of view of Mexico, NAFTA RoO were to a large extent inherited from those of the Canada-United States Free Trade Agreement (CUSFTA). Indeed, the correlation between the RoO contained in the two agreements is very high (0.91). Our results continue to hold if we instrument NAFTA sourcing restrictions with those contained in the CUSFTA agreement.

To study the impact of NAFTA RoO, we employ a difference-in-differences approach, which allows us to account for the role of time-invariant unobservable product characteristics. In particular, we examine changes in Mexican imports between 1991 and 2003

[6] Http://www.ustr.gov/trade-agreements/free-trade-agreements/north-american-free-trade-agreement-nafta).

[7] Alongside tariff classification 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).

(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. We also exploit variation in the intensity of treatment, both in terms of the number and type of sourcing restrictions. To isolate the effect of RoO from other determinants of changes in Mexican imports from third countries, we control for changes in Mexican tariffs and include sector and country of origin fixed effects.

Our results show that NAFTA RoO on final goods led to a significant reduction in Mexican imports of intermediate goods from non-NAFTA countries. As expected, the magnitude of this effect depends on whether the sourcing restrictions were strict or flexible (i.e. whether change in tariff classification rules were combined with alternative value added rules) and on the extent to which Mexican producers had incentives to comply with them (i.e. on the size of the preference margin and the importance of NAFTA export markets). On average, strict RoO decreased imports of intermediaries by around 30 percentage points. The results are robust to focusing on different sets of rules, using alternative methodologies to construct the treatment variables, using different samples of goods and countries, and instrumenting NAFTA RoO with those contained in the CUSFTA agreement.

The rest of the paper is organized as follows. Section 2 reviews the related literature. In Section 3, we present an brief overview of the history of the NAFTA agreement. In Section 4, we describe the data and variables used in our empirical analysis. Section 5 presents our empirical results. The last section concludes.

2 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 intra-regional 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 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.[8] 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 intermediaries.[9]

A few studies focus on the political economy determinants of RoO. Cadot *et al.* (2006) examine the impact of lobbying by U.S. 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 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: 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; and we employ a difference-in-differences approach, which allows us to account for the role of time-invariant unobservable product characteristics.

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

[8]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.

[9]A recent study by Bombarda and Gamberoni (2013) distinguishes between intermediate and final goods, but focuses on cumulation rules (defining the geographic area from which inputs can be sourced and still be considered as originating in a FTA). The potential impact of final-good RoO on trade in intermediaries is illustrated in cases studies discussed in the legal literature (e.g. Vermulst, 1992).

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%, US's welfare increased by 0.08%, and Canada's welfare declined by 0.06%) 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 much larger.

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 U.S. 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, 2012; Koopman, Wang, and Wei, 2013). Focusing on China, Kee and Tang (2013) find that the domestic value added ratio of its exports increased by more than 10% over 2000-2006, as a result of firms substituting domestic inputs for imported inputs, due to an expansion of domestic input variety triggered by decreasing tariffs and increasing FDI. Related contributions use input-output tables to measure the distance of an input relative to final demand (Antràs and Chor, 2013; Antràs *et al.*, 2012) or to construct an industry-pair specific measure of upstreamness (Alfaro *et al.*, 2015). 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; Alfaro *et al.*, 2015).

3 Brief history of the NAFTA agreement

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).[10] Canada joined the negotiations the following year, with the goal of creating one free trade area in North America.

The NAFTA agreement was signed in 1992 by Canada, Mexico, and the United States and entered into force on January 1, 1994. Approximately 50 percent of the tariffs were abolished as soon as the agreement took effect in January 1994. Most of the remaining tariffs were phased out during the following five to ten 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% of Mexican imports and 81.72% of Mexican exports took place within NAFTA, while the corresponding shares for the United States were 25.83% and 32.32%.

In our empirical analysis, we examine the impact of NAFTA RoO on trade between Mexico and third countries. The focus on Mexico allows us to deal with endogeneity concerns, given that NAFTA RoO can be taken as exogenous from the point of view of the smaller NAFTA member. There are two main reasons for this. First, the rules contained in NAFTA were to a large extent inherited from those contained in the Canada-US Free Trade Agreement.[11] Second, to the extent that RoO were modified during the NAFTA negotiations, Mexico had little power to affect such changes. The predominant role was clearly played by the United States: in some sectors, U.S. negotiators pushed for stricter rules, under the pressure of final good producers which wanted to ensure that foreign assembly companies would not be eligible for favorable tariff treatment.[12] In other sec-

[10] During the 1980's 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-1980's. Much of the governments 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 GATT in 1986.

[11] The correlation between the RoO of CUSFTA and those of NAFTA is 0.91 (see Section 5.4).

[12] For example, this was the case of the automobile industry — in which U.S. producers were concerned about competition from Japanese and European firms with plants in North America — and the textile

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

4 Data and Variables

4.1 Dataset on NAFTA Rules of Origins

The rules of origin contained in Annex 401 of the NAFTA agreement determine the conditions under which goods imported from the member countries are eligible to receive preferential tariff treatment. The NAFTA Certificate of Origin is used by customs officials in Canada, Mexico, and the Unites States to establish if the goods imported from their NAFTA partners receive MFN or reduced duties.[15] In the absence of such certificate, MFN tariff rates are applied.

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. Second, they are mostly defined in terms of tariff classification changes. This is not the case for other FTAs, in which valued added rules are predominant (e.g. free trade agreements between the EU 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"). NAFTA rules of origin for this product require the following:

industry — in which the U.S. producers wanted to ensure that the Mexican apparel industry would use U.S. (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.

[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]The Certificate of Origin must be completed by the exporter and sent to the importer. While this document does not have to accompany the shipment, the importer must have a copy in hand before claiming the NAFTA tariff preference at customs. See `http://forms.cbp.gov/pdf/CBP_Form_434.pdf` for the English version of the certificate.

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

We can divide this rule into a main rule and several additional requirements.[16] The first part ("A change to subheadings 6203.41 through 6203.49 from any other chapter") is the main rule and requires an HS chapter change, i.e. any non-originating input must be sourced outside the chapter of the final good (in the example above chapter 62). In other words, any input falling within chapter 62 must be sourced within NAFTA for the textile fabric to obtain origin status. The second part (from "except from headings 5106 through 5113" till 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 output (chapter 62).

Final good producers who do not fulfill these sourcing requirements are denied preferential tariff treatment when exporting to NAFTA partners. Going back to the textile example above, in 2001 a Mexican producer of trousers was denied origin status (and thus lower-than-MFN tariff treatment when exporting to NAFTA partners) because he had imported some restricted fabrics (falling under heading 5204 through 5212) from the Philippines. To comply with NAFTA RoO, the Mexican producer should have sourced these fabrics within the FTA.[17]

In the NAFTA agreement, value added (VA) rules are only used in combination with change of classification rules. There are two types of VA rules. 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 (fore more details, see Puccio, 2013).

[16]These additional requirements can be divided into two categories: those written at the Harmonized Schedule level, i.e. at the chapter, heading or sub-heading level and those written at the national schedule level, i.e. at the 8-digit level and, for the United States, at the 8 or 10 digit level. Those requirements written at the Harmonized Schedule level apply to all partners, while the those written at the national level apply only to goods exported to that partner. In the example given here, all additional requirements are written at the chapter, heading or sub-heading level.

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

The goal of our empirical analysis is to examine the impact of RoO on final goods on trade in intermediaries. To this purpose, we have constructed a dataset that codifies all the change of classification requirements (main rule and additional requirements) contained in Annex 401.[18] 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.

We define the dummy variable $RoO_{i,j}$, which is equal to 1 if RoO on final good i impose sourcing restrictions on intermediate good j. To capture the overall impact of NAFTA RoO on imports of intermediate good j, we count the number of sourcing restrictions that apply to this good, i.e. $\sum_i RoO_{i,j}$.[19] We construct three different versions of this variable. $RoO^1_{i,j}$ includes all rules on final goods i restricting the sourcing of j. $RoO^2_{i,j}$ excludes rules that Mexican producers have no incentives to comply with, given that the preference margin on their final good is zero.[20] $RoO^3_{i,j}$ further excludes change of classification rules that do not impose strict sourcing restrictions, i.e. instances in which final good producers can obtain origin status by complying with value added rules. In our empirical analysis, we will express our treatment variables in logs.

Table 1 provides descriptive statistics of these variables. The reported numbers are averages across intermediate goods j that fall within each of the broad sector categories. 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 445.67 to 1.98 when considering only strict change of classification rules.

[18] Trade flows are expressed at the 6-digit HS level. We have converted all RoO to 6 digits, expanding those written at the 2- or 4-digit level and dropping rules written at the national 8 or 10-digit levels.

[19] As shown in Section 5.3, the results are very similar if we weight each $RoO_{i,j}$ by the importance of the vertical linkage between i and j.

[20] As discussed in Section 4.2, we construct two versions of the variable $Preference\ Margin_{i,NAFTA}$: the first is an average between the preference margins of the U.S. and Canada; the second coincides with the preference margin of the U.S., which is by far the most important trading partner of Mexico.

Table 1

Descriptive statistics on NAFTA RoO

	Panel (A): RoO^1_{ij}			Panel (B): RoO^2_{ij}			Panel (C): RoO^3_{ij}		
HS	mean	min	max	mean	min	max	mean	min	max
01-05: Animal Products	57.39	0	87	18.01	0	24	17.86	0	24
06-15: Vegetables	39.77	0	57	23.43	0	43	22.80	0	41
16-24: Foodstuffs	23.60	0	44	18.49	0	37	17.95	0	36
25-27: Mineral Products	54.04	0	74	13.56	0	32	13.36	0	32
28-38: Chemicals	553.87	0	591	445.67	0	483	1.98	0	33
39-40: Plastics/Rubbers	21.03	1	61	12.89	0	36	10.69	0	28
41-43: Raw Hides, Skins, Leathers	21.39	9	34	18.82	4	30	17.44	4	27
44-49: Wood Products	38.52	0	93	27.89	0	77	19.11	0	58
50-63: Textiles	280.21	4	722	276.66	1	715	276.61	1	715
64-67: Footwear/Headgear	17.01	2	29	16.50	1	29	15.56	1	27
68-71: Stone/Glass	37.18	0	57	23.01	0	52	27.22	0	50
72-83: Metals	39.81	0	96	33.13	0	81	28.94	0	53
84-85: Machinery/Electrical	8.78	0	65	5.08	0	63	4.45	0	56
86-89: Transportation	9.54	1	22	8.30	0	20	6.81	0	20
90-97: Miscellaneous	19.94	0	44	15.59	0	41	13.96	0	41
All sector categories	148.15	0	722	124.24	0	715	55.98	0	715
Total number of RoO	746,383			625,957			281,976		

The table provides descriptive statistics of our treatment variables. For each sector, we report the mean, minimum and maximum number of sourcing restrictions imposed on intermediate goods in those sectors. $RoO^x_{i,j}$ 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 $\textit{Preference Margin}_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules.

Figure 1
NAFTA Rules of Origin

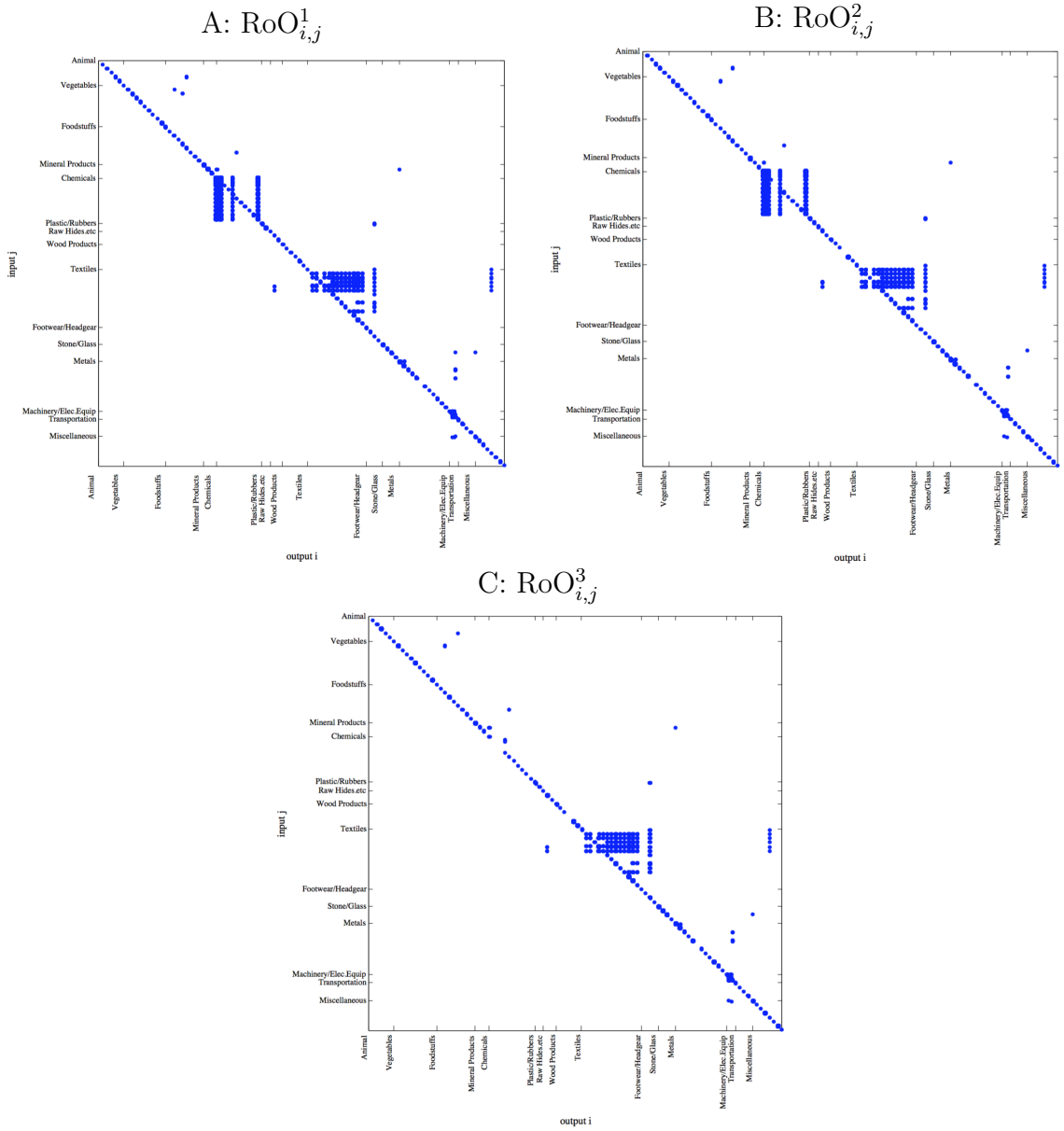

Figure 1 provides a graphical representation of NAFTA rules of origin. Outputs i are on the horizontal axis and inputs j are on the vertical axis. Each dot corresponds to $RoO_{i,j} = 1$, i.e. a rule on final good i that imposes sourcing restrictions on intermediate good j. Panel (A) shows $RoO^1_{i,j}$, which is the set of all rules. Panel (B) shows $RoO^2_{i,j}$, which includes only rules for which $Preference\ Margin_{i,NAFTA} > 0$. In Panel (C) we plot $RoO^3_{i,j}$, which includes only rules for which the output has a positive preference margin and with no facilitating value added rules.

Similar patters can be seen in Figure 1, which provides a graphical representation of the three RoO measures. Outputs i are located on the horizontal axis, whereas inputs j are on the vertical axes. 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. The figure represents well the input-output linkages in NAFTA RoO. However, it fails to show the full richness of our dataset: given the high disaggregation of our data (HS6 digit). As it can be seen from Figure A-1 in the Appendix, which zooms into Panel A of Figure 1, in many cases, there are hundreds or even thousands of RoO within each of the blue dots.[21]

Crucially, rules of origin can 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).[22] While the BEA employs NAICS 6-digit classification, the rules of origin use the HS trade classification. Unfortunately, the matching implied by the concordance table provided by the BEA is not one-to-one. In particular, each of the NAICS products is associated to several HS6 items.

To get a sense of how often RoO apply to vertically-related goods, we randomly match each NAICS 6-digit good with one of the associated HS 6-digit goods.[23] Each randomization generates an input-output table expressed in HS6 codes; we repeat the procedure 1000 times, to make sure that our results are stable across randomizations.[24] Using the input-output tables thus constructed, we can verify whether RoO on a good i impose sourcing restrictions on goods j that are actually inputs in the production of i. Formally, for each converted input-output table and each rule RoO_{ij}, we check whether i and j are vertically related, i.e. whether the input-output coefficient IO_{ij} is positive.

We apply this procedure to different types of RoO. In particular, we compute the percentage of rules defined at 2-, 4- and 6-digits of the HS classification that apply to

[21] See RoO movie.

[22] In particular, we use the direct requirement matrix provided in the 1997 Benchmark Input-Output Accounts. In contrast to earlier IO tables provided by the BEA, the 1997 one is constructed based on NAIC97 classification, which allows us to convert it to HS6 by using only one conversion table.

[23] Consider, for instance, the case of cement manufacturing. The NAICS 6-digit code for this good is 327310. However, according to the concordance table provided by the BEA, there are six different HS6 digit goods associated to it: "aluminous cement" (252330), "cement clinkers" (252310), "hydraulic lime" (252390), "portland cement except white portland cement" (252329), "white portland cement" (252321), and "hydraulic cement" (252390). In this case, we randomly match the the NAIC 6-digit product "cement manufacturing" with one of the HS6 goods associated to it.

[24] The input-output tables constructed using this randomization procedure do not contain all goods and thus do not allow us to check wether a particular rule applies to vertically-related goods. To this purpose, in Section 5.3 we use information on direct requirement coefficients of all possible $i-j$ matches.

vertically-related goods. 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 used as inputs in the production of the final good. Rules defined at the chapter level (HS2) apply to vertically-related goods in around 50% of the cases on average (with this number being very stable across randomizations). For rules defined at the heading level (HS4), this average increases to 68%. The higher percentage is found for rules defined at the sub-heading (HS6) level (96%).

In our empirical analysis, we will first examine the impact of RoO written at 6 digits which are more likely to identify vertically-related goods. We will then extend the analysis to rules written at 2 and 4 digits.

4.2 Trade data

As mentioned above, we study the effects of NAFTA RoO on Mexican imports from third countries. The focus on Mexico allows us to deal with concerns about the endogeneity of RoO: Mexico had little saying in the drafting of the rules that were included in Annex 401 of the NAFTA agreement, which were largely inherited from those of the Canada-United States Free Trade Agreement.

As discussed in the next section, we study the determinants of $\Delta Imports_{j,o}$, the log change in Mexican imports of a HS6-digit good j from non-NAFTA country o between 1991 and 2003. The source of this data is the World Integrated Trade Solution (WITS). We choose 1991 as our "before" period because this is the latest year before NAFTA came into force for which WITS provides data on Mexican imports. We choose 2003 as our "after" period to allow enough time for producers to learn about NAFTA sourcing restrictions and adjust their decisions accordingly.[25]

The list of non-NAFTA countries included in our analysis can be found in Table A-1 in the Appendix. In our benchmark regressions, we focus on all GATT/WTO members that had no preferential trade agreements with Mexico during our sample period, which faced MFN tariffs when exporting to Mexico in 1991 and 2003. In robustness checks, we also include countries with which Mexico had a FTA in force in 2003.[26]

We also collect from WITS data on the import tariffs applied by Mexico. This is straightforward for our main sample of countries, for which we can simply look at the MFN tariffs applied by Mexico in 1991 and 2003.[27] Information on the preferential

[25]NAFTA RoO were slightly modified after 2003. Before that date, there were only minor technical changes, e.g. to make the rules compatible with changes in the harmonized classification.

[26]The list of countries with which Mexico has FTAs and other types of preferential trade agreements and the dates on entry into force can be found at http://fas.org/sgp/crs/row/R40784.pdf.

[27]As mentioned before, before the NAFTA agreement, Mexico had a duty drawback scheme, which

tariffs applied by Mexico is not always available. For this reason, we can only include in our analysis a subset of Mexico's FTA partners.[28]

Table 2 reports descriptive statistics of Mexican imports and tariffs by sector in 1991 and 2003. In general, Mexican imports from third countries increased significantly between 1991 and 2003. For the average product-origin, the increase in imports was 217.29%. Average tariffs fell in most sectors. However, this is due to the inclusion of the preferential tariffs applied by Mexico on imports from FTA partners; the MFN tariffs applied by Mexico actually increased during our sample period.[29]

To isolate the effects of preferential RoO from those of preferential tariff liberalization, we construct the variable $\Delta Preferential\ Tariff_{j,o}$. This captures the extent to which, following the implementation of the NAFTA agreement, Mexico lowered tariffs on imports from Canada and the United States more than tariffs on imports from third countries. $\Delta Preferential\ Tariff_{j,o}$ is defined as $\Delta Tariff_{j,o} - \Delta Tariff_{j,NAFTA}$. The variable $\Delta Tariff_{j,o}$, is the log change in the tariff applied by Mexico on imports of good j from non-NAFTA country o between 1991 and 2003. The variable $\Delta Tariff_{j,NAFTA}$ is the log change in the tariff applied by Mexico to imports of good j from Canada and the United States between 1991 and 2003. To construct this variable, we use information on Mexican applied MFN tariffs in 1991 and on the preferential tariffs applied by Mexico to imports from its NAFTA partners in 2003. The larger is $\Delta Preferential\ Tariff_{j,o}$, the larger is the increase in protection on good j faced by producers from third countries relative to Canadian and U.S. producers when exporting to Mexico.

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 by Mexico are not available, so we use data on MFN applied tariffs to capture input tariffs in 1991.

[28]WITS provides data on Mexican preferential tariffs for three FTAs (with the EU, Chile and Israel). For these countries, we use the preferential tariffs applied by Mexico in 2004, due to the lack of information for 2003.

[29]Upon accessing the GATT in 1986, Mexico bound 100% 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. there was a significant gap between its bound and applied MFN tariffs. Following the Uruguay Round of multilateral trade negotiations (1986-1994), Mexico reduced the level of its tariff bindings (Blackhurst *et al.*, 1996). However, this did not result in lower applied MFN tariffs. Indeed, if we compare the MFN tariffs applied by Mexico in 1991 and 2003 (before and after the Uruguay Round), we find that on average they increased by 14.14 percent.

Table 2

Descriptive statistics of Mexican imports and applied tariffs

	Panel A imports			Panel B applied tariffs		
HS	1991	2003	%Δ	1991	2003	%Δ
01-05: Animal Products	104.73	356.35	122.45	13.97	19.40	30.89
06-15: Vegetables	154.15	204.50	28.26	12.77	10.44	-18.55
16-24: Foodstuffs	61.92	73.61	17.29	17.20	14.27	-17.55
25-27: Mineral Products	117.95	699.42	177.99	9.30	4.34	-65.73
28-38: Chemicals	101.34	715.27	195.41	11.23	5.74	-59.43
39-40: Plastics/Rubbers	114.26	1078.89	224.51	13.47	9.85	-28.71
41-43: Raw Hides, Skins, Leathers	20.49	214.15	234.68	13.55	13.02	-3.69
44-49: Wood Products	30.46	257.23	213.35	11.88	8.52	-30.22
50-63: Textiles	227.67	988.01	146.77	16.81	13.80	-18.50
64-67: Footwear/Headgear	52.11	242.24	153.64	19.17	18.75	-2.09
68-71: Stone/Glass	15.15	277.54	290.73	15.64	9.04	-50.53
72-83: Metals	141.39	1034.75	199.03	12.72	9.15	-30.06
84-85: Machinery/Electrical	721.99	19386.63	329.03	13.61	7.45	-54.69
86-89: Transportation	71.93	739.78	233.05	14.30	9.23	-40.27
90-97: Miscellaneous	221.41	1124.90	162.54	15.05	10.76	-31.06

Notes: Panel A of this table reports descriptive statistics on Mexican imports of good j from non-NAFTA countries o in 1991 and 2003. Imports are measured in millions of U.S.$ (current value). Changes in imports are computed as sectoral averages of $log(1 + Imports_{j,o,2003}) - log(1 + Imports_{j,o,1991})$. Panel B reports descriptive statistics of the tariffs applied by Mexico to imports of good j from non-NAFTA country o in 1991 and 2003. Tariffs are expressed in percentage terms. Changes in tariffs are computed as sectoral averages of $log(1 + Tariff_{j,o,2003}) - log(1 + Tariff_{j,o,1991})$.

RoO on final goods i should have a bigger impact of imports of intermediate goods j if final good producers have stronger incentives to comply with them. In turn, these incentives should depend on how much producers stand to gain from obtaining origin status. Using information from WITS on MFN and preferential tariff rates applied by Canada and the United States in 2003, we construct the variable $Preference\ Margin_{i,NAFTA}$, which captures the tariff gain from obtaining origin for Mexican producers of good i. This is defined as the average between the preference margins of Canada and the United States.[30] Notice that, unlike the variables $\Delta Imports_{j,o}$, $\Delta Tariff_{j,o}$ and $\Delta Tariff_{j,NAFTA}$ the variable $Preference\ Margin_{i,NAFTA}$ is not expressed as a difference between 1991 and

[30] We first average the preference margin across destination countries (Canada and the United States), for each final good i that imposes restriction on j. We then take the average across final goods. Given

2003 values. This is because the impact of NAFTA RoO should depend only on the preferential margin enjoyed by Mexican producers of i when exporting to Canada and the United States after the implementation of the NAFTA agreement.[31]

Finally, to proxy for the importance of the export markets of NAFTA partners for Mexican final good producers, we define the variable $Exports_{i,NAFTA}$, which is equal to total Mexican exports of good i to Canada and the United States. To avoid endogeneity concerns, we use pre-NAFTA (1991) exports to construct this measure.

5 Empirical analysis

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

The goal of our analysis is to verify whether NAFTA RoO gave rise to this trade diversion in intermediaries. Going back to the example mentioned in Section 4.1, we want to verify whether NAFTA sourcing restrictions on "men's or boys' trousers" had a detrimental effect on Mexican imports of the fabrics to which these restrictions apply.

5.1 Empirical methodology

To assess the impact of NAFTA rules of origin, we 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. In terms of notation, throughout this section, we refer to log changes whenever we use a Δ.[32] In addition, we express all the variables in logs unless specified. The definition of the variables used in our empirical analysis and the sources used to construct them can be found in Table A-2 in the Appendix.

In our benchmark regressions, we estimate

$$\Delta Imports_{j,o} = \alpha + \beta_1 \ RoO^x_{i,j} + \beta_2 \ \Delta Preferential \ Tariff_{j,o} + \delta_j + \delta_o + \epsilon_{j,o}. \qquad (1)$$

that the United States is by far the most important trading partner of Mexico, we have also tried to use a measure based on U.S. tariffs only, obtaining similar results.

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

[32] The Δ variables represent percentage changes. Since some variables y take values equal to zero, we compute changes in log $(1+y)$.

This difference-in-differences approach allows us to remove any potential bias that could be the result of time-invariant unobservable differences across goods. The dependent variable, $\Delta Imports_{j,o}$, 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 $RoO^x_{i,j}$, which captures the effect of the introduction of NAFTA RoO on final goods i imposing sourcing restrictions on intermediate j. As discussed in Section 4, we consider three versions of the treatment variable $RoO^x_{i,j}$. In the first treatment ($x = 1$), we include all RoO on final goods i imposing sourcing restrictions on good j. The second 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 $Preference\ Margin_{i,NAFTA}$ is equal to zero, which producers have no incentives to comply with. The last treatment ($x = 3$) also takes into account value added rules. This measure includes only rules for which the preference margin on the final good is positive and for which there are no alternative value added rules. We expect the estimated β_1 coefficient to be negative and significant, at least when using the more stringent treatment variables $RoO^2_{i,j}$ and $RoO^3_{i,j}$.

In all specifications, we include industry fixed effects δ_j (at HS3-digit level), which allows us to control for sector-specific trends,[33] as well as country-of-origin fixed effects, which account for any country-specific determinants of Mexican imports (e.g. distance, common language). In some specifications, we also include the variables $\Delta Preferential\ Tariff_{j,o}$, 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. We expect the coefficient β_2 to be negative, reflecting the trade diversion effect of preferential tariff liberalization among NAFTA partners.

5.2 Results based on NAFTA rules defined at 6 digits

As discussed in Section 4, NAFTA RoO are defined at the chapter level (HS2), heading level (HS4) or sub-heading (HS6) level. In this section, we focus on the impact of rules written at the HS6 level, which are more likely to identify vertically-related goods (they apply to vertically-related goods in 96% of the cases). In the next section, we show that our results are robust to including rules defined at a more aggregate level.

Table 3 shows the results of estimating equation (1). In columns 1, 3 and 5, we report the results of parsimonious specifications, in which we include only the RoO variables, industry and country-of-origin fixed effects. In columns 2, 4 and 6, we also control for the

[33] For example, the inclusion of industry dummies accounts for sectoral changes in employment or productivity, which may have affected Mexican imports from non-NAFTA countries.

difference in the tariffs applied by Mexico to imports from third countries and NAFTA partners.

Table 3

NAFTA RoO and change in Mexican imports from non-NAFTA countries

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	0.001	0.007				
	(0.086)	(0.085)				
$RoO^2_{i,j}$			-0.267***	-0.171**		
			(0.083)	(0.084)		
$RoO^3_{i,j}$					-0.306***	-0.207**
					(0.084)	(0.085)
Δ*Preferential Tariff*$_{j,o}$		-0.574***		-0.559**		-0.555***
		(0.074)		(0.084)		(0.075)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	7,015	7,003	7,015	7,003	7,015	7,003
R-squared	0.244	0.252	0.245	0.252	0.245	0.252

This table shows the results of the estimation of equation (1). The dependent variable is Δ*Imports*$_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. $RoO^x_{i,j}$ 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*$_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. Δ*Preferential Tariff*$_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA countries. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

The key results of our analysis concern the coefficients of the RoO variables, which capture the impact of NAFTA sourcing restrictions on Mexican imports of intermediaries. Looking first at column 1 and 2, we find that the coefficient associated to $RoO^1_{i,j}$ is not significant. As discussed above, RoO on final goods should lead to trade diversion in intermediaries only if the preference margin is positive. The fact that the coefficient is insignificant in column 1 suggests that, by including in $RoO^1_{i,j}$ final goods with zero preference margin, we might be mis-measuring the treatment. Columns 3 and 4 show that, when we use $RoO^2_{i,j}$ as a treatment, our coefficient of interest becomes significant at 1%. This finding confirms our prior: by including only final goods i for which the variable *Preference Margin*$_{i,NAFTA}$ is positive, we can isolate those RoO that constraint

producers' sourcing decisions and better measure their effect on imports of intermediate goods. In columns 5 and 6, we use $RoO^3_{i,j}$ to capture the impact of NAFTA sourcing restrictions. This is our preferred treatment variable, because it only includes rules that are relevant (final good producers have something to gain by complying to them) and strict (origin can only be obtained if the restricted inputs are sourced within NAFTA). Not surprisingly, the estimated coefficients of $RoO^3_{i,j}$ are significant at 1% and, as discussed below, the effect of this variable is larger than that of the weaker treatment variables.

How large was the trade diversion in intermediaries due to the introduction of NAFTA sourcing restrictions? The estimates of columns 4 and 6 in Table 3 indicate that RoO_2 and RoO_3 decreased imports of affected intermediate goods from non-NAFTA countries by around 22 and 26 percentage points, respectively.[34] The effect was much larger for intermediate goods that were subject to more sourcing restrictions. Consider for example the case of "Other Positive Rotary Displacement Pumps" (HS6 841360), for which the variable $RoO^3_{i,j}$ was equal to 14, the 90th percentile in the distribution of treated goods. The coefficient estimated in column 6 of Table 3 implies that NAFTA RoO reduced Mexican imports of this good from non-NAFTA countries by around 56 percentage points.

The results of Table 3 also confirm that NAFTA decreased imports from non-member countries through another more transparent channel, i.e. preferential tariff reductions vis-à-vis NAFTA partners. In columns 2, 4 and 6, the coefficient of the variable $\Delta Preferential\ Tariff_{j,o}$ is negative and significant at 1%, indicating that the trade diversion effect was larger in sectors characterized by larger reductions in Mexican tariffs on imports from Canada and the United States relative to imports from third countries.[35] In terms of magnitude, the estimated coefficient in column 6 indicates that preferential tariff cuts vis-à-vis NAFTA partners decreased imports of intermediate goods from third countries by around 155 percentage points.[36]

The results of Tables 3 should be considered as an underestimate of the effects of RoO. There are two main reasons for this. First, in 2003 some Mexican producers

[34]The magnitudes of these effects are obtained by multiplying the estimated coefficients of columns 4 and 6 in Table 3 by the averages of log $RoO^2_{i,j}$ and log $RoO^3_{i,j}$ for treated goods (-0.171 $\times$ 1.28 = -0.22 ; -0.207 $\times$ 1.27 = -0.26). These reductions represent around 14% and 17% of the average actual changes in imports of treated goods (0.22/1.57 = 0.14 ; 0.26/1.53 = 0.17).

[35]Instead of $\Delta Preferential\ Tariff_{j,o} \equiv \Delta Tariff_{j,o} - \Delta Tariff_{j,NAFTA}$, we can separately include in our regressions the variables $\Delta Tariff_{j,o}$ and $\Delta Tariff_{j,NAFTA}$. As expected, the estimated coefficients are both negative and significant at 1%.

[36]The estimated coefficient of $\Delta Tariff_{j,o}$ in column 6 of Table 3 is -0.55. The effect of input tariffs can be computed multiplying this coefficient by the average of $\Delta Tariff_{j,o}$ ($-0.55 * 2.8 = 1.55$). The absolute value of this effect as a percentage of the change in imports of goods with RoO this is 1.55/1.53 = 1.01.

had still to fully understand and adjust to NAFTA sourcing restrictions.[37] Second, in our analysis so far, we have only looked at the impact of RoO that were written at the sub-heading (HS6) level. As discussed in Section 4, these rules are more likely to affect sourcing decisions, given that they apply to vertically-related goods in 96% of the cases. By contrast, RoO defined at the chapter (HS2) and heading level (HS4) apply to vertically-related goods in only 50% and 68% of the cases, respectively. By excluding these rules, we have classified as "non treated" some intermediate goods that were actually subject to sourcing restrictions. In the next section, we will extend the analysis to NAFTA RoO defined at the chapter and heading level, exploiting information from input-output tables to identify the rules that apply to vertically-related goods.

We next focus on intermediate goods that were subject to strict sourcing restrictions (i.e. j goods for which the variable $RoO^3_{ij} > 0$) 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 Canada and the United States on their final goods, the stronger the incentives to source the restricted inputs within NAFTA. The effect of RoO on Mexican imports of intermediaries from non-member countries should thus be increasing in the variable $Preference\ Margin_{i,NAFTA}$.

The effect of NAFTA RoO should also have been more detrimental when the sourcing restrictions apply to final goods for which Canada and the United States represent more important export markets. To see this, consider the example of two Mexican producers, selling different final goods. Before NAFTA, both producers 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 the NAFTA agreement, the two producers can export their goods to Canada and the United States 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 $Exports_{i,NAFTA}$, the volume of pre-NAFTA (1991) Mexican exports of good i to Canada and the United States.

To verify whether the impact of RoO varies with the incentives of final good producers

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

to comply with them, we estimate the following:

$$\begin{aligned}\Delta Imports_{j,o} &= \alpha + \beta_1\ RoO^3_{i,j} \times Preference\ Margin_{i,NAFTA} + \beta_2\ RoO^3_{i,j} \times Exports_{i,NAFTA} \\ &\quad + \beta_3\ RoO^3_{i,j} + \beta_4\ Preference\ Margin_{i,NAFTA} + \beta_5\ Exports_{i,NAFTA} \\ &\quad + \beta_6\ \Delta Preferential\ Tariff_{j,o} + \delta_j + \delta_o + \epsilon_{j,o}. \qquad (2)\end{aligned}$$

We expect trade diversion in intermediaries to be larger when final good producers have stronger incentives to comply with NAFTA RoO. The estimated coefficients for β_1 and β_2 should thus be negative and significant.

Table 4

NAFTA RoO and change in Mexican imports from non-NAFTA countries

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^3_{i,j} \times Preference\ Margin_{i,NAFTA}$	-3.105	-3.780*			-4.500**	-5.615***
	(1.978)	(2.017)			2.094	(2.167)
$RoO^3_{i,j} \times Exports_{i,NAFTA}$			-0.010*	-0.021***	-0.021**	-0.023**
			(0.006)	(0.007)	(0.010)	(0.010)
$RoO^3_{i,j}$	3.672	4.301*	-1.334***	-0.839**	5.548**	6.192**
	(2.364)	(2.391)	(0.365)	(0.386)	(2.592)	(2.607)
$Preference\ Margin_{i,NAFTA}$	0.543	1.327			1.711	2.925*
	(1.522)	(1.581)			(1.648)	(1.738)
$Exports_{i,NAFTA}$			0.056***	0.085***	0.062	0.079*
			(0.021)	(0.024)	(0.043)	(.045)
$\Delta Preferential\ tariff_{j,o}$		-0.807**		-0.700**		-0.898**
		(0.383)		(0.206)		(0.397)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	348	346	600	598	348	346
R-squared	0.416	0.435	0.452	0.464	0.427	0.436

This table shows the results of the estimation of equation (2). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. $RoO^3_{i,j}$ is the number of final goods i that have a RoO restricting the sourcing of good j, excluding those with $Preference\ Margin_{i,NAFTA} = 0$ and with alternative VA rules. The variable $Preference\ Margin_{i,NAFTA}$ is constructed based on the MFN and preferential tariffs applied Canada and the United States in 2003. The variable $Exports_{i,NAFTA}$ measures Mexican exports of final goods i to Canada and the United States in 1991. $\Delta Preferential\ Tariff_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Significance levels: *; 10%; **: 5%; ***: 1%.

The results are reported in Table 4. In all specifications, the interactions terms between the RoO variable and $Preference\ Margin_{i,NAFTA}$ and $Exports_{i,NAFTA}$ are negative and significant. This confirms that the negative impact of NAFTA RoO 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. Based on the estimates of Table 4, we can compute the effect of *RoO* for different levels of *Preference Margin*$_{i,NAFTA}$ and *Exports*$_{i,NAFTA}$. For example, the estimates in column (6) imply a RoO coefficient of -3.01 for goods falling in the 90th percentile of the distribution of the *Preference Margin*$_{i,NAFTA}$ and a coefficient of -1.56 for goods in the 90th percentile of the distribution of *Exports*$_{i,NAFTA}$.

In the Appendix, we report the results of additional estimations to verify the robustness of our main results. In our benchmark regressions, we include only goods that Mexico imported from third countries in both 1991 and 2003. However, NAFTA sourcing restrictions may have also affected whether or not Mexico imported at all a given intermediate from non-member countries. To account for the effect of RoO on the extensive margin, we reproduce all the specifications of Table 3, including in our analysis goods that Mexico imported only in 1991 or 2003 (see Table A-3). The results confirm that NAFTA RoO led to a reduction in Mexican imports of intermediaries from non-member countries. As expected, the effect is stronger in columns 5 and 6, in which we consider only change of classification rules that apply to final goods with a positive preference margin and are not relaxed by alternative value added rules. We have also tried including in our sample non-NAFTA countries that negotiated an FTA with Mexico during our sample period (see Table A-4). The results continue to hold: NAFTA RoO had a detrimental effect on Mexican imports of restricted inputs from third countries.[38]

5.3 Results based on all NAFTA rules

RoO should only affect sourcing decisions if 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. For this reason, in our analysis so far we have focused on RoO defined at the HS6 level, which apply to vertically-related goods in almost 100% of the cases.[39]

In this section, we show that the results continue to hold when we include RoO

[38]The sample used in these regressions includes EU members, Chile and Israel. As discussed in Section 4.2, for these countries, WITS provides data on the preferential tariffs applied by Mexico to imports from the FTA partners, which we can use to compute the variable Δ*Preferential Tariff*$_{jo}$ (see footnote 28). Our analysis suggests that, to better explain changes in Mexican imports from these FTA partners, we would need to take into account the RoO contained in these trade agreements.

[39]Recall that, using information from input-output tables, we have computed the percentage of NAFTA RoO defined at 2-, 4- and 6-digits of the HS classification restricting the sourcing of vertically-related goods (see Section 4.1). Rules defined at 6 digits apply to vertically-related goods in 96% of the cases. The number is much lower for rules defined at 2 and 4 digits (50% and 68%, respectively).

defined at 2 and 4 digits. We follow three alternative approaches. First, we include all rules, independently of vertical linkages. Second, we use information from input-output tables to include only rules that apply to vertically-related goods. Finally, we allow the impact of the rules to depend on the importance of the vertical linkages.

Table 5

NAFTA RoO and change in Mexican imports from non-NAFTA countries (including all rules)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	-0.148*	-0.080				
	(0.089)	(0.088)				
$RoO^2_{i,j}$			-0.159**	-0.096		
			(0.069)	(0.069)		
$RoO^3_{i,j}$					-0.169***	-0.112*
					(0.063)	(0.063)
Δ*Preferential tariff*$_{j,o}$		-0.567***		-0.561***		-0.554***
		(0.075)		(0.075)		(0.075)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	7,015	7,003	7,015	7,003	7,015	7,003
R-squared	0.244	0.252	0.244	0.252	0.245	0.252

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. $RoO^x_{i,j}$ 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 $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

Table 5 reproduces the difference-in-differences specifications of Table 3, including all rules contained in Annex 401 of the NAFTA agreement, independently of whether or not they apply to vertically-related goods. Compared to our benchmark regressions, here we account for the potential impact of all NAFTA RoO on Mexican imports of intermediate goods. However, the treatment variables are less precisely measured, given that many of the rules defined at 2 and 4 digits do not apply to vertically-related goods.

The results continue to hold. We find that NAFTA RoO on final goods led to a reduction in Mexican imports of intermediaries from non-NAFTA countries. The effect

is significant only for rules that are relevant — apply to final goods with a positive preference margin—and strict strict — are not relaxed by alternative value added rules. In terms of magnitude, the estimated coefficient of column 6 in Table 5 implies that RoO of final goods decreased intermediate imports from third countries by 32 percentage points on average.[40]

Our next step is to exclude RoO that do not apply to vertically-related goods. To check whether a given rule RoO_{ij} imposes a sourcing restriction, we must verify whether good j is an input in the production of final good i. To this end, we exploit the information contained in the IO Direct Requirement table 1997 provided by the BEA and include in our treatment variables all rules for which $dr_{i,j} > 0$. Compared to the strategy used in Table 5, this methodology allows us to eliminate from our treatment variables RoO that do not impose any sourcing restrictions. However, the fact that IO tables are RoO are written using different classifications (NAICS and HS) introduces some noise in the measurement of vertical linkages. As discussed in Section 4.1, in the concordance table provided by the BEA, each NAICS 6-digit good corresponds to more than one HS 6-digit good. Imagine that, according to the concordance table, NAICS-6 good "a" corresponds to HS6 goods "1" and "2", and that NAICS-6 good "b" corresponds to HS6 goods "3" and "4". To identify RoO that apply to vertically-related goods, we look at the direct requirement coefficients of all matched NAICS-HS goods. If, for example, NAICS 6-digit goods "a" and "b" are vertically related (i.e. $dr_{a,b} > 0$), we assume that HS6 goods "1", "2", "3", and "4" are all vertically related.

Using this methodology, in the regressions of Table 6 we exclude from our treatment variables all rules that do not apply to vertically-related goods. Once again, we find a negative relationship between the number of NAFTA sourcing restrictions applied to an intermediate good and the change in Mexican imports of this good from non-member countries. Once we control for the change in input tariffs, the effect is significant only for rules with a positive preference margin and no alternative value added rules. The effect is slightly smaller than in Table 5. The coefficient of RoO_3 in column 6 implies that NAFTA sourcing restrictions decreased Mexican imports of intermediaries by 18 percentage points.[41]

[40] This effect is computed by multiplying the estimated coefficient (-0.112) by the average of log $RoO^3_{i,j}$ for treated goods (2.839). This represents around 25% of the actual change in imports (computed dividing the 32 percentage points reduction by 1.246, the average log change in imports of treated goods.

[41] This reduction in imports is obtained by multiplying the estimated coefficient of column 6 in Table 6 by the average of log $RoO^3_{i,j}$ (-0.069 $\times$ 2.65 $= -0.18$). This reduction represents around 15% of the average change in imports of goods subject to sourcing restrictions ($0.18/1.53 = 0.15$).

Table 6

NAFTA RoO and change in Mexican imports from non-NAFTA countries (including all rules for which $dr_{i,j} > 0$)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	-0.058	-0.051				
	(0.041)	(0.041)				
$RoO^2_{i,j}$			-0.026	-0.018		
			(0.038)	(0.038)		
$RoO^3_{i,j}$					-0.082**	-0.069*
					(0.041)	(0.041)
$\Delta Preferential\ tariff_{j,o}$		-0.572***		-0.573***		-0.569***
		(0.074)		(0.074)		(0.074)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	7,015	7,003	7,015	7,003	7,015	7,003
R-squared	0.244	0.252	0.244	0.252	0.244	0.252

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. The variable $RoO^x_{i,j}$ is the number (in logs) of rules $RoO_{i,j}$, weighted by the $dr_{i,j}$ coefficients. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

The effect of RoO on imports of intermediaries 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 (i.e. $dr_{i,j} > dr_{i',j}$). 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 dr coefficients proxy for higher quality inputs).[42]

[42]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 (i.e. $dr_{i,j} > dr_{i,j'}$). We would then expect Mexican imports of j

To allow for these heterogeneous effects, we modify our treatment variables, weighting each rule RoO_{ij} by the direct requirement coefficient dr_{ij}. Table 7 reproduces our difference-in-differences regressions when we use these alternative RoO regressors. Once again, we find that NAFTA RoO reduced Mexican imports of intermediaries from non-NAFTA countries. As in previous specifications, we also find that the effect is significant only for RoO_3. In terms of magnitude, the estimate in column 6 implies an average reduction in imports of affected intermediate goods of around 19 percentage points.[43]

Table 7

NAFTA RoO and change in Mexican imports from non-NAFTA countries (weighting rules by $dr_{i,j}$)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	-0.102	-0.116				
	(0.087)	(0.088)				
$RoO^2_{i,j}$			-0.124	-0.130		
			(0.090)	(0.091)		
$RoO^3_{i,j}$					-0.328***	-0.317**
					(0.123)	(0.124)
Δ*Preferential tariff*$_{j,o}$		-0.576***		-0.575***		-0.571***
		(0.074)		(0.074)		(0.074)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	7,015	7,003	7,015	7,003	7,015	7,003
R-squared	0.244	0.252	0.244	0.252	0.245	0.253

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. The variable $RoO^x_{i,j}$ is the number (in logs) of rules $RoO_{i,j}$, weighted by the $dr_{i,j}$ coefficients. 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*$_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. Δ*Preferential Tariff*$_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

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 $j\prime$ imports.

[43] As before, this percentage points reduction in imports is obtained by multiplying the estimated coefficient of column 6 in Table 7 by the average of log $RoO^3_{i,j}$ (-0.317×0.63 = −0.20). The absolute value of this effect as a percentage of the average change in imports of restricted goods is 0.20/1.23 = 0.16.

In this section we have shown that results on the effects of NAFTA RoO are robust to (i) including all rules, (ii) excluding rules that do not apply to vertically-related goods, and (iii) taking into account the importance of the input-output linkages when constructing our treatment variables. Our results show that preferential RoO on final goods negatively affect imports of intermediaries from non-member countries. Not surprisingly, the effect of RoO depends on whether final good producers have incentives to comply with the sourcing restrictions and whether these are strict or flexible. In terms of magnitude, the effect is quite stable across specifications. In the baseline regressions in which we include all rules, imports of goods subject to sourcing restrictions fell by more than 30 percentage points. In the other specifications, imports of restricted goods feel by around 20 percentage points.

5.4 Instrumenting NAFTA rules with CUSFTA rules

As mentioned earlier, our focus on Mexico is due to the fact that NAFTA RoO were to a large extent inherited from those contained in the Canada-United States Free Trade Agreement (CUSFTA). The sourcing restrictions embedded in Annex 401 of the NAFTA agreement can thus be considered as exogenous to Mexican final good producers.

To deal with any remaining endogeneity concerns, we next use the RoO contained in the CUSFTA agreement to instrument for NAFTA RoO. We argue that CUSFTA RoO satisfy the two requirements of an instrument. First, the extent to which the sourcing of a given intermediate good was restricted by CUSFTA RoO is unlikely to be correlated with any residual in equation (1). Second, the rules contained in the two agreements are highly correlated, which makes the instrument very strong: the correlation between the dummy variable RoO_{ij} in the two agreements is 0.91; the correlation between the treatment variables is 0.97 for RoO_1 and RoO_2, and 0.98 for RoO_3.[44]

Table 8 shows the results of estimating equation (1), when we instrument NAFTA RoO with their CUSFTA counterparts.[45] The first-stage coefficients associated to CUSFTA RoO_1, RoO_2 and RoO_3 are 0.66, 0.79, and 0.85 respectively. The three of them are statistically significant at 1%. As column (6) indicates, the effect of RoO on imports of intermediate goods remains negative and significant. The coefficients are larger and more precisely estimated than their OLS counterparts (see Table 5).

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

[45] In this section, we report the IV results using all rules. The results continue to hold if we consider only those rules defined at the HS-6 level in CUSFTA and NAFTA.

Table 8

NAFTA RoO and change in Mexican imports from non-NAFTA countries
(Instrumenting NAFTA rules with CUSFTA rules)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	-0.093	-0.098				
	(0.138)	(0.135)				
$RoO^2_{i,j}$			-0.270***	-0.167**		
			(0.081)	(0.081)		
$RoO^3_{i,j}$					-0.298***	-0.199**
					(0.074)	(0.074)
$\Delta Preferential\ Tariff_{j,o}$		-0.566***		-0.552***		-0.544***
		(0.075)		(0.075)		(0.074)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	7,015	7,003	7,015	7,003	7,015	7,003
R-squared	0.245	0.252	0.245	0.252	0.245	0.252

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. $RoO^x_{i,j}$ is the number (in logs) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j, instrumented using CUSFTA RoO. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

6 Conclusions

Recent decades have witnessed a proliferation of free trade agreements (FTAs). Preferential 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 intermediaries (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 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 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. Thanks to the specific legal features of Annex 401, we have been able to construct a unique dataset, which codes all the input-output linkages in NAFTA RoO: 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 RoO restrictions on its sourcing.

NAFTA RoO were to a large extent inherited from the Canada-United States Free Trade Agreement (the correlation between the rules contained in the two agreements is 0.91). They can thus be considered as exogenous from the point of view of Mexico, the country on which our analysis is focused. Using a difference-in-differences approach, we find that NAFTA RoO reduced Mexican imports of intermediaries from third countries. In our preferred specification, imports of restricted goods decreased on average by 26 percentage points (when focusing on rules defined at 6 digits) or 32 percentage points (when including all rules). As expected, the magnitude of the effect depends on whether the rules are strict or flexible, and on the incentives of final good producers to comply with them — which, in turn, depend on the extent of the preference margin and the importance of NAFTA export markets.

Our analysis allows us to identify the negative impact of the sourcing restrictions embedded in FTAs on imports of intermediaries from non-FTA members. An important avenue of future research is to quantify the impact of FTAs on aggregate productivity and welfare, through their effect of firms' sourcing decisions. To this purpose, we could include preferential tariffs and RoO in a model of global sourcing à la Antràs *et al.* (2014) and combine our dataset on NAFTA RoO with tariff data and Mexican firm-level trade data before and after NAFTA. Collecting firm-level data would also allow us to study the trade creation effects of NAFTA RoO and verify whether Mexican imports of intermediaries from third countries were displaced by inputs produced domestically or imported from Canada and the United States. It would also be interesting to study whether NAFTA sourcing restrictions led foreign suppliers to relocated 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 *et al.*, 2009). Our results show that, when accounting for the sourcing restric-

tions 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 regulations 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.

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Appendix

Table A-1

Countries included in our empirical analysis

Africa	Europe	Asia	America	Oceania
Angola	Albania	Bahrain	Antigua and Barbuda	Australia
Benin	Armenia	Bangladesh	Barbados	Brunei
Botswana	Bulgaria	Cambodia	Belize	Fiji
Brunei	Croatia	China	Canada	New Zealand
Burkina Faso	Cyprus	Egypt, Arab Rep.	Chile	Papua New Guinea
Burundi	Estonia	Hong Kong, China	Dominica	Solomon Islands
Cameroon	EU (2003) countries	India	Dominican Republic	Tonga
Cape Verde	Georgia	Indonesia	El Salvador	
Central African Republic	Hungary	Israel	Grenada	
Chad	Latvia	Japan	Guyana	
Congo, Dem. Rep	Lithuania	Jordan	Haiti	
Congo, Rep.	Macedonia, FYR	Korea, Rep.	Honduras	
Cote d'Ivoire	Malta	Kuwait	Jamaica	
Djibouti	Moldova	Kyrgyz Republic	Netherlands Antilles	
Gabon	Poland	Malaysia	Suriname	
Gambia, The	Slovak Republic	Maldives	Trinidad and Tobago	
Ghana	Slovenia	Mongolia	United States	
Guinea	Turkey	Myanmar		
Guinea-Bissau	Tunisia	Nepal		
Kenya	Ukraine	Oman		
Lesotho		Pakistan		
Macao		Philippines		
Madagascar		Qatar		
Malawi		Saudi Arabia		
Mali		Singapore		
Niger		Sri Lanka		
Nigeria		Taiwan, China		
Senegal		Thailand		
Sierra Leone		United Arab Emirates		
South Africa		Vietnam		
Swaziland				
Tanzania				
Togo				
Uganda				
Zambia				
Zimbabwe				
Namibia				
Mozambique				
Morocco				
Mozambique				
Morocco				
Mauritus				

This table lists all countries for which Mexico reported positive imports in 1991 and/or 2003, excluding countries which during our sample period had i) free trade agreements with Mexico, for which data on preferential tariffs are not available or ii) partial scope trade agreements with Mexico.

Table A-2

Sources and definitions of main variables

Variable	Source	Definition
$RoO_{i,j}$	Annex-401 of NAFTA	Dummy variable equal to one if good i has a RoO imposing sourcing restrictions on good j.
$RoO^1_{i,j}$	Annex-401 of NAFTA	Log number of goods i with RoO imposing sourcing restrictions on good j
$RoO^2_{i,j}$	Annex-401 of NAFTA	Log number of goods i with RoO imposing sourcing restrictions on good j, excluding those with *Preference* $Margin_{i,NAFTA} = 0$.
$RoO^3_{i,j}$	Annex-401 of NAFTA	Log number of goods i with RoO imposing sourcing restrictions on good j, excluding those with *Preference* $Margin_{i,NAFTA} = 0$ and those with alternative VA rules.
$Imports_{j,o,t}$	WITS	Value of Mexican imports of good j from non-NAFTA country o in year t
$Imports_{j,NAFTA,t}$	WITS	Value of Mexican imports of good j from US and Canada in year t
$\Delta Imports_{j,o}$	WITS	$log(1+Imports_{j,o,2003})$- $log(1+Imports_{j,o,1991})$
$\Delta Imports_{j,NAFTA}$	WITS	$log(1+Imports_{j,NAFTA,2003})$- $log(1+Imports_{j,NAFTA,1991})$
$Tariff_{j,o,t}$	WITS	Tariff applied by Mexico on imports of good j from non-NAFTA country o in year t
$Tariff_{j,NAFTA,t}$	WITS	Tariff applied by Mexico on imports of good j from US and Canada in year t
$\Delta Tariff_{j,o}$	WITS	$log(1+Tariff_{j,o,2003})$- $log(1+Tariff_{j,o,1991})$
$\Delta Tariff_{j,NAFTA}$	WITS	$log(1+Tariff_{j,NAFTA,2003})$- $log(1+Tariff_{j,o,1991})$
ΔPreferential Tariff$_{j,o}$	WITS	$\Delta Tariff_{j,o} - \Delta Tariff_{j,NAFTA}$
$Preference\ Margin_{i,NAFTA}$		Log average preferential margin of Mexican exports of good i to Canada and U.S. in 2003
$Exports_{i,NAFTA}$	WITS	Log value of Mexican exports of good i to Canada and U.S. in 1991

This table provides definitions and sources for all the variables used in the paper. WITS refers to the World Integrated Trade Solution of the World Bank.

Table A-3

NAFTA RoO and change in Mexican imports from non-NAFTA countries (including zero imports)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	0.003	0.005				
	(0.044)	(0.044)				
$RoO^2_{i,j}$			-0.141***	-0.085**		
			(0.044)	(0.044)		
$RoO^3_{i,j}$					-0.156***	-0.096**
					(0.045)	(0.046)
Δ*Preferential tariff*$_{j,o}$		-0.328***		-0.319***		-0.318***
		(0.040)		(0.040)		(0.040)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	29,057	28,067	29,057	28,067	29,057	28,067
R-squared	0.208	0.217	0.208	0.217	0.208	0.217

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and/or 2003. $RoO^x_{i,j}$ 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 $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. Δ*Preferential Tariff*$_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

Table A-4

NAFTA RoO and change in Mexican imports from non-NAFTA countries (including Mexico's FTA partners)

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO^1_{i,j}$	-0.011	-0.011				
	(0.045)	(0.045)				
$RoO^2_{i,j}$			-0.106**	-0.086*		
			(0.044)	(0.044)		
$RoO^3_{i,j}$					-0.119***	-0.098**
					(0.046)	(0.046)
$\Delta Preferential\ tariff_{j,o}$		-0.155***		-0.149***		-0.148***
		(0.042)		(0.042)		(0.042)
Industry FE (HS3)	yes	yes	yes	yes	yes	yes
Country of origin FE	yes	yes	yes	yes	yes	yes
Observations	17,547	17,531	17,547	17,531	17,547	17,535
R-squared	0.139	0.140	0.139	0.140	0.139	0.146

This table shows the results of the estimation of equation (1). The dependent variable is $\Delta Imports_{j,o}$, the log change in Mexican imports of good j (defined at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. $RoO^x_{i,j}$ 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 $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. $\Delta Preferential\ Tariff_{j,o}$ is difference between the log change in the tariff applied by Mexico to imports of good j from non-NAFTA country o and the log change in the tariff applied by Mexico to imports of good j from NAFTA partners. Robust standard errors in parenthesis. Significance levels: *; 10%; **: 5%; ***: 1%.

Figure A-1
NAFTA RoO