From Final Goods to Inputs: the Protectionist Effect of Rules of Origin*

Paola Conconi
ULB (ECARES), CEPR, CESifo

Manuel García-Santana
UPF, Barcelona GSE, CEPR

Laura Puccio
European Parliament

Roberto Venturini
ULB (ECARES)

February 2017

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 led to a sizeable reduction in the growth rate of imports of intermediate goods from third countries. 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 classifications: F23, F53.

Keywords: Trade Agreements, Rules of Origin, Input-Output Linkages.

*We are particularly grateful for their helpful comments and suggestions Pol Antràs, Emily Blanchard, Chad Bown, Ben Faber, Gene Grossman, Rob Johnson, Hiau Looi Kee, Kala Krishna, James Lake, Petros Mavroidis, Martin Peitz, and André Sapir. We also wish to thank participants at the annual ETSG conference at LMU Munich, the workshop on Global Fragmentation of Production and Trade Policy at ECARES, the DISSETTLE workshop at the Graduate Institute of International and Development Studies in Geneva, the EEA annual meeting at the University of Mannheim, the PRONTO conference on Non-Tariff Barriers in Vienna, the first conference of the CEPR Research network on Global Value Chains, Trade and Development at the World Bank, the SITE workshop on International Trade Policy at Stanford University, the RIDGE workshop on trade and firm dynamics, and the 2016 NBER Summer Institute on International Trade and Investment, as well as seminar participants at DG Trade, the World Bank, and UPF. Funding from the FNRS and the European Commission (Grant Agreement No. FP7-PEOPLE-2010-ITN 264633) is gratefully acknowledged. Correspondence should be addressed to Paola Conconi, pconconi@ulb.ac.be. Responsibility for the information and views expressed in this article lies entirely with the authors.

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 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] This trend can help to explain why global value chains are actually regional in nature (Baldwin, 2013). Regional trade agreements allow substantial trade liberalization among members, without the need to reciprocate to other GATT/WTO contracting parties.[3] Around 90% 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. For example, Caliendo and Parro (2015) examine the impact of preferential tariff changes among members of the North American Free Trade Agreement (NAFTA). They find little evidence of trade diversion and conclude that "the rest of the world was hardly affected by NAFTAs tariff reductions" (p. 25). However, these studies neglect a second key channel through which FTAs can also distort trade in intermediaries: preferential rules of origin (RoO). FTAs employ these rules to distinguish goods originating from member countries from those originating from third countries. In principle, RoO are meant to prevent trade deflection, i.e. to ensure that goods being exported at preferential rates from one FTA partner to another truly originate from the area and are not simply assembled from components originating from third countries. In

[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).

practice, they also prevent final good producers from choosing the most efficient input suppliers around the world, in order to avoid losing origin status and the tariff preference it confers. In this paper, we show that preferential RoO compound the trade diversion effect of preferential tariffs, further deterring imports of intermediate goods from non-member countries.

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

[4]For example, the RoO contained in the NAFTA agreement 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).

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.

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. 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 have RoO restricting the sourcing of that particular input. We next exclude rules associated with final goods with zero preference margin. These rules should have no impact on sourcing decisions, given that final good producers have no incentives to comply with them. We then further exclude flexible rules, i.e. instances in which final good producers can qualify for origin by meeting a value added requirement. We 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. Like other trade policies, RoO can be influenced by lobbying pressure.[8] The empirical literature on the political economy of trade policy shows that the level of protection increases with import penetration (e.g. Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000). If policymakers manipulate RoO to protect domestic producers, we would expect them to set stricter rules in sectors characterized by a stronger increase in import competition. Crucially, this type of endogeneity would

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

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

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

make it harder to find evidence for the trade diverting effect of RoO.

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

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 (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 the characteristics of the 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 the change of Mexican imports of intermediate goods from non-NAFTA countries. As expected, the size of the effect depends on the extent to which Mexican producers had incentives to comply with them (i.e. the size of the preference margin and the importance of NAFTA export markets) and whether the sourcing restrictions were strict or flexible (i.e. whether change in tariff classification rules were combined with alternative value added rules). The results are robust to focusing on different sets of rules, using alternative methodologies to construct the treatment variables, using different samples of goods and countries, clustering standard errors at different levels of sectoral aggregation, and instrumenting NAFTA RoO with those contained in the CUSFTA agreement.

In terms of magnitude, depending on the specification, we find that RoO decreased the growth rate of imports of affected goods from non-NAFTA countries by between 27 and 152 percentage points (representing between 17% and 122% of the actual change in imports of treated goods). By comparison, preferential tariff liberalization decreased the growth rate of imports from third countries by between 120 and 157 percentage points (representing between 97% and 104% of the actual change in imports of treated goods).

The rest of the paper is organized as follows. Section 2 reviews the related literature. In Section 5, 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 the legal complexity of the rules, which makes measurement difficult. Several papers examine the impact of RoO on trade flows (e.g. Carrere and de Melo, 2006). To capture the restrictiveness of RoO, most of these studies use synthetic indices like the one constructed by Estevadeordal (2000), which do not allow to capture vertical linkages between goods.[9] To the best of our knowledge, this is the first paper to map input-output linkages in preferential RoO and examine the impact of these sourcing restrictions on trade in intermediaries.[10]

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

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

[10]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).

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 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 *et al.*, 2014). Focusing on China, Kee and Tang (2016) find that the domestic value added ratio of its exports increased by more than 10% over 2000-2006. This was the result of firms substituting domestic inputs for imported inputs, due to an expansion of domestic input variety triggered by decreasing tariffs and increasing FDI. Related contributions use input-output tables to measure the distance of an input relative to final demand (Antràs *et al.*, 2012; Antràs and Chor, 2013) or to construct an industry-pair specific measure of upstreamness (Alfaro *et al.*, 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.*, 2015 and 2016).

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).[11] 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. NAFTA rules of origin were applied as soon as the agreement took effect in January 1994. By contrast, only approximately 50 percent of the internal tariffs were abolished in 1994; most of the remaining tariffs were phased out during the following 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

[11] 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 government's efforts in addressing the challenges were placed on privatizing state industries and moving toward trade liberalization. In the late 1980s and early into the 1990s, the Mexican government implemented a series of measures to restructure the economy, including steps toward unilateral trade liberalization and accession to the GATT in 1986.

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 final goods on Mexican imports of intermediaries from third countries. As mentioned in the introduction, NAFTA RoO can be taken as exogenous from the point of view of Mexico. There are two main reasons for this. First, the rules contained in NAFTA were largely inherited from those contained in the Canada-US Free Trade Agreement (see Section 5.5). Second, to the extent that RoO were modified during the NAFTA negotiations, Mexico had little power to affect such changes. As in the CUSFTA negotiations, the predominant role was played by the United States, by far the largest FTA member: in some sectors, U.S. negotiators pushed for stricter rules, under the pressure of producers that were subject to strong import competition.[12] In other sectors, 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

This section describes the data we use and the construction of the key variables. We start by describing our new dataset on NAFTA RoO, and the treatment variables we construct to examine the impact of these sourcing restrictions on trade in intermediaries. We then move to the description of the other trade data and variables used in our empirical analysis.

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

4.1 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.

As mentioned in the introduction, two features of NAFTA RoO make them appealing for our purposes. First, they are written at a very disaggregated level, with specific rules applying to each product (defined using the HS classification at the 4- or 6-digit level). Second, they are mostly defined in terms of tariff classification changes, which impose sourcing restrictions on a set of inputs (at the 2-, 4- or 6-digit level of the HS classification). In the NAFTA agreement, value added (VA) rules are only used in combination with change of classification rules.[15] This is not the case for other FTAs, in which VA rules are predominant (e.g. free trade agreements between the 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:

"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 the rule into two parts. The first part ("A change to subheadings 6203.41 through 6203.49 from any other chapter") is the main rule and requires an HS chapter change, i.e. any non-originating input must be sourced outside the chapter of the final good. In other words, any input falling within chapter 62 must be sourced within NAFTA for the trousers to obtain origin status. The second part (from "except from headings 5106 through 5113" 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 trousers.[16]

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

[16] In general, additional requirements can be divided into two categories: those written at the Harmonized Schedule level, i.e. at the chapter, heading or 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

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

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

NAFTA RoO are very difficult to bypass. In order to obtain origin status, producers must obtain from their suppliers all the relevant information to show that production of their final good satisfies the rules set out in Annex 401. In case of verification, producers must have all the record keeping in line with the requirements of NAFTA and be able to prove the origin of all their intermediate inputs. Failure to submit the Certificate of origin and the supporting documentation upon request results in the importing NAFTA partner denying preferential tariff treatment. Material false statements, acts or omissions, or failure to maintain and provide records, may result in civil or criminal penalties, including penalties for fraud and negligence.[18]

Avoiding NAFTA RoO is also hard because the rules contained in Annex 401 are such that, when there are rules that restrict the sourcing of some inputs necessary to produce a particular final good, there are also rules on the restricted inputs. Consider again the example of the Mexican producer of trousers who was denied origin because he

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.

[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).

[18]See `www.cbp.gov/sites/default/files/documents/3810_014a_3.pdf`.

had imported cotton yarn, one of the restricted inputs, from the Philippines. To obtain origin, the Mexican producer of trousers might be tempted to import fabrics similar to cotton yarn from third countries and claim origin after making minor modifications. However, cotton yarn is itself subject to a change of chapter rule plus additional requirements, which means that the sourcing of those other fabrics would be restricted too. The correlation between RoO on final goods and RoO on the restricted inputs is 0.98.[19]

Our goal 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.[20] We have also coded whether rules on change in tariff classification are combined with alternative or complementary VA rules. In total, our dataset contains more than 700,000 input-output pairs defining rules of origin. This dataset allows us to link each final good to all the intermediate inputs that must be sourced within NAFTA for the final good to obtain origin. Similarly, we can link each intermediate good to all the final goods that impose restrictions on its sourcing.

Using this dataset, we define the dummy variable $RoO_{i,j}$, which is equal to 1 if there is a RoO on final good i that restricts the sourcing of intermediate good j. Figure 1 provides a graphical representation of the sourcing restrictions contained in Annex 401, by plotting all the dummy variables $RoO_{i,j}$. Outputs i are on the horizontal axis, whereas inputs j are on the vertical 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. As it can be seen from Figure 2, which zooms into 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]

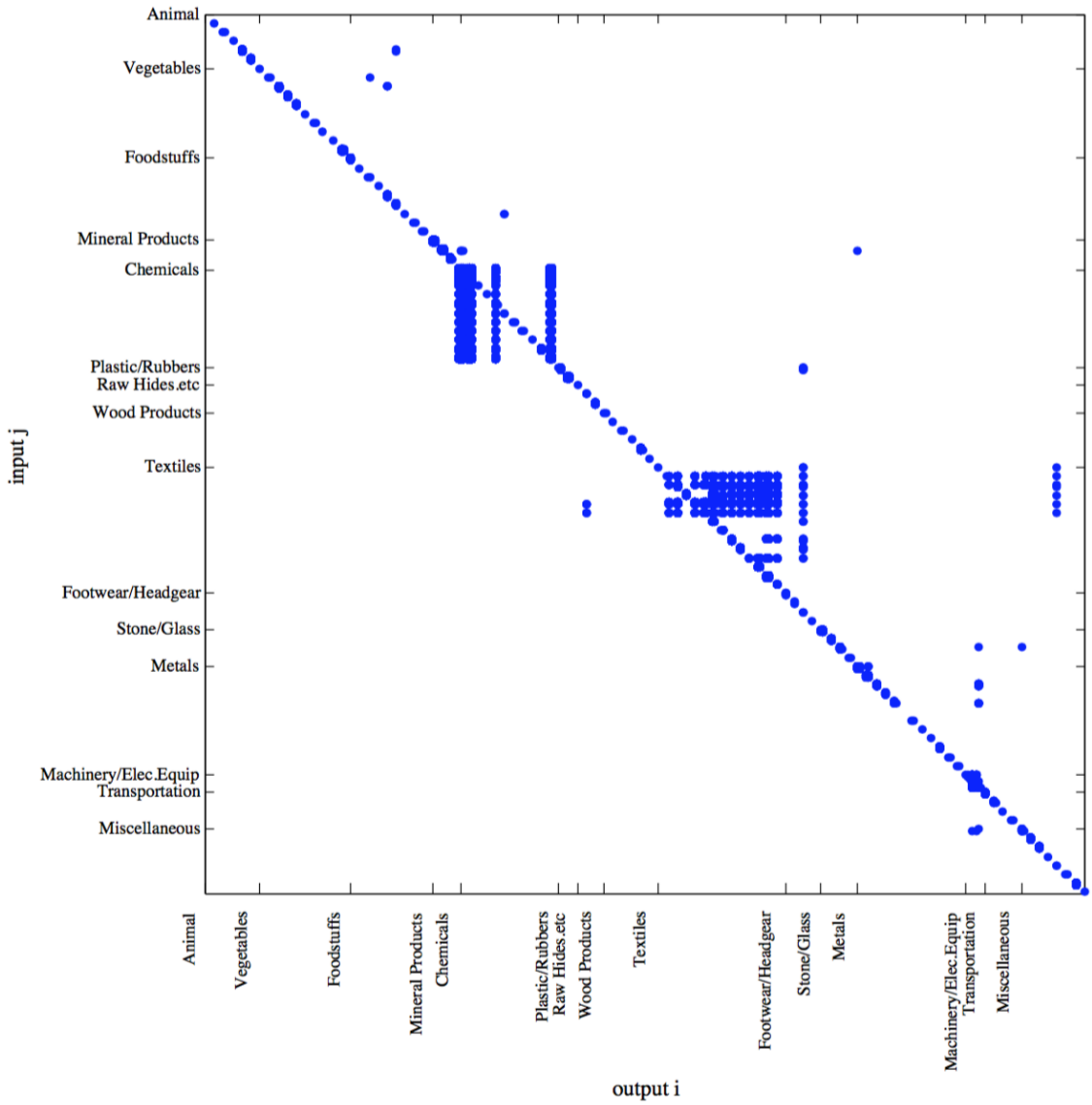
[19]This number is computed by correlating the number of RoO on a final good i with the average number of RoO across the restricted inputs j used to produce good i.

[20]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.

[21]You can find an animated version of the picture at this link.

[22]In particular, we use the direct requirement matrix provided in the 1997 Benchmark Input-Output Accounts. In contrast to earlier versions, this table is constructed based on the NAIC97 classification, which allows us to convert it to HS6 by using only one conversion table. See the Online Appendix for more details.

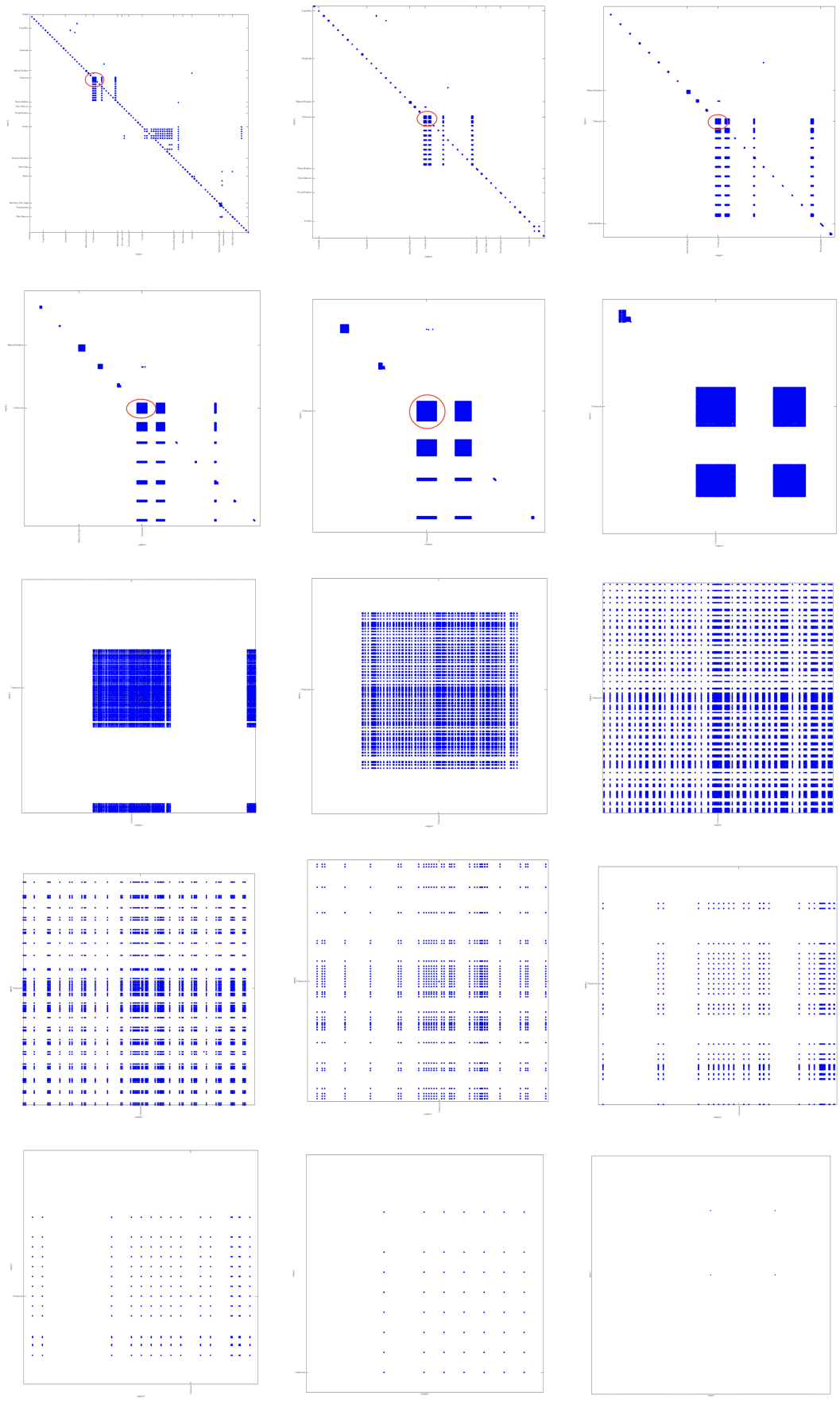
Figure 1
NAFTA Rules of Origin (RoO_{ij})



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

Figure 2

NAFTA RoO (zooming into Figure 1)



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. $RoO_j = \sum_i RoO_{i,j}$. This approach is justified by the way in which NAFTA RoO are written. The fact that the origin of products is defined in terms of detailed change of classification rules — with VA rules used only in combination with change of classification rules — implies that all restricted inputs must be sourced within NAFTA to obtain origin. In turn, this implies that the impact of different RoO on final goods should not depend on the value added of the input. Indeed, in alternative specifications we obtain similar results when we weight each $RoO_{i,j}$ dummy by the importance of the vertical linkage between i and j, as captured by direct requirements from input-output tables.

We construct three different versions of the RoO treatment variable. RoO_j^1 includes all rules on final goods i restricting the sourcing of j. RoO_j^2 excludes rules that Mexican producers have no incentives to comply with, given that the preference margin on their final good is zero.[23] RoO_j^3 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 alternative VA rules.

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.

[23] 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_j^1			Panel B: RoO_j^2			Panel C: RoO_j^3		
HS	mean	min	max	mean	min	max	mean	min	max
01-05: Animal Products	57.39	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_j^x is the number (in logs) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which *Preference Margin*$_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules.

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. 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. 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. 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.[24]

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 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. 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 (see Section 5.2). These represent a very small share of the sourcing restrictions contained in Annex 401 of the NAFTA agreement (only 1274 of the $RoO_{i,j}$ dummies are written at 6 digits). In Section 5.3, we extend the analysis to the broader set of rules written at 2 and 4 digits, using input-output coefficients to capture vertical linkages.

4.2 Other trade data and variables

We study the effects of NAFTA RoO on Mexican imports from third countries. As discussed in the next section, our dependent variable is $\Delta Imports_{j,o}$, 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]

[24]The input-output tables constructed using this randomization procedure do not contain all goods and thus cannot be used in our empirical analysis. See Section 5.3 and the Online Appendix for details on how we construct input-output tables that contain all HS-6 goods.

[25]NAFTA RoO were slightly modified after 2003 (e.g. to add rules on new goods). Before that date, there were only minor technical changes (e.g. to make the rules compatible with changes in the

The list of non-NAFTA countries included in our analysis can be found in Table IV in the Online 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]

Panel A of Table 2 reports descriptive statistics of Mexican imports from our main sample of countries. 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%.

Panel B of Table 2 reports descriptive statistics from WITS on the MFN tariffs and NAFTA preferential tariffs applied by Mexico.[27] Between 1991 and 2003, applied MFN tariffs fell in some sectors and increased in others.[28] In most sectors, the preferential tariffs applied by Mexico in 2003 to imports from its NAFTA partners were close to zero.

Based on this information, 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 the United States and Canada 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 the United States and Canada between 1991 and 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 when exporting to Mexico, relative to Canadian and U.S. producers.

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

[28]On average, applied Mexican MFN tariffs increased by around 14 percent between 1991 and 2003. 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).

Table 2

Descriptive statistics on imports and tariffs

HS Code	Description	Panel A Mexican imports		Panel B Mexican tariffs			Panel C US and Canadian tariffs	
		1991	2003	MFN 1991	MFN 2003	NAFTA 2003	MFN 2003	NAFTA 2003
01-05	Animal Products	104,09	383,89	13,98	18,53	0,00	2,18	0,28
06-15	Vegetables	139,53	179,04	12,78	10,08	0,05	3,29	0,02
16-24	Foodstuffs	78,69	109,55	17,21	15,40	0,21	9,58	0,63
25-27	Mineral Products	119,78	670,89	9,31	4,70	0,07	0,39	0,00
28-38	Chemicals	110,43	729,23	11,23	6,02	0,22	2,73	0,00
39-40	Plastic/Rubbers	134,81	1010,36	13,47	9,91	0,54	3,72	0,00
41-43	Raw Hides,Skins,Leathers	16,83	183,15	13,56	13,90	0,00	4,31	0,00
44-49	Wood Products	28,02	162,20	11,88	8,91	0,03	0,69	0,00
50-63	Textiles	215,98	979,72	16,81	13,34	0,05	10,38	0,00
64-67	Footwear/Headgear	36,69	167,83	19,18	18,40	0,11	9,35	0,51
68-71	Stone/Glass	32,25	341,26	15,64	9,98	0,10	2,87	0,17
72-83	Metals	108,78	657,25	12,72	9,08	0,21	2,02	0,00
84-85	Machinery/Electrical	692,23	11715,84	13,62	7,63	0,28	1,56	0,00
86-89	Transportation	83,54	966,81	14,31	8,33	0,19	4,07	0,00
90-97	Miscellaneous	233,45	1328,88	15,06	11,69	0,07	2,75	0,00

Notes: Panel A reports descriptive statistics on Mexican imports from non-NAFTA countries. Panel B reports descriptive statistics of the MFN tariffs applied by Mexico in 1991 and 2003, as well as the preferential tariffs applied by Mexico in 2003 on imports from its NAFTA partners. Panel C reports descriptive statistics of the average MFN and NAFTA preferential tariffs applied by the United States and Canada. All tariffs are expressed in percentage terms.

Panel C of Table 2 reports average MFN and NAFTA preferential tariffs applied by the United States and Canada in 2003. NAFTA RoO should only divert Mexican imports of intermediate goods from third countries if the difference between these tariffs rates is large enough to compensate for the costs of complying with RoO (costs of switching to NAFTA suppliers, administrative costs to fulfill the requirements of Annex 401). To capture the gains of complying with NAFTA RoO, we use the information in Panel C to construct the variable *Preference Margin*$_{i,NAFTA}$, which is defined as the average between the preference margins of the United States and Canada.[29] Notice that, unlike the variables Δ*Imports*$_{j,o}$ and Δ*Preferential Tariff*$_j$, the variable *Preference Margin*$_{i,NAFTA}$ is not expressed as a difference between 1991 and 2003 values. This is because the impact of NAFTA RoO should only depend only on the preferential margin enjoyed by Mexican producers of i when exporting to the United States and Canada *after* the implementation of the NAFTA agreement.[30]

Previous studies suggest that tariff preferences may not be used unless export volumes are large enough to result in substantial duty savings. To proxy for the importance of NAFTA export markets for Mexican final good producers, we use the variable *Exports*$_{i,NAFTA}$, which is equal to total Mexican exports of good i to the United States and Canada. 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 the United States and Canada — Mexican final good producers may have substituted inputs produced by third-country suppliers with inputs produced by NAFTA suppliers.

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

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

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

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.[31] In addition, we express all the variables in logs unless specified. The definition of all the variables used in our empirical analysis and the sources used to construct them can be found in Table A-1 in the Appendix.

In our benchmark regressions, we estimate

$$\Delta Imports_{j,o} = \alpha + \beta_1 \ RoO_j^x + \beta_2 \ \Delta Preferential \ Tariff_{j,o} + \delta_j + \delta_o + \epsilon_{j,o}. \tag{1}$$

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_j^x, 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_j^x. In the first treatment ($x = 1$), we include all dummies RoO_{ij}, i.e. all rules on final goods i imposing sourcing restrictions on good j. The second 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 on tariff classification shifts 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_j^2 and RoO_j^3.

In all specifications, we cluster standard errors at 6 digits. We include industry fixed effects at 3 or 4 digits (δ_j), which allow us to account for broad sectoral trends, while retaining within-industry variation between treated and non-treated goods.[32] We also

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

[32] When looking at the full set of NAFTA RoO, we can use 4-digits fixed effects. When focusing on the much smaller set of RoO defined at 6-digits, we use instead 3-digit sector fixed effects (i.e. industries that share the same first three digits of the HS classification). The results continue to hold if we use 3-digit fixed effects throughout our analysis (see Conconi *et al.*, 2016).

include country-of-origin fixed effects (δ_o), which account for country-specific determinants of Mexican imports (e.g. distance, common language). In some specifications, we also control for $\Delta Preferential\ Tariff_{j,o}$, 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. 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 difference in the tariffs applied by Mexico to imports from third countries and NAFTA partners.

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 from third countries. Looking first at column 1 and 2, we find that the coefficient associated to RoO_j^1 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_j^1 final goods with zero preference margin, we might be mis-measuring the treatment. Columns 3 and 4 show that, when we use RoO_j^2 as a treatment, our coefficient of interest becomes significant. 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 actually constrain producers' sourcing decisions and identify their effect on imports of intermediate goods. In columns 5 and 6, we use RoO_j^3 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 with them) and strict (origin can only be obtained if the restricted inputs are sourced within NAFTA). The estimated coefficients of RoO_j^3 are negative and significant at 1%. In terms of magnitude, the coefficient reported in column 6 implies that NAFTA RoO

reduced the growth rate of imports of "treated" intermediates from third countries by 27 percentage points.[33]

Table 3

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

	(1)	(2)	(3)	(4)	(5)	(6)
RoO_j^1	0.001	0.007				
	(0.119)	(0.115)				
RoO_j^2			-0.280***	-0.186*		
			(0.104)	(0.103)		
RoO_j^3					-0.307***	-0.208**
					(0.107)	(0.106)
$\Delta Preferential\ Tariff_j$		-0.575***		-0.558***		-0.556***
		(0.118)		(0.118)		(0.118)
Industry FE (HS3)	Yes	Yes	Yes	Yes	Yes	Yes
Country of origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7015	7003	7015	7003	7015	7003
R-squared	0.244	0.252	0.245	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 (at the HS6 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_j^x is the number (in logs) of final goods i for which there is a NAFTA RoO (defined at the HS 6-digit level) 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 countries. Industry fixed effects defined at 3 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). Significance levels: *; 10%; **: 5%; ***: 1%.

The results of Tables 3 should be considered as an underestimate of the effects of RoO. There are three main reasons for this. First, in 2003 some Mexican producers had still to fully understand and adjust to NAFTA sourcing restrictions.[34] Second, in our

[33]This effect is computed by multiplying the estimated coefficient of RoO_j^3 by the mean of this variable for treated goods (see Section 5.6 for a discussion of the magnitude of the effects of RoO in the different specifications). We have also tried specifications in which we included both strong rules (captured by RoO_j^3) and weak rules (rules on tariff classification shifts with a value added alternative, captured by $RoO_j^2 - RoO_j^3$). The coefficient for the weak rules was not significant.

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

analysis so far, we have only looked at the impact of the small set of rules 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 almost always apply to goods that are inputs in the production of the final goods. By contrast, many rules defined at the chapter (HS2) and heading level (HS4) apply to goods that are not vertically related. By excluding these rules, we have classified as "non treated" many intermediate goods that were actually subject to sourcing restrictions. In the next section, we will show that we obtain larger estimates of the β_1 coefficient when we extend the analysis to the rules defined at the chapter and heading level, exploiting information from input-output tables to identify the rules that apply to vertically-related goods. Finally, NAFTA RoO were to a large extent inherited from those contained in the CUSFTA agreement negotiated years earlier between the United States and Canada. As mentioned in the introduction, if these rules were modified during the NAFTA negotiations due to pressure by import-competing producers located in Mexico, this should make it harder to find evidence for trade diversion. In line with this argument, in Section 5.5 we obtain larger estimates when using the rules contained in the CUSFTA agreement to instrument for NAFTA RoO.

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 the United States and Canada 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 157 percentage points.

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 the United States and Canada on their final goods, the stronger the incentives to source the restricted inputs within NAFTA. The effect of RoO on Mexican imports of intermediaries from non-member

[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 coefficient is negative and significant for the former and positive and significant for the latter.

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 the United States and Canada represent more important export markets. To see this, consider the example of two Mexican producers, selling different final goods. Before NAFTA, both producers imported some inputs from third countries (e.g. Germany or Japan). Exports of the first producer were mostly destined for the North American market, while the second producer exported more to the rest of the world. Following the entry into force of the NAFTA agreement, the two producers can export their goods to the United States and Canada at preferential rates, but only if they stop importing certain inputs from third countries. NAFTA RoO should have a stronger impact on the sourcing decisions of the first producer, who stands to gain more from complying with them. The impact of RoO on Mexican imports of intermediate goods j should thus depend on the importance of NAFTA export markets for Mexican producers of final goods i. This is proxied by the variable $Exports_{i,NAFTA}$, the volume of pre-NAFTA (1991) Mexican exports of good i to the United States and Canada.

To verify whether the impact of RoO varies with the incentives of final good producers to comply with them, we estimate the following:

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

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.

The results are reported in Table 4. The interactions terms between the RoO variable and $Preference\ Margin_{i,NAFTA}$ and $Exports_{i,NAFTA}$ are always negative and, when included together, are both 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.

Table 4

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

	(1)	(2)	(3)	(4)	(5)	(6)
$RoO_j^3 \times$ *Preference Margin*$_{i,NAFTA}$	-3.106	-3.781			-4.500*	-5.615**
	(2.335)	(2.408)			(2.413)	(2.575)
$RoO_j^3 \times$ *Exports*$_{i,NAFTA}$			-0.011	-0.022**	-0.022*	-0.024*
			(0.010)	(0.010)	(0.013)	(0.013)
RoO_j^3	3.672	4.301	-1.334***	-0.840*	5.549*	6.192**
	(2.804)	(2.859)	(0.497)	(0.503)	(2.795)	(2.873)
Preference Margin$_{i,NAFTA}$	0.544	1.328			1.712	2.925
	(1.764)	(1.857)			(1.829)	(2.011)
Exports$_{i,NAFTA}$			0.057*	0.085**	0.062	0.080
			(0.033)	(0.034)	(0.056)	(0.058)
Δ*Preferential Tariff*$_j$		-0.807		-0.701**		-0.899
		(0.558)		(0.275)		(0.590)
Industry FE	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	0.417	0.424	0.453	0.464	0.428	0.437

This table shows the results of the estimation of equation (2). The dependent variable is Δ*Imports*$_{j,o}$, the log change in Mexican imports of good j (at the HS 6-digit level) from non-NAFTA country o between 1991 and 2003. RoO_j^3 is the number of final goods i that have a RoO (defined at the HS6 level) 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 the United States and Canada in 2003. The variable *Exports*$_{i,NAFTA}$ measures Mexican exports of final goods i to the United States and Canada in 1991. 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. Industry fixed effects defined at 3 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). Significance levels: *; 10%; **: 5%; ***: 1%.

Based on the estimates of Table 4, we can compute the effect of rules of origins for different levels of *Preference Margin*$_{i,NAFTA}$ and *Exports*$_{i,NAFTA}$. For example, the estimates in column 6 imply a RoO coefficient of -3.51 for goods falling in the 90th percentile of the distribution of *Preference Margin*$_{i,NAFTA}$. This coefficient, together with the fact that the average of RoO_j^3 was 0.69, indicates that the change in imports from third countries were reduced by 241 percentage points. Column 6 also implies a coefficient of -1.56 for goods in the 90th percentile of the distribution of *Exports*$_{i,NAFTA}$. Give that the average

of RoO_j^3 for these goods was 2.40, this corresponds to a 374 percentage points reduction in the growth rate of imports.

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.

In this section, we show that the results continue to hold when we include RoO 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 reproduces the difference-in-differences specifications of Table 3, when we include all rules contained in Annex 401 of the NAFTA agreement, irrespective of whether 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.

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 — 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 imports from third countries by almost 115 percentage points on average, a much larger effect than when focusing only on rules defined at 6 digits (see Section 5.6 for a discussion of the magnitude of the effects of RoO across specifications).

Table 5

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

	(1)	(2)	(3)	(4)	(5)	(6)
RoO_j^1	-0.176	-0.124				
	(0.300)	(0.291)				
RoO_j^2			0.055	0.074		
			(0.320)	(0.314)		
RoO_j^3					-0.424**	-0.404**
					(0.166)	(0.163)
$\Delta Preferential\ Tariff_j$		-0.443***		-0.445***		-0.429***
		(0.162)		(0.162)		(0.162)
Industry FE (HS4)	Yes	Yes	Yes	Yes	Yes	Yes
Country of origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7015	7003	7015	7003	7015	7003
R-squared	0.390	0.392	0.390	0.392	0.391	0.393

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 (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_j^x is the number (in logs) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which $Preference\ Margin_{i,NAFTA} = 0$. 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. Industry fixed effects defined at 4 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). Significance levels: *; 10%; **: 5%; ***: 1%.

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 Input-Output (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 written using different classifications (NAICS and HS) introduces

some noise in the measurement of vertical linkages. As discussed in Section 4.1 and in the Online Appendix, 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.

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_j^1	-0.064	-0.072				
	(0.089)	(0.088)				
RoO_j^2			-0.030	-0.036		
			(0.092)	(0.091)		
RoO_j^3					-0.199**	-0.198**
					(0.094)	(0.094)
Δ*Preferential Tariff* $_j$		-0.448***		-0.446***		-0.441***
		(0.162)		(0.162)		(0.162)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country of origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7015	7003	7015	7003	7015	7003
R-squared	0.390	0.392	0.390	0.392	0.391	0.393

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 (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_j^x 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. Industry fixed effects defined at 4 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). Significance levels: *; 10%; **: 5%; ***: 1%.

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. As in Table 5, the effect is significant only for rules that are both relevant and strict.

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_j^1	-0.064	-0.072				
	(0.089)	(0.088)				
RoO_j^2			-0.249	-0.270		
			(0.229)	(0.226)		
RoO_j^3					-0.670***	-0.666***
					(0.222)	(0.222)
$\Delta Preferential\ Tariff_j$		-0.448***		-0.451***		-0.442***
		(0.162)		(0.162)		(0.162)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country of origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7015	7003	7015	7003	7015	7003
R-squared	0.390	0.392	0.390	0.392	0.391	0.393

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 (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_j^x 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. Industry fixed effects defined at 4 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). 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 IO coefficients proxy for higher quality inputs).[36]

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 only significant for RoO_j^3.

Summing up, in this section we have reported the results of different specifications: (i) including all NAFTA RoO; (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 NAFTA RoO on final goods reduced imports of intermediaries from non-member countries. In line with the results of Section 5.2, the effect of NAFTA sourcing restrictions depends on whether final good producers had incentives to comply with them and whether they were strict or flexible.

5.4 Additional robustness checks

We have performed a series of additional estimations to verify the robustness of our results on the impact of RoO. These results are reported in the Online Appendix.

In our benchmark regressions, we have included 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 have included in our analysis goods that Mexico imported only in 1991 or 2003. The results confirm that NAFTA RoO led to a reduction in Mexican imports of intermediaries from non-member countries. As expected, the effect is larger when we consider only change of tariff classification rules that apply to final goods with a positive preference margin and that are not relaxed by alternative value added rules.

We have also tried including in our sample non-NAFTA countries that negotiated

[36]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 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.

a FTA with Mexico during our sample period. The results continue to hold: NAFTA RoO had a sizeable detrimental effect on Mexican imports of restricted inputs from third countries.[37]

5.5 Instrumenting NAFTA rules with CUSFTA rules

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

The advantage of focusing on Mexico is that NAFTA RoO were to a large extent inherited from those contained in the CUSFTA agreement. However, it might still be the case that some of the modifications introduced during the NAFTA negotiations reflected pressure by Mexican-based import-competing producers. If this is the case, the results reported in the previous tables could be an underestimate of the true effect of NAFTA RoO. To verify this, we have instrumented these rules with those contained in the CUSFTA agreement.

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). Our discussion in Section 5 suggests that CUSFTA RoO might be correlated with trends in U.S. imports before the agreement was signed. If these trends were strongly correlated with their counterpart for Mexico, CUSFTA rules would not be a valid instrument. We have verified that this is not the case, using information from the Center for International Data (cid.econ.ucdavis.edu).[38] Second, the rules contained in the two agreements are highly correlated, which makes the instrument very strong: the correlation between the treatment variables is 0.97 for RoO_j^1 and RoO_j^2, and 0.98 for RoO_j^3.[39]

[37]The sample used in these regressions includes EU members, Chile and Israel. 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 $\Delta Preferential\ Tariff_{j,o}$. 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.

[38]The digital version of this data, elaborated by Feenstra (1996), contains detailed information about the quantity and value of imports at the product level (based on SITC rev. 4 codes), disaggregated by country of origin. Using this data, we have constructed the variables $\Delta Imports_j^{US}$ and $\Delta Imports_j^{Mex}$, which respectively measure the log change in U.S. and Mexican imports of good j between 1980 and 1987, the year before the signature of the CUSFTA agreement. When we run a regression of $\Delta Imports_j^{Mex}$ against $\Delta Imports_j^{US}$ we find a statistically significant positive coefficient of 0.006, which implies a negligible relationship between the two variables. See also Figure II in the Online Appendix.

[39]We have performed the Hausman test by including as a regressor the residuals of the first stage in

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)
$RoO\ NAFTA_j^1$	-2.211*	-2.051*				
	(1.214)	(1.167)				
$RoO\ NAFTA_j^2$			-1.442	-1.223		
			(0.922)	(0.827)		
$RoO\ NAFTA_j^3$					-0.566***	-0.538***
					(0.184)	(0.180)
$\Delta Preferential\ Tariff_j$		-0.410***		-0.437***		-0.424***
		(0.153)		(0.152)		(0.151)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country of origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7015	7003	7015	7003	7015	7003
R-squared	0.385	0.388	0.387	0.390	0.391	0.393

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 (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_j^x 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. Industry fixed effects defined at 4 digits. Standard errors in parenthesis clustered by industry (at the HS6 level). Significance levels: *; 10%; **: 5%; ***: 1%.

Table 8 reproduces the results of Table 5 when we instrument NAFTA RoO with their CUSFTA counterparts. The first-stage coefficients associated to CUSFTA RoO_j^1, RoO_j^2 and RoO_j^3 are 0.66, 0.79, and 0.85 respectively. The three of them are statistically significant at the 1% level. The coefficient of our preferred RoO treatment variable in Table 8 is negative and also significant at 1%. Notice that its absolute value is larger than in the corresponding OLS regression of Table 5. This is consistent with the argument that some of the rules of the CUSFTA agreement may have been modified

the OLS regression. Endogeneity of the instrument is rejected at the 1% level in all cases.

during the NAFTA negotiations, to protect Mexican-based producers facing increasing import competition.

5.6 Magnitude of the effects of rules of origin

How large was the trade diversion effect of NAFTA RoO? In what follows, we discuss the magnitude of this effect across different specifications. We focus on the estimated coefficients in column 6 of our previous tables, which capture the impact of rules that are both relevant and strict. Table 9 summarizes the results.

Table 9
Quantification of the effect of RoO

	(1) Table 3	(2) Table 5	(3) Table 6	(4) Table 7	(5) Table 8
$\hat{\beta}_1$	-0.208	-0.404	-0.198	-0.666	-0.538
Mean RoO_j^3	1.277	2.840	2.660	0.630	2.832
$\Delta Imports_j$	1.532	1.246	1.228	1.228	1.246
Effect of RoO_j^3 (in percentage points)	-26.5	-114.7	-52.7	-42.0	-152.3
Effect of RoO_j^3 (as % of $\Delta Imports_j$)	17.31%	92.08%	42.88%	34.19%	122.27%

This table shows that magnitude of the effects of NAFTA RoO on Mexican imports from non-NAFTA countries across different specifications. $\hat{\beta}_1$ is the coefficient of RoO_j^3 reported in column 6 of Tables 3, 5-8. *Mean* RoO_j^3 is the average of RoO_j^3 across treated goods. $\Delta Imports_{j,o}$ is is the average percentage change in imports across treated goods. The effect of RoO_j^3 (in percentage points) is computed by multiplying $\hat{\beta}_1$ by $RoO^3 * 100$. The effect of RoO_j^3 (as % of $\Delta Imports$) is computed by dividing the absolute value of the effect of RoO_j^3 (in percentage points) by $\Delta Imports_{j,o}$.

Column 1 reports the effect of rules defined at the 6-digit level of the HS classification, which are more likely to apply to vertically-related goods. The results reported in column 6 in Table 3 indicate that RoO_j^3 decreased the growth rate in imports (measured as the log difference) of treated intermediate goods from non-NAFTA countries by around 27 percentage points. This number is obtained by multiplying the estimated coefficient of RoO_j^3 by the average of this variable for treated goods ($-0.208 \times 1.277 = -0.265$). This represents 17.3% of the average actual change in imports of treated goods ($0.265/1.532 = 0.173$). This is equivalent to say that, had the variable RoO_j^3 been zero, imports of these goods would have been 17.3% higher.

The remaining columns of Table 9 report the corresponding effects when we extend the analysis to RoO defined at 2 and 4 digits of the HS classification. In general, these

estimates indicate a larger trade diversion effect. Consider first the results reported in column 2. These correspond to Table 5, in which we include all rules contained in Annex 401 of the NAFTA agreement, without matching them with input-output data to verify whether they apply to vertically-related goods. The estimated coefficient of the RoO_j^3 variable implies that NAFTA sourcing restrictions decreased the growth rate of imports from third countries by almost 115 percentage points on average. This represents around 92% of the actual change in imports, which is computed by dividing the 1.15 reduction by 1.24, the average log change in imports of treated goods. The next two columns report the effect of RoO when we match our dataset with input-output tables to include only rules that apply to vertically-related goods (column 3) or weight the rules depend on the importance of the vertical linkages (column 4). In these cases, our estimates indicate that NAFTA RoO decreased the growth rate of imports of affected intermediate goods from third countries by around 52 and 42 percentage points, respectively (corresponding to around 43% and 34% of the actual change in imports of treated goods). Finally, the results reported in column 5 of Table 9 are based on the estimates of Table 8, in which we instrument NAFTA RoO with their CUSFTA counterparts. These results indicate that NAFTA RoO decreased the growth rate of imports of treated intermediates from non-member countries by around 152 percentage points, corresponding to around 122% of the actual change in imports of treated goods.

These results confirm that NAFTA RoO on final goods acted as input tariffs, leading to a significant and sizeable reduction in imports of intermediate goods from third countries. We can contrast the impact of RoO with that of preferential tariffs, using the estimated coefficients of $\Delta Preferential\ Tariff_j$ corresponding to the specifications of Table 9. In most cases, preferential tariff liberalization had a larger effect, decreasing the growth rate of imports from non-NAFTA countries by between 120 and 157 percentage points (representing between 97% and 104% of the actual change in imports of treated goods).[40] Only in the specification of Table 8, in which we use the sourcing restrictions of the CUSFTA agreement as an instrument, we find that RoO had a larger impact than preferential tariffs.

5.7 Triple-difference results

In our analysis so far, we have employed a difference-in-differences approach, comparing 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

[40]These effects are obtained by multiplying the estimated coefficients of $\Delta Preferential\ Tariff_j$ by the mean of this variable for treated goods.

were not subject to sourcing restrictions).

Recall that in our benchmark regression of equation (1), we cannot include 6-digit sector fixed effects, given that the RoO treatment varies at the same level. Although we do include broader fixed effects (at 3 or 4 digits) to control for sectoral trends, one might be concerned that we are not accounting for more disaggregated sectoral trends, which could be correlated with both the dependent variable and the RoO variables, resulting in biased estimates.

To deal with this concern, we employ a triple-difference methodology, comparing changes in Mexican imports from "treated countries" (outside NAFTA) and "non-treated countries" (NAFTA partners). This approach exploits both cross-sectoral and cross-country variation in the effects of RoO. We estimate the following regression:

$$\Delta Imports_{j,NON-NAFTA} - \Delta Imports_{j,NAFTA} = \alpha_0 + \alpha_1 \, RoO_j^x + \epsilon_{j,NAFTA,NON-NAFTA}, \quad (3)$$

which can be written as the difference between

$$\Delta Imports_{j,NON-NAFTA} = \beta_0 + \beta_1 \, RoO_j^x + \Delta Preferential\, Tariff_j + \beta_X \, X_j + \epsilon_{j,NON-NAFTA} \quad (4)$$

and

$$\Delta Imports_{j,NAFTA} = \gamma_0 + \gamma_1 \, RoO_j^x + \Delta Preferential\, Tariff_j + \gamma_X \, X_j + \epsilon_{j,NAFTA}, \quad (5)$$

where the vector X_j accounts for all sectoral trends that might affect Mexican imports of good j. Notice that X_j cancels out in equation (3), allowing us to deal with omitted variable concerns.[41] NAFTA RoO restricting the sourcing of good j should have had a detrimental impact only on Mexican imports of j from non-NAFTA countries. We thus expect the coefficient α_1 to be negative.

Table 10 shows the results of estimating equation (3). In all specifications, the coefficient of the RoO variable is negative and significant, confirming the detrimental

[41] The left-hand-side variables in (4) and (5) are given by

$$\begin{aligned} \Delta Imports_{j,NON-NAFTA} &= \log\left(\sum_{o,NON-NAFTA} Imports_{j,o}^{2003}\right) - \log\left(\sum_{o,NON-NAFTA} Imports_{j,o}^{1991}\right), \\ \Delta Imports_{j,NAFTA} &= \log\left(\sum_{o,NAFTA} Imports_{j,o}^{2003}\right) - \log\left(\sum_{o,NAFTA} Imports_{j,o}^{1991}\right). \end{aligned}$$

impact of NAFTA RoO on imports of treated goods from non-NAFTA countries. As expected, the effect gets larger when we exclude rules that final good producers have no incentives to comply with (moving from column 1 to column 2), and when we further exclude "flexible" rules (column 3).

Table 10
NAFTA RoO and change in Mexican imports
(difference between non-NAFTA and NAFTA countries)

	(1)	(2)	(3)
RoO_j^1	-0.060**		
	(0.026)		
RoO_j^2		-0.067***	
		(0.024)	
RoO_j^3			-0.173***
			(0.025)
Observations	4146	4146	4146
R-squared	0.001	0.002	0.012

This table shows the results of the estimation of equation (3). The dependent variable is $\Delta Imports_{j,NON-NAFTA} - \Delta Imports_{j,NAFTA}$, the difference between the log change in Mexican imports of good j (at the HS 6-digit level) between 1991 and 2003 from non-NAFTA countries and the corresponding change from NAFTA countries. The dependent variable includes goods for which Mexican imports were positive in 1991 and 2003. RoO_j^x is the number (in logs) of final goods i for which there is a NAFTA RoO restricting the sourcing of good j. When $x = 1$, the treatment includes all final goods i. When $x = 2$, the treatment excludes rules associated to final goods i for which $Preference\ Margin_{i,NAFTA} = 0$. When $x = 3$, the treatment further excludes change of tariff classification rules that are combined with alternative value added rules. 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 (around 90 percent of the rules in the two agreements are identical). 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 led to a sizeable reduction in Mexican imports of intermediaries from third countries. Depending on the specification, our estimates indicate that the growth rate of imports of restricted goods from third countries decreased by between 27 and 152 percentage points (representing between 17% and 122% of the actual change in imports of these goods). 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. Our results can help to explain why global value chains are actually regional in nature, with most trade in intermediates goods concentrated within "Factory North America", "Factory Europe", and "Factory Asia" (Baldwin, 2013).

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 the United States and Canada. 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 restrictions embedded in preferential trade agreements, the effective rate of protection on these goods is much higher. Our analysis suggests that many FTAs, including NAFTA, violate multilateral trade rules. Paragraph 5 (b) of Article XXIV of the GATT states that "the duties and other regulations of commerce maintained in each of the constituent territories and applicable at the formation of such free-trade area" (...) "shall not be higher or more restrictive than the corresponding duties and other 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.

We hope that our study conveys that accounting for the role of preferential RoO is not only feasible, but also key to understanding the implications of regional trade agreements.

References

Alfaro, L., P. Antràs, D. Chor, and P. Conconi (2015). "Internalizing Global Value Chains: A Firm-Level Analysis," NBER Working Paper 21582.

Alfaro, L., P. Conconi, H. Fadinger, and A. Newman (2016). "Do Prices Determine Vertical Integration?" *Review of Economic Studies* 83, 1-35.

Antràs, P., and D. Chor (2013). "Organizing the Global Value Chain," *Econometrica* 81, 2127-2204.

Antràs, P., D. Chor, T. Fally, and R. Hillberry (2012). "Measuring the Upstreamness of Production and Trade Flows," *American Economic Review Papers & Proceedings* 102. 412-416.

Antràs, P., T. Fort, and F. Tintelnot (2014). "The Margins of Global Sourcing: Theory and Evidence from U.S.," NBER Working Paper No. 20772.

Baldwin, R. (2013). "Global Supply Chains: Why They Emerged, Why They Matter, and Where They Are Going, in *Global Value Chains in a Changing World*, D. K. Elms, and P. Low (eds), Geneva, World Trade Organization.

Blackhurst, R., A. Enders, and J. F. Francois (1996). "The Uruguay Round and Market Access: Opportunities and Challenges for Developing Countries," in W. Martin and L. A. Winters (eds.), *The Uruguay Round and the Developing Countries*, Cambridge University Press.

Blaum, J., C. Lelarge, and M. Peters (2013). "Estimating the Productivity Gains from Importing," mimeo.

Bombarda, P., and E. Gamberoni (2013). "Firm Heterogeneity, Rules of Origin and Rules of Cumulation," *International Economic Review* 54, 307-328.

Bown, C. P., and M. A. Crowley (2006). "Policy Externalities: How U.S. Antidumping Affects Japanese Exports to the EU," *European Journal of Political Economy* 22: 696-714.

Bown, C. P., and M. A. Crowley (2007). "Trade Deflection and Trade Depression," *Journal of International Economics* 72: 176-201.

Caliendo, L., and F. Parro (2015). "Estimates of the Trade and Welfare Effects of NAFTA," *Review of Economic Studies* 82, 1-44.

Carrere, C., and J. de Melo (2006). "Are different rules of origin equally costly? estimates from NAFTA," in O. Cadot, A. Estevadeordal, A. Suwa-Eisenmann and T. Verdier (eds.) *The origin of goods - Rules of Origin in Regional Trade Agreements* Oxford University Press, 191-212.

Chang, W. and A. L. Winters (2002). "How Regional Blocs Affect Excluded Countries: The Price Effects of MERCOSUR," *American Economic Review* 92, 889-904.

Chase, K. A. (2008). "Protecting Free Trade: The Political Economy of Rules of Origin," *International Organization* 62, 507-530.

Conconi, P., M. García-Santana, L. Puccio, and R. Venturini (2016). "From Final Goods to Inputs: The Protectionist Effect of Rules of Origin," CEPR Discussion Paper 11084.

Dixit, A. K., and Grossman, G. M. (1982). "Trade and Protection with Multistage Production," *Review of Economic Studies* 49, 583-594.

Duttagupta, R., and A. Panagariya (2007). "Free Trade Areas and Rules of Origin: Economics and Politics," *Economics and Politics* 19, 169-190.

Eaton, J., and S. S. Kortum (2002). "Technology, Geography, and Trade?" *Econometrica* 70, 1741-1779.

Estevadeordal, A. (2000). "Negotiating Preferential Market Access: The Case of the North American Free Trade Agreement," *Journal of World Trade* 34, 141-166.

Estevadeordal, A., and K. Suominem (2006). "Mapping and measuring rules of origin around the world," in O. Cadot, A. Estevadeordal, A. Suwa-Eisenmann and T. Verdier (eds.) *The origin of goods — Rules of Origin in Regional Trade Agreements* Oxford University Press, 69-113.

Falvey, R., and G. Reed (1998). "Economic Effects of Rules of Origin," *Review of World Economics*, 134, 209-229.

Feenstra, R. C. (1996). "U.S. Imports, 1972-1994: Data and Concordances," NBER Working Paper 5515.

Gawande, K., and U. Bandyopadhyay (2000). "Is Protection for Sale? A Test of the Grossman-Helpman Theory of Endogenous Protection," *Review of Economics and Statistics* 89, 139-152.

Goldberg, P. K., and G. Maggi (1999). "Protection for Sale: An Empirical Investigation," *American Economic Review* 89, 1135-1155.

Grossman, G. M. (1981). "The Theory of Domestic Content Protection and Content Preference," *Quarterly Journal of Economics* 96, 583-603.

Grossman, G. M., and E. Helpman (1995). "The Politics of Free Trade Agreements," *American Economic Review* 85, 667-690.

International Trade Centre (2015). "The Invisible Barriers to Trade: How Businesses Experience Non-Tariff Measures."

Johnson, R. C. and G. Noguera (2012). "Accounting for Intermediates: Production Sharing and Trade in Value Added," *Journal of International Economics* 86, 224-236.

Ju, J., and K. Krishna (2005). "Firm behavior and Market Access in a Free Trade Area," *Canadian Journal of Economics* 38, 290-308.

Kee, H. L., and H. Tangi (2016). "Domestic Value Added in Exports: Theory and Firm Evidence from China,"' *American Economic Review* 106, 1402-1436.

Kehoe, T., and K. Ruhl (2013). "How Important is the New Goods Margin in International Trade?" *Journal of Political Economy* 121, 358-392.

Koopman, R., Z. Wang, and S-J Wei (2014). "Tracing Value-Added and Double Counting in Gross Exports,"' *American Economic Review* 104, 459-494.

Krishna, K., and A. O. Krueger (1995). "Implementing Free Trade Areas: Rules of Origin and Hidden Protection," in A. Deardorff, J. Levinsohn and R. Stern (eds.), *New Directions in Trade Theory*, University of Michigan Press.

Miroudot, S., R. Lanz, and A. Ragoussis (2009). "Trade in Intermediate Goods and Services," *OECD Trade Policy Working Paper* 93.

Puccio, L. (2013). *Building Bridges between Regionalism and Multilateralism: Enquiries on the Ways and Means to Internationally Regulate Rules of Origin and their Impact on Systemic Problems of FTA*. EUI Thesis - Cadmus Repository, 355.

Ramanarayanan, A. (2014). "Imported Inputs and the Gains from Trade," mimeo.

Vousden, N. (1987). "Content Protection and Tariffs under Monopoly and Competition," *Journal of International Economics* 23, 263-282.

Villarreal, M. A. (2010). "NAFTA and the Mexican Economy," CRS Report for Congress R40784.

Winters, A. L., and W. Chang (2000). "Regional Integration and Import Prices: an Empirical Investigation," *Journal of International Economics* 51, 363-377.

Appendix

Table A-1

Definitions and sources of main variables

Variable	**Source**	**Definition**
RoO_j^1	Annex-401	$log(\sum_j RoO_{i,j})$
RoO_j^2	Annex-401	$log(\sum_j RoO_{i,j})$, excluding goods i for which *Preference Margin*$_{i,NAFTA} = 0$
RoO_j^3	Annex-401	$log(\sum_j RoO_{i,j})$, excluding goods i for which *Preference Margin*$_{i,NAFTA} = 0$ and those with alternative VA rules
$\Delta Imports_{j,o}$	WITS	$log(1+Imports_{j,o,2003})$- $log(1+Imports_{j,o,1991})$
Δ*Preferential Tariff*$_j$	WITS	$\Delta Tariff_j - \Delta Tariff\ NAFTA_j$
Preference Margin NAFTA$_i$	WITS	Average between *Pref. Margin*$_i^{US}$ and *Pref. Margin*$_i^{CA}$
Exports NAFTA$_i$	WITS	Log (Mexican exports of good i to Canada and U.S. in 1991)

Variable	**Source**	**Definition**
$RoO_{i,j}$	Annex-401	Dummy variable equal to one if good i has a RoO restricting the sourcing of good j
$Imports_{j,o,t}$	WITS	Value of Mexican imports of good j from country o in year t
$Tariff_{j,t}$	WITS	MFN Tariff applied by Mexico on imports of good j in year t
Tariff NAFTA$_{j,t}$	WITS	Preferential Tariff applied by Mexico on imports of good j from the US and Canada in year t
$\Delta Tariff_j$	WITS	$log(1+Tariff_{j,2003})$- $log(1+Tariff_{j,1991})$
$\Delta Tariff\ NAFTA_j$	WITS	$log(1+Tariff\ NAFTA_{j,2003})$- $log(1+Tariff_{j,1991})$
$Tariff_i^{US}$	WITS	MFN tariff applied by the US to imports of good i in 2003
Tariff NAFTA$_i^{US}$	WITS	Preferential tariff applied by the US to Mexican imports of good i in 2003
Pref. Margin$_i^{US}$	WITS	$log(1 + Tariff_{i,t}^{US}) - log(1+Preference\ Tariff_i^{US})$
$Tariff_i^{CA}$	WITS	MFN tariff applied by Canada to imports of good i in 2003
Tariff NAFTA$_i^{CA}$	WITS	Preferential tariff applied by Canada to Mexican imports of good i in 2003
Pref. Margin$_i^{CA}$	WITS	$log(1 + Tariff_i^{CA}) - log(1 +\ Pref.\ Tariff_i^{CA})$

The table provides the definition and sources for all the variables used in our analysis (top panel), and in their construction of such variables (bottom panel).