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Diagonal Cumulation and Sourcing Decisions

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Abstract

Free trade agreements (FTAs) are characterized by rules of origin (RoO) and cumulation. These rules define which intermediate goods allow a final product to qualify for preferential access. Recent literature shows that RoO led to a reduction in imports of intermediate goods from third countries relative to partners. We consider the impact of the Pan-European Cumulation System (PECS), which provided the possibility of cumulating stages of production across European Union's FTA peripheral partners. We find that PECS reshaped regional supply chains by increasing imports of intermediates among these peripheral countries relative to both the European Union (EU) and third countries. We also find that PECS reinforced their value chain links with third countries relative to the EU, contributing to multilateralize regionalism.

JEL classification: F12, F13, F14, F15.

Keywords: Intermediate Trade, rules of origin, diagonal cumulation, PECS, input-output tables.

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1 Introduction

Global Value Chains (GVCs), as a way to organize the production process across nations, have large implications on international trade flows. Throughout 1995 and 2011 trade within GVCs accounted for 60–67 percent of global trade in value-added terms. In 2009, 66 percent of world exports was characterized as trade flows in intermediate goods. This is suggestive of a production process split across nations. Statistics on intra-regional exports of trade in intermediate and final manufactured goods over 1995–2015 for Europe, the Americas, Asia, and the rest of the world highlight the large shares of intra-regional linkages (World Bank and the WTO, 2017). This confirms that GVCs are organized mainly at the regional level, creating what Baldwin and Lopez-Gonzalez (2013) call "Factory Asia," "Factory North America," and "Factory Europe."

The trade literature has analyzed the determinants behind the participation of countries in GVCs. This literature has focused on countries' endowments and institutions. Antràs and Helpman (2008) propose a model in which contractual frictions affect the decision to offshore versus outsource part of the production process. Nunn (2007) provides empirical evidence about the role of the quality of contract-related institutions on comparative advantage in contract-intensive goods. Moreover, Antràs et al. (2012) show that the distance of the export basket to final use (a measure of upstreamness in the production process) negatively correlates with a country's quality of institutions, skill endowment, and access to finance. The literature has also suggested that location and trade related costs matter for GVCs. For instance, Antràs and de Gortari (2017) show that the optimal location of production of a given stage in the global value chain depends also on the proximity of that location to the preceding and the subsequent desired locations of production. They show that it is optimal to locate relatively downstream stages of production in relatively central locations.

To explain the ability of a country to participate in GVCs, this paper considers the role of a specific European Union (EU) trade policy: the introduction in 1997 of the Pan European Cumulation System (henceforth PECS). PECS aimed at harmonizing the heterogeneous set of free trade agreements (FTAs) that the EU had put in place with Central and Eastern European countries (CEECs) in the early nineteens.[1] At the heart of each FTAs there are rules of origin (henceforth RoO), and their corresponding cumulation of origin rules. By determining the origin of a product, RoO define whether or not a good qualifies for preferential access. Cumulation of origin rules defines whether a firm can use imported intermediate goods from a specific country, so that the final product of the importing firm does not lose the originating status. A preferential regime can allow either for bilateral, diagonal, or full cumulation. Bilateral cumulation is operated between two partners. This implies that producers in either partner country can use intermediates originating in the other's country as if they are originated in their own country. Operations carried out in one partner country can be aggregated with the operations carried out in another partner country to confer orig-

[1] CEECs is an OECD term that includes BAFTA and CEFTA countries. BAFTA includes Estonia, Latvia, Lithuania. CEFTA includes: Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovak Republic and Slovenia.

inating status to goods traded between them. Diagonal cumulation operates between more than two countries. Considering three countries, A, B and C, diagonal cumulation requires these countries to be bound together by bilateral FTAs characterized by identical set of RoO. Then, a firm in country A can use intermediate goods originating from FTA partners in B and C to produce an originating product in country A. Alternatively, a preferential regime can allow for full cumulation. In this case all stages of production coming from free trade area partners can be counted as qualifying to achieve the origin status, regardless of whether the processing is sufficient to confer originating status.

The proliferation of different FTAs in the early '90s generated an increasing level of complexity among countries participating or willing to participate into the slicing up of the value added chain. The set of FTAs signed in the European region were all characterized by bilateral cumulation. Let's consider for example the bilateral FTAs that the EU signed with Hungary and Poland in the 1990s. Suppose that RoO on cloth impose that all shirts imported duty-free into the EU market to be made either of EU cloth or of locally-produced cloth. RoO will force Hungarian shirt producers to switch from buying Polish cloth to buying EU cloth in order to get preferential treatment for their exports of shirts in the EU market. The bilateral cumulation plus RoO act like a Hungarian tariff on Polish cloth.[2] Thus, bilateral cumulation was limiting the fragmentation of the production process within the area, specifically among the EU and CEECs.

To tame the European "Spaghetti Bowl", the EU pushed through PECS. PECS, which came in 1997, completed the missing FTAs, it harmonized the rules of origin protocols of all the underlying FTAs, and most importantly introduced diagonal cumulation. With diagonal cumulation, countries belonging to the PECS agreement can source parts and components from within PECS partners without fear of the resulting product losing its origin status, and thus its right to preferential treatment. Using the above example, when cumulation is diagonal this would allow the Hungarian shirt-makers to use Polish cloth in meeting the RoO (Baldwin, 2013). PECS provided an opportunity to split the value chain of production among several PECS peripheral partners, since the final good could still benefit from the preferential tariffs.[3] As a result, countries belonging to the cumulation zone enjoyed a cost advantage, which influenced the organization of value chains for goods destined to the EU market. Since the cumulation zone was initially established among countries in the region, it should have contributed to the creation of a "factory Europe."

Using PECS as a natural experiment, this paper studies how the relaxation of RoO achieved via diagonal cumulation altered the setting up of international supply chains among peripheral countries in the PECS network. We consider changes in imports of intermediate goods over the period 1995-2002 in different PECS peripheral countries, i.e. BAFTA and CEFTA members. Specifically, we compare imports coming from different exporting countries: the other Spokes (PECS network), third countries (also called rest of the world countries, RoW), and EU15.[4] Our findings show that, as a result of diagonal cumulation,

[2]This example is discussed in Baldwin (2013).
[3]PECS peripheral partners are also referred to as Spoke countries.
[4]EU15 is used to indicate those countries that joined the EU until 1995.

PECS peripheral countries increase imports of intermediate goods among themselves relative to other countries (RoW and EU15), and that this increase is larger, the stricter the rules of origin applied to the related final products. Moreover, we show that following diagonal cumulation, PECS peripheral partners also increase their imports of intermediate goods from third countries (RoW) compared to the EU15. The evidence presented in this paper suggests that diagonal cumulation have led to a reassessment of sourcing decisions established during the pre-PECS period. Indeed, diagonal cumulation allows preferential access for exports of final goods that are produced with intermediates imported by a larger set of countries. Since RoO do not typically require whole obtained originating status, the increase in sourcing choices may have led PECS peripheral countries to import more intermediate goods also from RoW. Therefore, our results also support the idea that diagonal cumulation can lead to a multilateralization of regionalism (Baldwin, 2006).

Our analysis is developed in three steps. First, we present some stylized facts on the extent to which EU-RoO on final goods affect intermediate goods. We show that the restrictiveness of RoO is linked to the nature of the production process in which intermediate goods participate. For example, intermediate goods classified as textiles mainly enter into the production process of textile goods. Final goods classified as textiles require more than 40 percent of regional value added to benefit from preferential access in the EU. Intermediate goods classified as vegetables, by contrast, enter mainly into the production process of final goods classified as chemicals, which need to fulfill less restrictive rules of origin. This evidence stresses the need for translating in intermediate goods terms RoO defined at the final good level.

Second, we follow Conconi et al. (2018) and use a triple difference model to analyze the impact of diagonal cumulation on changes in each peripheral country's imports of intermediates before and after PECS (1995 - 2002). This allows us to control for unobservable product specific time-invariant characteristics, as well as product level trends common across our set of countries. As the effect of diagonal cumulation is strictly linked to the restrictiveness of rules of origin, we exploit an index developed by Cadot et al. (2006). This index measures the restrictiveness of RoO applied to final goods. To evaluate the effects of PECS on imports of intermediate goods, we translate this RoO index in terms of intermediate goods by combining it with the US IO1997 table. In the empirical strategy, we compare changes in Spokes' imports of intermediates from the RoW to changes in Spokes' imports from the other Spokes. We show that following the introduction of diagonal cumulation the intermediate imports from the RoW declined compared to imports from the other Spokes. The magnitude of this decline is positively associated with the extent of the restrictive RoO applied to the associated final goods.

Finally, owing to the nature of the experiment, we also exploit other control groups and try to disentangle trade creation from trade diversion effects in intermediate goods. Switching from bilateral to diagonal cumulation can boost trade in intermediates thanks to the fact that diagonal cumulation provides new sourcing possibilities compared to the initial FTAs characterized by more stringent (bilateral) rules of cumulation. Thus, diagonal cumulation could lead Spoke countries to change their supply chain linkages, by substituting

intermediates imported from the EU market with cheaper intermediates coming from Spoke countries. As a consequence of this, also exports from third countries, outside the PECS cumulation zone, may have been favored. The relaxation of RoO induced by PECS, may have allowed Spoke countries to increase their imports of intermediates from third countries (RoW), while still enjoying preferential treatment when exporting to EU market. In sum, diagonal cumulation may have led exporting firms in Spoke countries to reassess sourcing decisions towards other Spoke as well as RoW countries, and away from the EU.

To assess these additional mechanisms, we consider two alternative changes in Spokes' imports. First, we compare changes in imports of intermediates by each Spoke country from the RoW to those from the EU15. Our results show that diagonal cumulation reduced imports of intermediate goods from the EU15 vis-à-vis RoW. Second, we consider changes in imports by each Spoke country from the PECS network to changes in imports from the EU15. Similarly, we find that diagonal cumulation reduced imports of intermediate goods from the EU15 *vis-à-vis* the other Spokes. These additional results highlight that Spokes countries reorganize their production process towards the other peripheral countries in the PECS network as well as third countries, moving away from EU15. The magnitude of these effects is also positively associated with the extent of the restrictive RoO applied to the associated final goods.

Our findings suggest that indeed PECS allowed a reassessment of sourcing decisions. Diagonal cumulation allowed peripheral countries to re-organize global value chain links. In terms of magnitude, our estimates imply that PECS reduced Spokes' intermediate imports from RoW relative to the PECS network by around 14%. Using the other control groups, we also show that PECS increased imports from RoW and PECS network relative to the EU15 respectively by 3% and 9%. Due to the specific economic integration in the European region, we try to address possible identification threats that may arise from pre-existing trends. Finally, we provide several robustness checks to show that our results are robust to using different samples of exporting countries, using an alternative way to construct the dependent variable, and the control variable (where we focus on RoO based on whether final goods face stringent value added requirements).

Related Literature

The theoretical literature on regional trade agreements and fragmentation of the production process is vast (Ornelas et al., 2019, Blanchard, 2015, Antràs and Staiger, 2012 among others). A strand of this literature has shown that FTAs can potentially lower trade costs if the benefits from preferential access outweigh the costs of fulfilling RoO, therefore affecting a firm's sourcing decisions. Demidova et al. (2012) build a heterogeneous firm setting which shows that firms sort according to the export markets and the different types of trade policy. They model the response of Bangladesh firms in two sectors, the woven and non-woven sectors, with respect to the decision to export to the EU market under the "Everything But Arms" (EBA) initiative, and to the US market under the quota regime. In both cases firms can take advantage of these trade policies only if they comply with RoO. Modeling RoO as

an additional marginal and fixed cost, they show that firms that take advantage of the less restrictive EU RoO are less productive than those firms that export to the US, where tariffs are higher. By adding an intermediate good sector in a hub-spoke setting, Bombarda and Gamberoni (2013) show that only the most productive final good firms are able to export under preferential tariffs associated with RoO and bilateral cumulation. In their model RoO and diagonal cumulation affect sourcing decisions: switching from bilateral to diagonal cumulation relaxes the restrictiveness of RoO, leading to an increase in trade among firms in the Spoke countries. Our findings build on this theoretical literature and confirm the prediction that diagonal cumulation relaxes the restrictiveness of RoO by allowing larger trade among Spoke countries.

This paper further adds to recent empirical research that shows that RoO affect sourcing decisions. To the best of our knowledge, we provide first-time evidence that cumulation of origin rules affects input choices, and that less stringent rules may help reducing trade diversion effects in intermediate goods. Existing empirical work shows that RoO increase production costs and negatively affect trade flows. Anson et al. (2005) show that in the case of the North American Free Trade Agreement (NAFTA), up to 40 percent of Mexico's preferential access to the US market in 2000 (estimated at 5 percent) was absorbed by RoO-related administrative costs. Cadot et al. (2006) construct, for both NAFTA and EU-related preferences, an index of restrictiveness of RoO at the six-digit level of the harmonized system. This index shows that RoO tend to be more restrictive for activities with greater processing, that sectors with higher RoO have lower utilization rates, and that non-least developing countries face restrictive RoO in sectors in which they have a revealed comparative advantage. Unlike this literature that considers the role of RoO on trade flows and utilization rates, our paper focus on RoO and sourcing decisions for CEECs countries as an example of the participation of EU peripheral countries in GVCs under a hub-spoke setting. Closely related to out paper, is the work by Augier et al. (2005). Using aggregated data, they show that lack of cumulation before PECS impeded trade by 10% to 50%, depending on the time period and group of countries concerned. Differently from Augier et al. (2005), we account for the specific nature of RoO and their corresponding cumulation rules. Specifically, we work with data at the six digit level of the Harmonized System (HS6), which has about 5,000 product categories. Moreover, using a disaggregated IO table, we assess the effect of RoO on trade within global value chains rather than on overall trade.

Our paper also relates to the recent work measuring global value chains (Johnson and Noguera, 2017, Koopman et al., 2014 and Antràs et al., 2012 among others). Specifically, we relate to studies evaluating the role of government policies on the ability of a country to participate in GVCs. More closely related to our work is the recent analysis by Caliendo and Parro (2015) and Conconi et al. (2018). Caliendo and Parro (2015) study the impact of NAFTA's tariff reductions extending the Eaton and Kortum (2002) model to account for multiple-sector linkages. They find that the trade created, mostly between NAFTA members, was larger than the trade diverted from other economies. Conconi et al. (2018) consider the role of NAFTA RoO in affecting trade creation and diversion. They show that, controlling for the size of the preference margin, NAFTA RoO led to a sizeable reduction in

Mexico's imports of intermediate goods from third countries relative to NAFTA partners. For their analysis they built the RoO index using Input-Output tables. Specifically, for each intermediate good, they construct a measure based on the number of final goods facing a RoO-related restriction. They then use triple difference methodology to estimate the effect of NAFTA on non-members. Differently from Caliendo and Parro (2015) and Conconi et al. (2018), we focus on diagonal cumulation, and show that more flexible RoO can revert sourcing decisions that may have resulted from the introduction of a FTA. Our results suggest that diagonal cumulation can foster trade among peripheral FTA members and may provide for an outcome closer to a multilateral liberalization. Focusing on EU-RoO allows us to take advantage of different control groups to better disentangle the effect of PECS on trade creation and diversion in intermediate goods.

The paper is structured as follows. Section 2 presents preliminary evidence on the role of PECS in influencing sourcing decisions. Section 3 describes the data and variables construction. Section 4 presents the empirical strategy, and the possible identification threats. The estimation results, and robustness checks are discussed in Section 5. Section 6 concludes.

2 A Glance at PECS and Sourcing Decisions

FTAs have been a major instrument behind reciprocal liberalization. Between 1950 and 2017, 288 Regional Trade Agreements entered into force with FTAs representing the largest part of the category.[5] To prevent trade deflection or simple transshipment— whereby products from non-preferred countries are redirected through a free trade partner to avoid the payment of customs duties— RoO are used in FTAs. Theoretically, for each FTA, a particular set of RoO can be established, negotiated according to the trade, industrial, and economic interests of each party.

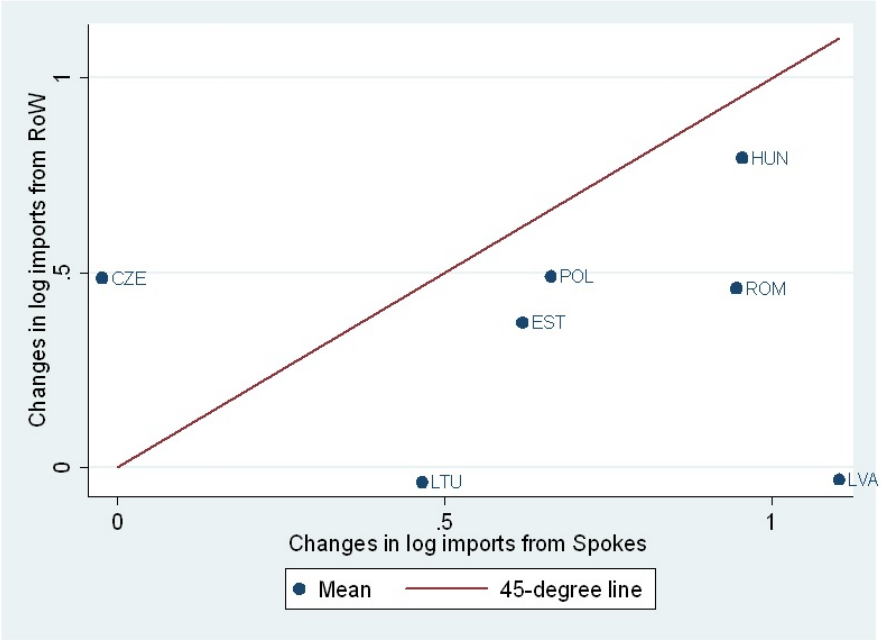
Around 1993, trade in Europe was regulated by roughly 60 bilateral and plurilateral FTAs regulating European trade (Baldwin, 2013). These FTAs were characterized by bilateral cumulation, which implied that only inputs among the countries belonging to the FTA could be cumulated to count towards the establishment of the origin of the product. In the example discussed previously, the bilateral FTAs that the EU signed with Hungary and Poland in the 1990s foresaw bilateral cumulation. This implied that Hungary could cumulate inputs only from the EU or from itself to obtain origin status for the related final good, and export at preferential tariffs to the EU market (Baldwin, 2013). The existence of multiple FTAs led to a spaghetti bowl of preferential areas (and thus RoO) that did not favor the slicing up of the value chain across Europe. To reduce the heterogeneity of RoO in the pan-Euro-Mediterranean region, the EU and its partners agreed on a single set of rules of origin. This was achieved in 1997, which saw the creation of PECS. While the PECS system was introduced in 1997, countries did not join immediately. Among the BAFTA and

[5]For further information see http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

CEFTA countries, the system could be considered mainly in place as of 1999.[6]

Since this paper analyzes the impact of RoO and diagonal cumulation on sourcing decision, we exploit the introduction of the PECS and investigate changes in imports among a group of the EU FTA's peripheral partners, BAFTA and CEFTA (also called Spokes), between 1995 and 2002. To provide preliminary evidence of the effect of PECS on trade relationships, in Figure 1 we plot the evolution of imports of Spoke countries (in sample) before and after the introduction of PECS.[7] The vertical axis measures changes in imports by each Spoke country from third countries (non-participating countries). The horizontal axis measures changes in overall imports by each Spoke country from the rest of the Spoke countries before and after 1997. Figure 1 shows that, between 1995 and 2002, the majority of Spoke countries experienced a larger increase in imports from the rest of the Spoke countries as opposed to the average imports from non-participating countries.

Figure 1: Change in Imports (1995–2002)



Source: Authors' calculation using WITS Comtrade database

[6]The system was based on the EEA agreement (1994) between the EU, the EFTA (European Free Trade Association), the CEEC (Central Eastern European Countries) and the Baltic States. Table 15 in Appendix A provides further details about the preferential agreements providing for diagonal cumulation of origin between the EU and the Spoke countries. The system was then widened to Slovenia and to industrial products originating in Turkey (1999). The system was also enlarged to the Faroe Islands in 2005 and later to the countries of the Mediterranean and Balkan region.

[7]Our analysis considers imports of BAFTA and CEFTA countries. Notice that Bulgaria, the Slovak Republic, and Slovenia are dropped from our analysis due to absence of tariff data in the period under consideration. Table 9 in Appendix A provides a complete list of countries used in our study. Additional details about trade and tariff data used can be found in Section (3.2).

3 Data Description

This section describes the data used in the analysis and the methodology adopted to construct the variables of interest.

3.1 RoO Index at the Intermediate Level

We start the analysis by discussing the construction of the main variable of interest, which summarizes the difficulty in sourcing an intermediate product according to the RoO faced by the related final good. We follow Conconi et al. (2018) in constructing a data set that maps input-output linkages to the EU-RoO (which are defined according to the six digits of the 1992 Harmonized System). These input-output linkages are based on the US IO1997 table and are converted into the six digits of the 1988/1992 Harmonized System of classification, HS6 (see Conconi et al., 2018). Despite focusing on the EU context, we use the US IO tables for two reasons. Firstly, the match allows us to keep the same level of disaggregation of the trade data, that is HS6. Secondly, it enables us to follow the rationale in Rajan and Zingales (1998), who construct a measure of the extent of an industry's dependence on external funds in the United States, and apply this measure to all other countries. As pointed out by the authors, the assumption is that "there is a technological reason why some industries depend more on external finance than others" and these technological reasons are the same in the United States as in other countries. Additionally, the authors use US data on capital markets since, among other things, these markets are among "the most advanced in the world, and large publicly traded firms typically face the least frictions in accessing finance. Thus, the amount of external finance used by large firms in the United States is likely to be a relatively pure measure of their demand for external finance." In the same spirit, we exploit the US IO tables to better identify a production process that is less subject to distortions (such as product market restrictions), and therefore can be considered among the most efficient, allowing the identification of a production process driven by technological reasons.

Before describing the variable used to capture EU-RoO, it seems important to discuss the origin-determining criteria behind the rules of origin. These criteria determine how and when a product can be considered as originating in the European Community or in the partner country. Origin confers certain benefits on goods traded between countries that have agreed such an arrangement, usually entry of products at a reduced tariff rate. Therefore, origin criteria generally demand that these products undergo a certain amount of working or processing in the origin country. Specifically, a product is considered as originating if it has been wholly obtained, or sufficiently worked or processed with wholly or partly imported materials (Articles 5, 6, and 7 of the harmonized Protocol 4). Wholly obtained products are mainly mining, agricultural and fisheries products. While in the field of industrial products, most products are required to have undergone sufficient processing in either the Community or the partner country. There are three criteria used in determining sufficient working or processing: value added rules, change of tariff classification, and specific rules. Value

added rule means that the value of the non-originating materials must not exceed a certain percentage of the ex-works price of the finished product. Change of tariff classification (mostly at HS4) requires the non-originating raw materials or components used to have a different HS tariff classification from the HS tariff classification of the finished product. Specific rules may require additional minimum processing permitted to confer originating status (i.e. wholly obtained, from yarn etc.). Annex II of the origin protocols introduced by PECS shows that some rules of origin are a mixture of the above three categories of rules.

To measure EU-RoO, we use an index developed by Cadot et al. (2006) which is based on Annex II introduced by PECS. This RoO index applies to final goods classified at the HS6 level, and varies from 1 to 7, with 7 representing the most restrictive EU-RoO. Therefore, it is based on change in tariff classification (CTC), and almost always accompanied by other criteria to be met to obtain origin. As a matter of comparison, less than 17% of EU-RoO are uniquely based on CTC, against 89% of NAFTA RoO. Additionally, EU-RoO are largely based on value added requirements (VA). In fact, 26% of tariff lines are based on CTC and VA requirements, 13% of which uniquely rely on VA criteria.[8] This seems to suggest that the EU-RoO are more heterogeneous than the NAFTA RoO. To account for the heterogeneous level of complexity embodied in the EU-RoO, the synthetic RoO index constructed by Cadot et al. (2006) seems more appropriate than counting the number of final goods products that use a specific intermediate as Conconi et al. (2018) propose to focus on NAFTA .

To translate the EU-RoO for final goods in terms of intermediate goods, we combine the previous two data sets, i.e. US IO1997 table and EU-RoO index by Cadot et al. (2006).[9] Using these databases, for each intermediate good we create two measures: a simple and a weighted average of the RoO index faced by the associated final goods. We call these measures the IO-RoO Index and the weighted IO-RoO Index respectively. For each intermediate, the simple average is constructed by considering all final goods to which this intermediate contributes. This measure, called IO-RoO, is thus computed as follows:

$$\text{IO-RoO}_j = \frac{\sum_i RoO_{ij}}{n_i} \tag{1}$$

where j and i refer to the intermediate and final good respectively, and RoO_{ij} is the RoO index at the level of the final good, i, associated to each intermediate, j. In equation (1) we sum the RoO index, RoO_{ij}, across all final goods into which an intermediate j enters, and we divide it by the number of these IO relations, n_i. The drawback associated to the measure in equation (1) is that it gives to all products using a specific intermediate the same importance. To account for the heterogeneity in the use of the intermediate, we also construct a weighted measure where we exploit the direct input-output coefficient requirement which assigns a higher weight to final goods served most prominently by an

[8] For further details on the product specific rules of origin see Table 2 in Cadot et al. (2006).

[9] Notice that in combining EU-RoO index to US IO1997 table, we do not find a match for 173 tariff lines.

intermediate good. This weighted measure, called *weighted* IO-RoO, is then computed as:

$$\text{weighted IO-RoO}_j = \sum_i \left(RoO_{ij} \frac{dr_{ij}}{\sum_i dr_{ij}} \right) \tag{2}$$

where dr_{ij} refers to the direct requirement coefficient.[10] This *weighted* IO-RoO Index is our preferred measure. We believe that it better reflects the production process common across countries and therefore, it provides a more accurate proxy of the production technology.[11]

Table 1 presents descriptive statistics for the I-O relations according to the restrictiveness of the RoO index faced by final goods according to the sector of the intermediate goods and the resulting sector-level averages of our IO-RoO Indexes. Columns 1 to 7 present the share of intermediate goods hit by these sourcing restrictions.[12] For example, 5.9% of chemical intermediate goods contributes to a final good that faces a RoO Index = 1, with the vast majority of chemicals, 41%, contributing to the production process of a final good facing a RoO Index = 5. Finally, columns 9 and 10 in Table 1 provide the resulting simple and weighted IO-RoO Indexes when looking at the sector of the intermediate good using the 2-digit level of the HS (HS2).

To further stress the importance of considering the synthetic index rather than counting the IO relations, Tables 11 and 12 in Appendix A show descriptive statistics at the HS2 on the number of IO relationships and on the average RoO Index faced by intermediates entering into final goods. More precisely, Table 11 calculates the percentage of IO-relations at the HS2 level. For example, about 20% of IO relations are between intermediate goods classified as chemicals entering into the production of final goods classified as chemicals. Conversely, in Table 12 we compute the simple average RoO at the HS2 level. For example, intermediate goods classified as chemicals face an average RoO index associated to the production of final goods classified as chemicals of 3.3. Comparing Tables 11 and 12 suggests that in the EU context what matters is not only the number of lines into which the intermediate enters; instead what seems crucial is the restrictiveness of the RoO that the final goods face. For instance, from Table 11 we see that 40.7% of intermediate goods classified as textiles enter into the production process of textile goods, and these face an average RoO-Index of 6 (see Table 12). Meanwhile, 17.3% of intermediate goods classified as plastic and rubbers enter into the machinery production process, which faces an average RoO-Index of 5, and fewer of them (13.3%) enter into the textile production process, which faces a higher RoO-Index. Tables 11 and 12 underline that the sourcing restrictions strongly depend on the production process in which the intermediate is used.

[10] The direct requirement matrix is taken from Conconi et al. (2018).

[11] A simple average will provide equal weights to final goods served by an intermediate good, even if an intermediate good may, for example, be used only for 0.1% of a final good process.

[12] The total amount of input-output pairs (amount of intermediates entering in final goods) contained in our data set is $9,499,930$.

Table 1: Descriptive Statistics on EU-RoO index

HS2 Sector	RoO=1	RoO=2	RoO=3	RoO=4	RoO=5	RoO=6	RoO=7	Total	IO-RoO	weighted IO-RoO
Animal Products	30.9	4	9.7	16.9	23.2	7	8.3	100	3.5	3.1
Chemicals	5.9	3.8	16.4	22.2	41	3.6	7	100	4.3	3.9
Foodstuffs	25.7	3.8	17.5	17.5	15.1	12.9	7.5	100	3.6	3.7
Footwear/Headgear	9.3	3	8.9	21.8	36.4	7.6	13.1	100	4.5	5
Machinery/Electrical	5.5	3.1	13.9	18.5	49	3.7	6.4	100	4.4	4.7
Metals	4.8	2.9	14.3	20.7	48.9	3.2	5.2	100	4.4	4.5
Mineral Products	5.5	3.8	19.7	21.5	40.9	3.1	5.6	100	4.2	3.8
Miscellaneous	6.5	3	14.6	17.9	44.8	4.9	8.4	100	4.4	4.5
Plastic/Rubbers	7	3.3	13.5	22.3	41.8	4.1	8	100	4.3	4.3
Raw Hides,Skins,Leathers	9.3	4.1	12.4	18.7	33.1	7.4	15	100	4.4	4.1
Stone/Glass	3.8	3.1	19.4	18.9	47.2	2.4	5.2	100	4.3	4.3
Textiles	4.6	1.4	8.4	20.6	37.4	7.5	20.1	100	4.9	5.6
Transportation	9.4	3.4	12.4	19.4	45	4.2	6.2	100	4.2	4.6
Vegetables	19.2	3.9	24.8	16.1	18.9	10.3	6.8	100	3.7	3.1
Wood Products	6.9	3.6	14.2	20.7	41.9	4.4	8.2	100	4.3	4.3

Notes: Columns 1 to 8 report the share of intermediate goods that enter final goods which face a RoO Index, from 1 to 7, as a share of total number of IO relations. Columns 9 and 10 present mean values for simple and weighted IO-RoO Index.

3.2 Tariffs and Imports Data

In the empirical analysis, we consider the effect of PECS on changes in Spokes' import flows from third countries (RoW) relative to the other Spokes. Then, we further assess the role of diagonal cumulation in relaxing the restrictiveness of RoO using alternative type of comparisons. For this purpose, we use trade data from the World Integrated Trade Solution (WITS) for 1995 and 2002, which correspond to pre- and post-PECS years. Using these years also allows us to exploit the available tariffs information.[13]

Our group of importing countries is composed of the BAFTA and CEFTA members. After eliminating those countries with missing tariff observations for the pre-PECS period, i.e. Bulgaria, the Slovak Republic and Slovenia, we are left with 7 Spoke countries: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland and Romania. Depending on the specification used, the set of exporting countries is divided into non-participating countries (RoW), EU15 countries (treated as a single group), and Spoke countries (treated also as a group). RoW includes countries with which our Spokes did not have free trade agreements over the period considered. Tables 9 and 10 in Appendix A provide the list of countries included in our study. In the period under study, members of EFTA (Iceland, Norway, and Switzerland) and Turkey (for the subset of industrial goods) also joined the PECS. To assess the impact of diagonal cumulation on a more homogeneous group of countries, our benchmark regression does not include EFTA and Turkey in the set of Spokes exporting countries. Nevertheless, these will be included in robustness checks.[14] Table 2 presents descriptive statistics of Spoke countries' imports from RoW and among themselves. Looking at total amounts, Spoke countries' imports from non-participating countries (RoW) increased by 77%, and by 128% from EU15. The increase in imports among Spoke countries is much larger, at about 161%.[15]

In the empirical specification, we perform three sets of triple difference estimations. In the main specification, our dependent variable captures product-level changes in each Spoke country's imports from RoW relative to imports from the Spokes themselves, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. In the second specification, our dependent variable captures product-level changes in each Spoke country's imports from RoW relative to imports from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. Finally, in the last specification the dependent variable captures product-level changes in each Spoke country's imports from the other Spokes countries relative to imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$.

In our data set, imports from RoW retain the by-product-exporter-importer dimension, i.e. imports by Estonia at the HS6 level from each third country. Meanwhile, imports of each Spoke from the other Spokes lose the exporter-importer dimension and are aggregated at the HS6 level, i.e. total imports into Estonia of a particular HS6 line from all the other 6 Spokes (the same is true for imports from EU15). The rationale behind this aggregation choice is to capture the third country effects compared to the cumulation zone effect. Furthermore,

[13] For data availability reasons we cannot take a symmetric 5-years window around 1997. More details on tariffs data are provided below.

[14] Notice that we never include EFTA and Turkey in our group of importing countries.

[15] Table 16 in Appendix A presents descriptive statistics about Spokes' imports from EU15.

we only keep imports from non-participating countries or from Spoke countries that have at least a non-zero entry, i.e. we eliminate imports from the RoW or from other Spoke countries that take the value zero in both years. This implies that, first the dependent variable does not take the value zero, unless changes in imports flows from the Spoke countries equals change in imports from a third country for a specific product defined at the HS6. Second, this approach implies that we are comparing changes in trade flows among HS6 products for which Spoke countries compete with the rest of the world.

We combine trade data with tariff-level data from UNCTAD Trade Analysis Information System (TRAINS), which provides HS-based tariff line level (HS 6-digit). When tariff data are missing, we use the nearest data point available favoring earlier years when possible (both for pre- and post-PECS). Our tariff measure captures by how much Spoke countries lowered tariffs on imports among themselves compared to tariffs on products from non-participating countries or from EU15. We compute the tariff change using both preferential tariffs and most favored nation (MFN) tariffs. Specifically, we use MFN tariff every time that we have a missing preferential tariff. Table 2 presents descriptive statistics on tariffs applied by Spoke countries with respect to other Spokes and RoW countries.[16] Notice that the change in import tariff from RoW, $\Delta\tau_{j,srow}$, keeps a bilateral dimension (at the six-digit level of the HS), while the change in tariff from the other Spokes, $\Delta\tau_{j,ss}$, and EU15 countries, $\Delta\tau_{j,sEU15}$, are constructed as a simple average of the HS6 tariff applied by each Spoke country to the other Spokes, and EU15 countries.

[16] Table 16 in Appendix A presents descriptive statistics about Spokes' import tariff applied to EU15.

Table 2: Descriptive Statistics on Imports and Tariffs

In sample averages:	Avg Spokes imports from RoW		Avg Spokes imports from Spokes		Avg Tariffs applied to RoW		Avg Tariffs applied to Spokes	
	Pre PECS	Post PECS	Pre PECS	Post PECS	Pre PECS	Post PECS	Pre PECS	Post PECS
Animal Products	152,79	224,44	180,00	314,88	8,60	10,49	8,75	11,80
Chemicals	114,13	183,74	698,03	1 201,98	5,60	4,73	4,57	4,11
Foodstuffs	200,35	255,67	683,80	1 739,38	14,89	19,49	14,78	17,42
Footwear/Headgear	59,27	129,61	339,72	791,91	10,13	9,62	9,46	6,02
Machinery/Electrical	90,37	342,53	394,25	1 077,37	6,38	4,55	5,54	3,76
Metals	69,54	141,12	529,70	958,77	5,98	5,62	5,54	4,73
Mineral Products	3 511,16	6 073,35	3 674,93	12 659,99	2,23	1,91	1,75	1,91
Miscellaneous	46,50	94,55	207,30	569,63	7,15	5,38	5,95	3,94
Plastic/Rubbers	73,46	129,95	858,21	1 775,21	7,96	6,45	6,86	5,41
Raw Hides,Skins,Leathers	63,48	103,78	201,82	518,69	7,77	7,21	7,21	4,66
Stone/Glass	30,65	62,25	337,48	668,08	7,58	6,65	6,88	5,53
Textiles	38,18	72,11	164,20	395,90	10,13	10,24	9,65	7,21
Transportation	185,43	532,02	1 234,72	3 244,34	7,26	6,54	6,28	5,46
Vegetables	137,82	129,08	345,75	353,71	6,50	8,15	6,03	7,62
Wood Products	66,75	109,40	846,92	1 728,52	6,64	5,39	5,77	4,33

Notes: Values are in thousands of US$. All tariffs are expressed in percentage terms. The first two columns refer to average imports from non partner countries, with which our Spokes did not have free trade agreement (FTA) during our sample period.

4 Empirical Strategy

4.1 Identification Strategy

We provide an empirical assessment of the impact of relaxing RoO on sourcing decisions of intermediate goods, and therefore its role in shaping international supply chains. We employ the introduction of the PECS, which introduced diagonal cumulation, and focus on peripheral countries like BAFTA and CEFTA countries (the Spokes) to investigate their changes in imports of intermediate goods between 1995 and 2002.

The empirical analysis is based on a triple difference estimation in the spirit of Conconi et al. (2018). In our benchmark specification we compare changes in imports of intermediate goods by each Spoke country from countries outside the PECS cumulation zone (RoW countries) and from the Spokes themselves. The change is captured by considering pre- and post-PECS periods. Since PECS was introduced in 1997 and all Spoke countries considered in our analysis joined the PECS system by 1999, we look at changes in their imports between 1995 and 2002. Specifically, let us define:

$$\Delta imp_{j,srow} = \alpha_0 + \alpha_1 \text{IO-RoO}_j + \alpha_2 \Delta\tau_{j,srow} + X_j + \gamma_{srow} + \epsilon_{j,srow} \tag{3}$$

where $\Delta imp_{j,srow}$ is the change in log imports of intermediate good j, defined at the six-digit level of the HS, by each Spoke country from the RoW between 1995 and 2002. $\Delta\tau_{j,srow}$ is the change in log tariffs with respect to the RoW, and X_j are product level trends.[17] Finally γ_{srow} are bilateral time-variant fixed effects.

To capture the change in imports of intermediate goods among Spoke countries, we define:

$$\Delta imp_{j,ss} = \beta_0 + \beta_1 \text{IO-RoO}_j + \beta_2 \Delta\tau_{j,ss} + X_j + \gamma_s + \epsilon_{j,ss} \tag{4}$$

where $\Delta imp_{j,ss}$ is the change of log imports in intermediate good j, defined at the six-digit level of HS, by each Spoke country from all other Spoke countries between 1995 and 2002. IO-RoO$_j$ is our our proxy for the effect of PECS (related to the restrictiveness of the RoO facing each intermediate good). $\Delta\tau_{j,ss}$ is the change in the HS6 average tariffs applied by each Spoke country to the other Spokes. Finally, X_j are product-level trends, and γ_s is the time-variant importer fixed effect.

Subtracting equation (4) from (3) yields our benchmark specification:

$$\Delta imp_{j,srow} - \Delta imp_{j,ss} = \gamma_0 + \gamma_1 \text{IO-RoO}_j + \gamma_2 \Delta\tau_j + \gamma_{srow} + \gamma_s + \epsilon_{j,srows} \tag{5}$$

where $\Delta\tau_j = \Delta\tau_{j,srow} - \Delta\tau_{j,ss}$ captures by how much Spoke countries lowered tariffs on imports among themselves compared to tariffs on products from the RoW.[18] Since we assume that product-level trends are the same for imports from RoW and from Spoke countries,

[17] As explained in section 3.2, our tariff variable is computed using both preferential and MFN tariffs. In particular, we use the MFN tariff every time we have a missing preferential tariff.

[18] The change in tariff is defined as $\Delta\tau_{j,srow} - \Delta\tau_{j,ss}$, where $\Delta\tau_{j,srow} = log(1 + \tau_{j,srow2002}) - log(1 + \tau_{j,srow1995})$, and $\Delta\tau_{j,ss} = log(1 + \tau_{j,ss2002}) - log(1 + \tau_{j,ss1995})$.

X_j cancels out in equation (5).[19] IO-RoO$_j$ is our proxy for the effect of PECS. Since the impact of diagonal cumulation is linked to the restrictiveness of the RoOs, PECS is captured by the restrictiveness of the IO-RoO facing each intermediate good (simple and weighted average). The IO-RoO index captures the effect of diagonal cumulation rather than the effect of RoOs.[20]

Our identification strategy relies on the triple difference specification where we compare changes in imports, before and after PECS, from third countries and from the other Spoke countries. Specifically, our treatment, PECS, is captured by the second part of the triple difference, which considers imports from those peripheral countries signing PECS (which could diagonally cumulate). Then, using this econometric specification we study how PECS (captured by IO-RoO$_j$) differently affect imports from RoW and Spokes. The use of a triple difference, as in equation (5), allows us to reduce omitted variable bias compared to the standard estimates used in the literature. Similar to the standard approach generally used to study the effect of free trade agreements on trade flows, our approach reduces potential bias deriving from unobservable time-invariant product characteristics. Additionally, by taking a triple difference, we are able to control for unobservable time-variant product characteristics (product-level trends).[21] In every specification, we correct for heteroskedastic standard errors using the Eicker-Huber-White correction.[22]

The variable IO-RoO$_j$ captures the effect of diagonal cumulation. This variable should affect trade flows of intermediate good j depending on which final good the intermediate good j contributes to, and on the level of RoO restrictiveness this final good faces. We expect the sign of IO-RoO$_j$ to be negative if diagonal cumulation led Spoke countries to import more intermediate goods from other Spoke countries relative to the non-participating countries (RoW). Additionally, we expect $\Delta\tau_j$ to be negative since it captures by how much Spoke countries lowered tariffs on imports among themselves compared to tariffs on products from the RoW.[23]

Owing to the nature of the experiment, we further assess the role of diagonal cumulation in relaxing the restrictiveness of RoO using alternative control groups over the same period,

[19] More specifically, our dependent variable is $\Delta imp_{j,srow} - \Delta imp_{j,ss}$, where $\Delta imp_{j,srow} = log(1 + Imp_{j,srow2002}) - log(1 + Imp_{j,srow1995})$, and $\Delta imp_{j,ss} = log(1 + Imp_{j,ss2002}) - log(1 + Imp_{j,ss1995})$.

[20] Notice that our IO-RoO index is constructed using the PECS rules of origin protocols (see Cadot et al., 2006). The set of RoO included in the PECS protocols do not represent a fundamental change with respect to those used in bilateral agreement signed by the EU with each CEECs countries in pre-PECS period (see Estevadeordal and Suominem, 2006 and Bart and Graafsma, 1999).

[21] Exploiting the panel structure would have required HS6 fixed effects. But this implies dropping our measure IO-RoO$_j$, since it only varies at HS6, and not over time.

[22] Following Abadie et al. (2017), we think our design problem does not face aggregation issues that would require clusters. First, our sampling does not follow a two-stage process, and second PECS is at the country level and affect the universe of all the importing countries under analysis. Additionally, it is important to notice that, despite RoO are defined mostly at the 4 digit levels and apply to final goods, our estimation strategy focuses on intermediate goods. In fact, our variable of interest, IO-RoO, is constructed by: i) matching the input-output table with the RoO variables applied to each final good, ii) and taking averages by intermediate goods. This implies that our IO-RoO measure has variation within HS4.

[23] We also run additional regressions where we change the group of Spokes' exporting countries used to create $\Delta imp_{j,ss}$. We first consider changes in imports coming only from Spoke countries belonging to the same FTAs (either BAFTA or CEFTA). Then, we consider changes in imports coming from Spoke countries outside the FTA (i.e. imports of each BAFTA country from CEFTA countries, and the reverse). Results are all consistent with our benchmark findings.

i.e. 1995-2002. This will allow us to better disentangle trade creation from trade diversion effects in intermediate goods. Firstly, we estimate the triple difference comparing changes in imports by each Spoke country from the RoW to those from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. This yields:

$$\Delta imp_{j,srow} - \Delta imp_{j,sEU15} = \gamma_0 + \gamma_1 \text{IO-RoO}_j + \gamma_2 \Delta\tau_j + \gamma_{srow} + \gamma_s + \epsilon_{j,srowEU15} \quad (6)$$

Then, we compare changes in imports by each Spoke country from the rest of the Spoke countries to changes in imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. This gives:

$$\Delta imp_{j,ss} - \Delta imp_{j,sEU15} = \gamma_0 + \gamma_1 \text{IO-RoO}_j + \gamma_2 \Delta\tau_j + \gamma_{sEU15} + \gamma_s + \epsilon_{j,ssEU15} \quad (7)$$

A positive coefficient of IO-RoO_j in both control groups would indicate that producers in Spoke countries are importing less from the EU15 compared to RoW and the other Spoke countries. This could happen if, following diagonal cumulation, producers in the PECS cumulation zone were able to reassess sourcing choices more in line with their cost minimization objectives, and still obtain preferential access for exports of their final good.

4.2 Threats to Identification

A key econometric aspect when analyzing the effect of trade policy is that trade policy can result from economic conditions. For example, trade policy can ratify changes in trade that were already happening for other reasons (Goldberg and Pavcnik, 2016). The endogeneity of trade policy generates bias estimates. And according to the specific case considered, this would overstate or understate the effect of trade policy on trade flows. It may understate if the policy change simply follow trade changes that have already occured. Alternatively, the effect of trade policy on trade flows may be overstated if countries expect increases in trade and as a result form a trade agreement (Goldberg and Pavcnik, 2016). In this latter case, the normative implications of the findings may not be generalized.

In relation to our paper, recent studies have highlighted that the fragmentation of production process generates incentive for firms to influence trade policy (Blanchard, 2007, Blanchard et al., 2016, and Blanchard and Matschke, 2015). In Europe, after the fall of the iron curtain, a process of unbundling of the production process took place: parts and components crossing borders many times before being sold to consumers (see Baldwin, 2013). However, the economic integration of Europe's markets were opposed by the complex network of about 60 bilateral and plurilateral free trade agreement regulating European trade. This plethora of FTAs was characterized by RoO with bilateral cumulation, which led to the spaghetti bowl pattern. EU producers, in particular when delocated in other Spoke countries, were hurted in two ways. First, bilateral cumulation hindered the EU firms located in the Spoke economies from sourcing their inputs most efficiently. Second, the different set of RoO associated to different FTAs imposed additional administrative costs. To solve the drawbacks associated with overlapping of FTAs, policymakers implemented the Pan-European Cumulation System which instituted common rules of origin, and diagonal

cumulation of origin rules. PECS allowed EU affiliates to enjoy more efficient combination of intermediate inputs, while still access the EU market under preferential tariff.

In this paper, we take the perspective of several peripheral European countries (Spokes), where producers played a less active role towards PECS. Additionally, the PECS deal was part of broad process of European integration, motivated mainly by political factors. Thus, the issue related to endogeneity of trade policy should be less severe. Yet econometric endogeneity may still be present due to pre-existing trends. Pre-existing trends might be related to the increasing economic integration, and can be spuriously correlated with the trade policy changed considered. To rule out this possibility, in Section 5.2 we implement the triple difference methodology using different pre-PECS periods, i.e. 1992-1993, and 1992-1996. Due data availability problems, related to import flows and tariffs, we focus uniquely on Hungary.

5 Empirical Results

The following sections present the results and some robustness and sensitivity analysis.

5.1 Benchmark Specification

Table 3 reports OLS estimates of equation (5), which compares changes in imports by each Spoke country from countries outside the PECS cumulation zone (RoW) to those from the rest of the Spoke countries. Columns (1) and (3) include only the IO-RoO Indexes (weighted and simple) controlling for importer and for exporter time-variant characteristics. Columns (2) and (4) include the differences in the change of tariffs, as described in Section 3.2. The coefficients of both the simple and weighted average IO-RoO indexes are negative and significant. This suggests that diagonal cumulation reduced imports of intermediate goods of Spoke countries from non-participating countries relative to the other Spoke countries that joined the cumulation zone in the period under analysis. Our preferred measure, weighted IO-RoO, has the largest coefficient. The coefficient of the change in tariff, $\Delta\tau_j$, is always negative and significant. This confirms that the change in preferential tariff reduced Spokes imports from non-participating countries compared to imports from the other Spokes.

Table 3: PECS and change in imports from RoW and Spokes

Dep Var:	Change in log Imports: RoW and other Spokes			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.116***	-0.138***		
	(0.008)	(0.016)		
IO-RoO$_j$			-0.071***	-0.087***
			(0.012)	(0.021)
$\Delta\tau_j$		-3.776***		-3.889***
		(0.652)		(0.658)
Observations	117,877	25,890	117,877	25,890
R-squared	0.077	0.115	0.075	0.113
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of imports from the rest of Spoke countries, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

Tables 4 and 5 propose OLS estimates using the alternative groups of countries. Table 4 shows changes in imports of intermediate j of each Spoke country from the RoW compared to changes in imports from the EU15, as in equation (6). Similarly to Table 3, columns (1) and (3) include only our IO-RoO Index (weighted and simple), controlling for importer and exporter time-variant fixed effects. Columns (2) and (4) include the differences in the change of tariffs. The coefficients of both the simple and weighted average IO-RoO indexes are positive and significant, with the exception of the simple average IO-RoO index which loses significance when tariffs are not controlled for. These results suggest that diagonal cumulation increased imports of intermediate goods of Spoke countries from non-participating countries relative to the EU15. The mechanism behind this result relates to the fact that RoO in general do not require that products must be fully obtained within the cumulation zone to qualify for preferential access. Therefore, diagonal cumulation could have enlarged the set of countries from which it was possible to cumulate inputs for obtaining originating status. Specifically, it may have led exporting firms in Spoke countries to reassess sourcing decisions in favor of the RoW, rather than the EU15. Concerning the coefficient of the change in tariff, $\Delta\tau_j$, this is always negative and significant. This suggests that the change in preferential tariff reduced Spoke's imports from the rest of the world compared to the increase in preferential access provided by the EU15.

Table 4: PECS and imports from RoW and EU15

Dep Var:	Change in log Imports: RoW and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.044***	0.031**		
	(0.007)	(0.013)		
IO-RoO$_j$			0.009	0.035*
			(0.010)	(0.018)
$\Delta\tau_j$		-1.747***		-1.725***
		(0.317)		(0.317)
Observations	127,960	31,720	127,960	31,720
R-squared	0.104	0.163	0.103	0.163
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of log imports from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

In sum, diagonal cumulation appears to have also allowed producers to rethink sourcing decisions more in line with costs minimization factors. Before the introduction of PECS, to obtain preferential access for their final good in the EU15 market, producers in peripheral countries could cumulate inputs only accordingly to the specific FTA signed. Following PECS, producers could cumulate inputs from a larger set of countries to fulfill RoO, and still enjoy preferential access to the EU15. This may have led producers to change the composition in terms of origin of their input basket and still obtain preferential tariffs.

This mechanism seems also confirmed in Table 5, where we consider the impact of diagonal cumulation on changes in imports of each Spoke country from the other Spoke countries compared to changes in imports from the EU15 (equation (7)). In columns (1) and (2) we use the weighted average IO-RoO measure, which assigns a higher weight to final goods most prominently served by intermediates. The positive and significant coefficient suggests that PECS have led exporting firms in Spoke countries to reassess sourcing decisions in favor of the other Spoke countries in the PECS network, rather than the EU15. Differently, in columns (3) and (4) we use the simple average IO-RoO Index, which assumes that an intermediate good is used in similar proportions across every final product to which the intermediate good contributes to. The IO-RoO Index coefficient is negative, but only when we do not control for the effect of tariff changes. The coefficient associated to the change in tariff, $\Delta\tau_j$, captures the effect of the process of economic integration in the European area (by comparing changes in tariffs among spokes to changes in tariffs to the EU). The sign is always positive but not significant. This suggests that the process of tariffs reduction had homogenous effects in the whole European area.

Table 5: PECS and imports from Spokes and EU15

Dep Var:	Change in log Imports: Spokes and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.054***	0.094***		
	(0.018)	(0.020)		
IO-RoO$_j$			-0.064**	0.007
			(0.026)	(0.027)
$\Delta\tau_j$		0.510		0.811
		(0.596)		(0.602)
Observations	22,364	12,484	22,364	12,484
R-squared	0.039	0.045	0.039	0.043
Importer FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable represents changes in log imports of intermediate goods of each Spoke country from the rest of the Spoke countries compared to change of imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

5.2 Pre-Trends

In this part we address the issue related to econometric endogeneity. To reassure our-self that what we capture is really the PECS effect, and thus to eliminate other confounding factors we consider previous periods. We implement the triple difference methodology in the pre-PECS period using alternative sub periods, i.e. 1992-1996, and 1992-1993. Due data availability problems, related to both import flows and tariffs, we are able to focus uniquely on imports of Hungary.[24]

Results are reporter in Table 6.[25] Columns (1) and (2) present the results for change in imports from RoW and Spokes, in line with equation (5). Columns (3) and (4) present the results for change in imports from RoW and EU15, as in equation (6). Finally, columns (5) and (6) present the results for change in imports from Spokes and EU15, as in equation (7). For both sub periods, the coefficients of IO-RoO in columns (1) and (2) are significant, and with an opposite sign with respect to the benchmark case in Table 3. For what concerns the other group of countries, columns (3) to (6), the coefficients of IO-RoO it is never significant. The only exception is in column (3) for the sub period 1992-1996, where again we have an opposite sign with respect to the benchmark case in Table 5.

These results need to be set in the context of our sub periods. Hungary joined CEFTA at the end of 1992. Despite CEFTA, which entered into force in March 1993, each CEFTA member continued to have bilateral agreement with EU. The RoO index constructed by Cadot et al. (2006) is based on the PECS protocols which introduced harmonization of RoO (and diagonal cumulation). Nevertheless, the set of RoO included in the PECS protocols do not represent "per se" a fundamental change with respect to those used in bilateral agreement signed by the EU with each CEECs countries in pre-PECS period (see Estevadeordal and Suominem, 2006 and Bart and Graafsma, 1999).

In light of this, the estimated increase in imports from EU15 compared to the RoW

[24] Also Hungary does present problems in terms of tariffs data availability. For the sub period 1992-1993, we use tariffs data corresponding to 1991. For the sub period 1992-1996, we use tariff data corresponding to 1991 and 1996.

[25] Results are unchanged when using EU12, therefore when excluding Austria, Finland, and Sweden, which joined EU in 1995.

during 1992-1996, column (3), appears therefore consistent with the findings of Conconi et al. (2018). They show that, following the entry into NAFTA, the related NAFTA RoO lead to an increase in import of intermediate from NAFTA partners relative to non-partner countries. Similarly, the positive sign of IO-RoO$_j$ in columns (1) and (2), seem to reflect the impact of restrictive RoO with their cumulation rules (bilateral) in the pre-PECS period. The stricter the RoO, the more likely Hungary imports from the RoW rather than from the other Spoke countries with which cumulation possibilities were still limited in the sub period 1992-1996.

Table 6: Pre-Trends 1992-1996: The Case of Hungary

Dep Var:	Imports from RoW vs. Spoke		Imports from RoW vs. EU15		Imports from Spoke vs. EU15	
	(1)	(2)	(3)	(4)	(5)	(6)
	weighted IO-RoO$_j$	IO-RoO$_j$	weighted IO-RoO$_j$	IO-RoO$_j$	weighted IO-RoO$_j$	IO-RoO$_j$
Subsample$_{1992-1996}$	0.128***	0.243***	-0.051***	0.014	0.009	0.105
	(0.037)	(0.048)	(0.019)	(0.026)	(0.087)	(0.115)
Observations	7,718	7,718	17,540	17,540	989	989
R-squared	0.314	0.314	0.330	0.330	0.000	0.000
Subsample$_{1992-1993}$	0.124***	0.240***	-0.002	0.034	0.014	0.044
	(0.037)	(0.050)	(0.018)	(0.025)	(0.086)	(0.116)
Observations	6,669	6,669	15,077	15,077	958	958
R-squared	0.340	0.342	0.368	0.368	0.000	0.000

Notes: OLS estimation. The dependent variable is the difference between log change in Hungary's imports of intermediate j considering the three sub-samples of countries: (1) non-participating countries vis à vis the other Spoke countries, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$; (2) non-participating countries vis à vis the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$; and other Spokes vis à vis the EU15, , $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. All columns control for $\Delta\tau_j$ is the log change in preferential tariff (where we use MFN in case of missing preferential tariff). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures respectively. Importing country is Hungary. The group of Spokes exporting countries include: Czech Republic, Estonia, Lithuania, Latvia, Poland, Romania.

5.3 Additional Robustness and Sensitivity Analysis

In this section we present robustness checks to overcome possible limitations of the analysis. We start by extending the set of Spokes' exporting countries. In fact, in the period under analysis, PECS also included EFTA countries and Turkey.[26] To maintain a homogenous group of countries, the benchmark regressions do not include these countries in the group of the Spoke countries. EFTA countries and Turkey are also not included in the sample of the RoW countries, since they belong to the cumulation zone. To verify that our results are not altered by this exclusion, Table 7 replicates Table 3 with EFTA countries and Turkey included in the set of Spoke exporting countries. The coefficients of both IO-RoO indices continue to be negative and their significance improves compared to baseline regression in Table 3 . The coefficient of the change in tariff is negative and significant.[27]

[26]Notice that in 1999 PECS was widened to industrial products originating in Turkey (1999). However, in the database we keep all products exported from Turkey.

[27]In Appendix B, Table 17 reports the results with only EFTA countries.

Table 7: PECS and change in imports from RoW and Spokes (with EFTA and Turkey)

Dep Var:	Change in log Imports			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.140***	-0.140***		
	(0.008)	(0.015)		
IO-RoO$_j$			-0.104***	-0.087***
			(0.012)	(0.020)
$\Delta\tau_j$		-2.734***		-2.785***
		(0.487)		(0.492)
Observations	122,565	28,355	122,565	28,355
R-squared	0.076	0.122	0.075	0.120
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between log change in each Spoke's imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change in imports from the other Spoke countries (including EFTA and Turkey), $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the log change in preferential tariff (where we use MFN in case of missing preferential tariff). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania. The group of Spokes exporting countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, EFTA and Turkey. EFTA include Iceland, Norway, and Switzerland.

All our results remain unchanged and become even stronger also when we extend the group of Spokes exporting countries in the regression for imports from Spokes and EU15. Table 8 shows that now the simple average IO-RoO coefficient is always positive and significant, differently from Table 5. The same happens for the coefficient of the relative change in tariffs.

Table 8: PECS and change in imports from Spoke and EU 15 (with EFTA and Turkey)

Dep Var:	Change in log Imports			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.117***	0.135***		
	(0.017)	(0.018)		
IO-RoO$_j$			0.024	0.061**
			(0.024)	(0.024)
$\Delta\tau_j$		0.772*		1.145**
		(0.440)		(0.447)
Observations	24,391	14,649	24,391	14,649
R-squared	0.027	0.034	0.026	0.031
Importer FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable represents changes in log imports of intermediate goods of each Spoke country from the rest of the Spoke countries compared to change of imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, EFTA and Turkey.

Second, we change the definition of our control variable, IO-RoO, and focus mainly on RoO based on value added requirement. This implies that our new IO-RoO measure focuses on tariff lines facing a RoO index equal or greater than 5.[28] For this, we modify the RoO index from Cadot et al. (2006) by assigning a value of 1 to final goods facing a RoO-index equals or greater than five and zero otherwise. Then, similarly to what we discussed in Section 3.1, we match this modified RoO index with US IO1997 table to get our IO-RoO measures, simple and weighted average. Tables 19 to 21 in Appendix B report the results. These results are in line with our baseline results discussed in Section 5.1, but the magnitude is larger (in absolute terms).

[28]A RoO index equal or greater than 5 implies, among othe things, a regional value-added requirement ranging between 50 and 85 percent. For additional information, see Table A1 in Cadot et al. (2006).

Finally, we change the definition of our dependent variable. In our benchmark regression, the dependent variable is the change in imports of intermediate goods from third countries outside the PECS cumulation zone (RoW countries) with respect to the change in imports of intermediate goods from within the PECS network. Imports from RoW keep the product-importer-exporter dimension, while imports from the other Spoke countries and from the EU15 only keep the product-importer dimension. Therefore, we analyze whether the benchmark estimations are preserved when RoW's exports are also aggregated by product and importer. Tables 22 to 25 in Appendix B report the results with aggregation.

Table 22 considers changes in imports from RoW vis-à-vis the change in imports from Spoke countries. Looking at our preferred specifications (columns (2) and (4)), the impact of diagonal cumulation turns not significant in this estimation. This result appears to be driven by the large flow of exports coming from China, which during the period 1995-2002 undertook an important liberalization process including its accession to the WTO. Once China is excluded from the RoW sample, results are once again significant and in line with the findings of the benchmark regression (Table 23). Results remain instead unchanged when we consider changes in imports from RoW relative to EU15 (Tables 24 and 25).

6 Conclusion

Between 1950 and 2017, 288 Regional Trade Agreements entered into force, with FTAs representing most of the category. At the heart of each FTAs there are RoO, and their corresponding cumulation of origin rules. By determining the origin of a product, RoO define whether a good qualifies for preferential access. Cumulation of origin rules define whether a firm can use imported intermediate goods from a specific country such that the final product of the importing firm does not lose the originating status.

Recent empirical literature has shown that RoO can change sourcing decisions in favor of FTA members. This paper goes one step further and study the role of trade policy on global value chains across nations. Specifically, it analyzes whether moving from an FTA characterized by RoO and bilateral cumulation to an FTA characterized by RoO and diagonal cumulation can revert or further strengthen value chain links between FTA members. To study the impact of diagonal cumulation on sourcing decisions, we use the introduction of the PECS in 1997. PECS completed the missing FTAs, it harmonized the rules of origin protocols of all the underlying FTAs, and most importantly introduced diagonal cumulation. Exploiting input-output relations, we translate the RoO measure of sourcing restrictions borrowed from Cadot et al. (2006) at the intermediate level. Then, using this new measure of intermediate sourcing restrictions, we analyze changes in imports of intermediates by a set of PECS peripheral countries, i.e. BAFTA and CEFTA members, before and after the introduction of PECS (over the period 1995-2002).

Our results show that intermediate goods imports from PECS peripheral countries increased relatively to imports from third countries (RoW). To disentangle trade creation from trade diversion effects in intermediate goods, we also exploit other control groups. First,

we show that diagonal cumulation increased imports of intermediate goods from the RoW *vis-à*-vis the EU15. Second, we find that diagonal cumulation increased imports of intermediate goods from the PECS network relatively to the EU15. Overall, we show that PECS peripheral countries increase imports of intermediate goods among themselves relative to other countries (RoW and EU15), and that this increase is larger, the stricter the rules of origin applied to the related final products. Moreover, we show that following diagonal cumulation, PECS peripheral partners also increase their imports of intermediate goods from third countries (RoW) compared to the EU15.

These findings suggest that diagonal cumulation appears to have further strengthen the value chain links within the PECS network. Yet, our results also put forward that imports of intermediates from third countries tend to follow a multilateral liberalization type of outcome. Therefore, these findings seem to give support to the idea that diagonal cumulation can lead to a multilateralization of regionalism.

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Appendix

Appendix A provides additional details on our data. Appendix B provides additional robustness checks.

A Additional data and figures

Tables 9 and 10 show the list of countries included in our empirical analysis. From the group of countries, we exclude those with missing trade information. Tables 11 and 12 provide descriptive statistics at the HS2 digit level on the number of IO relationships and on the average RoO Index faced by intermediates entering into final goods.

Table 9: List of partner countries

Spokes Importing	Spokes Exporting	EU15
Czech Republic	Czech Republic	Austria
Estonia	Estonia	Belgium
Hungary	Hungary	Denmark
Latvia	Latvia	France
Lithuania	Lithuania	Finland
Poland	Poland	Germany
Romania	Romania	Greece
	EFTA	Ireland
	Turkey	Italy
		Luxembourg
		Netherlands
		Portugal
		Sweden
		Spain
		United Kingdom

Notes: EFTA includes: Iceland, Norway, and Switzerland.

Table 10: List of non-participating countries

Afghanistan	Guinea	Mongolia	Trinidad and Tobago
Angola	Guadeloupe	Mozambique	Tunisia
Albania	Gambia, The	Mauritania	Tanzania
Algeria	Guinea-Bissau	Martinique	Uganda
United Arab Emirates	Equatorial Guinea	Mauritius	Ukraine
Argentina	Greenland	Malawi	Uruguay
Armenia	Guatemala	Malaysia	United States
Australia	French Guiana	Namibia	Uzbekistan
Azerbaijan	Hong Kong SAR, China	Nicaragua	Venezuela, RB
Burundi	Honduras	Niger	Vietnam
Benin	Croatia	Nigeria	Vanuatu
Burkina Faso	Haiti	Nepal	Yemen, Rep.
Bangladesh	Indonesia	Nauru	South Africa
Bosnia and Herzegovina	India	New Zealand	Congo, Dem. Rep.
Belarus	Iran, Islamic Rep.	Oman	Zambia
Belize	Iraq	Pakistan	Zimbabwe
Bolivia	Jamaica	Panama	
Brazil	Jordan	Peru	
Brunei Darussalam	Japan	Philippines	
Bhutan	Kazakhstan	Papua New Guinea	
Botswana	Kenya		
Central African Republic	Korea, Rep.	Paraguay	
Canada	Kyrgyzstan	Qatar	
Chile	Cambodia	Réunion	
China	Korea	Russian Federation	
Côte d'Ivoire	Kuwait	Rwanda	
Cameroon	Lao	Saudi Arabia	
Congo, Rep.	Lebanon	Senegal	
Colombia	Liberia	Serbia-Montenegro	
Cabo Verde	Libya	Singapore	
Costa Rica	Sri Lanka	Sierra Leone	
Cuba	Lesotho	El Salvador	
Djibouti	Macao	Somalia	
Dominican Republic	Morocco	Eswatini	
Ecuador	Madagascar	Chad	
Egypt, Arab Rep.	Mexico	Togo	
Eritrea	Mali	Thailand	
Ethiopia	Malta	Tajikistan	
Gabon	Myanmar	Turkmenistan	
Georgia		East Timor	
Ghana		Tonga	

Notes: Table 10 lists all the countries included in our empirical analysis. These are countries from which our Spoke countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Romania) reported positive imports in 1995 and/or 2002. and with which our Spokes did not have free trade agreement (FTA) during our sample period.

Table 11: Number of IO relations (in percentage)

Intermediate/Final	Anim.	Chem.	Food.	Foot.	Mach.	Met.	Min.	Misc.	Plast.	Raw	Stone	Text.	Transp.	Veg.	Wood	Total
Animal Products	25	10.6	15.1	1.9	1.1	8	0.6	3.8	1.1	4.5	1	14.4	0.6	10	2.4	100
Chemicals	1.9	20.9	2.9	1.2	15.3	11.8	3.2	7.6	4.8	1.3	4.3	13.2	2.7	4.2	4.8	100
Foodstuffs	14.2	21	21.9	0.6	2.9	4.6	0.9	2.5	2.4	1.7	1	4.5	0.7	17.3	4	100
Footwear/Headgear	2.8	10.4	3.1	3.3	12.2	11.3	2.8	7.4	5.5	1.4	3.4	20.7	4	6.1	5.7	100
Machinery/Electrical	2.2	17.4	2.4	0.8	20.8	11.7	2.5	8.3	3.9	0.8	3	14.8	3.4	3.9	4.2	100
Metals	2	17.8	2.7	0.8	20.9	15.7	2.7	9.1	3.9	0.5	4.1	9.9	3.5	3.3	2.9	100
Mineral Products	2	25.8	2.4	0.6	14.4	15.8	4.1	5.6	3.3	0.7	5.4	10.3	2.4	3.6	3.6	100
Miscellaneous	2.9	18.9	3.5	0.9	14.3	11.6	1.5	9	4	0.9	3.1	17.8	3	4.2	4.3	100
Plastic/Rubbers	2.9	16.9	3.1	1.6	17.3	10.3	2	9.6	5.8	1.1	3.7	13.3	2.8	4	5.5	100
Raw Hides.Skins.Leathers	4.7	15.4	4.2	2.8	10	7.3	1	7	4.5	3.4	1.9	25.3	3.2	4.3	4.9	100
Stone/Glass	1.9	24.7	2.1	0.8	15.2	12.4	1.6	9.4	4.7	0.4	4.9	13.9	3.4	1.6	3.1	100
Textiles	1.5	8.4	1.4	3	10.2	3.3	0.6	8.8	7.9	1.7	1.6	40.7	3.3	1.9	5.8	100
Transportation	4.1	15.4	3.2	0.7	16.9	11	3.5	8.1	3.6	0.9	3.1	13.1	5	6.8	4.6	100
Vegetables	6.7	33.4	14.1	0.8	1.9	1.6	1	2.2	2.5	0.7	0.7	12.7	0.4	18.1	3.1	100
Wood Products	3.3	17.9	3.5	1.1	15.4	11.5	2.5	7.5	4	1.1	3.5	16.5	2.6	4.2	5.3	100
Total	2.6	18.3	3.1	1.2	16	11.2	2.3	8.1	4.7	1.1	3.5	16.4	3	4.1	4.4	100

Notes: Table 11 shows descriptive statistics on our main control variable. Columns report the number of IO relationships.

Table 12: Average RoO Index

Intermediate/Final	Anim.	Chem.	Food.	Foot.	Mach.	Met.	Min.	Misc.	Plast.	Raw	Stone	Text.	Transp.	Veg.	Wood	Total
Animal Products	1	3.3	5.4	4.1	5	4.8	3	4.5	4.1	3.3	4.1	5.2	4.4	2.9	4	3.5
Chemicals	1.1	3.3	5.2	2.8	5	4.6	3.3	4.5	4.2	3.1	4	5.9	4.9	2.5	4.2	4.3
Foodstuffs	1.1	3.3	5	3.5	5	4.7	2.9	4.4	4.4	3	3.9	5.8	4.7	2.8	4.2	3.6
Footwear/Headgear	1.1	3.4	5	2.3	5	4.7	3.4	4.4	4.3	3.4	4.2	6.2	4.8	2.7	4.3	4.5
Machinery/Electrical	1.1	3.3	5.3	3.2	5	4.6	3.3	4.6	4.2	3.2	4	5.7	4.9	2.6	4.1	4.4
Metals	1.1	3.3	5.2	3.6	5	4.6	3.3	4.6	4.2	3.4	4	5.8	4.9	2.7	4.2	4.4
Mineral Products	1.1	3.3	5.3	3.3	5	4.7	3.3	4.5	4.2	3.2	4	5.9	4.9	2.6	4.2	4.2
Miscellaneous	1.1	3.3	5.2	3.5	5	4.7	3.1	4.7	4.2	3.3	4.1	5.8	4.8	2.7	4.2	4.4
Plastic/Rubbers	1.1	3.3	5.2	2.8	5	4.6	3.3	4.6	4.2	3.5	3.9	6	4.9	2.6	4.2	4.3
Raw Hides,Skins,Leathers	1.1	3.3	5.3	2.8	5	4.7	2.7	4.4	4.2	3.2	4	6.1	4.8	2.6	4.1	4.4
Stone/Glass	1.1	3.3	5.4	4	5	4.6	3.1	4.6	4.2	3.4	4	5.6	4.8	2.7	4.1	4.3
Textiles	1	3.4	5.3	3.1	5	4.6	3.2	4.3	4.2	3.3	4.1	6	4.7	2.5	4.6	4.9
Transportation	1.1	3.3	5.2	4	5	4.6	3.4	4.6	4.2	3.5	4	5.7	4.9	2.4	4	4.2
Vegetables	1.1	3.3	4.9	3.2	5	4.5	2.6	4.3	4.3	3.4	3.8	5.5	4.7	2.8	4.1	3.7
Wood Products	1.1	3.3	5.2	3	5	4.6	3.3	4.6	4.2	3.2	4	5.8	4.9	2.6	4	4.3
Total	1.1	3.3	5.2	3.1	5	4.6	3.3	4.5	4.2	3.2	4	5.9	4.8	2.6	4.2	4.4

Notes: Columns report the simple average IO-RoO Index.

Table 13: Weighted RoO Index

Intermediate/Final	Anim.	Chem.	Food.	Foot.	Mach.	Met.	Min.	Misc.	Plast.	Raw	Stone	Text.	Transp.	Veg.	Wood	Total
Animal Products	3.1	2.8	2.9	2.9	4.1	3.4	3.8	3.0	3.8	2.8	4.4	3.2	3.4	2.9	3.3	3.1
Chemicals	3.9	3.8	4.0	3.9	3.9	3.9	3.8	3.9	3.9	3.9	3.9	4.0	3.9	3.8	3.9	3.9
Foodstuffs	3.5	3.6	3.8	3.2	4.0	3.5	3.8	3.7	3.4	3.3	4.0	3.7	4.1	3.7	3.7	3.7
Footwear/Headgear	5.0	4.8	5.0	3.8	4.8	5.1	5.2	5.0	5.1	5.2	5.1	5.2	5.3	5.2	5.1	5.0
Machinery/Electrical	4.6	4.6	4.7	4.7	4.7	4.7	4.6	4.7	4.7	4.7	4.7	4.8	4.7	4.4	4.7	4.7
Metals	4.5	4.5	4.5	4.5	4.6	4.6	4.6	4.5	4.5	4.5	4.6	4.4	4.6	4.5	4.5	4.5
Mineral Products	3.7	3.8	3.7	3.6	3.8	3.9	3.8	3.8	3.8	3.6	3.8	3.7	3.8	3.7	3.7	3.8
Miscellaneous	4.4	4.4	4.4	4.6	4.5	4.5	4.6	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Plastic/Rubbers	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.4	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Raw Hides,Skins,Leathers	3.7	3.8	3.6	3.8	4.6	4.3	4.6	4.3	4.5	3.5	4.2	4.2	4.5	3.7	4.4	4.1
Stone/Glass	4.3	4.4	4.1	4.5	4.4	4.3	4.5	4.4	4.4	4.2	4.4	4.3	4.4	4.2	4.3	4.3
Textiles	5.3	5.3	5.0	5.7	5.8	5.5	5.8	5.7	5.8	5.8	5.5	5.7	5.7	4.7	5.8	5.6
Transportation	4.5	4.6	4.6	4.7	4.7	4.7	4.4	4.7	4.7	4.5	4.7	4.7	4.7	4.3	4.7	4.6
Vegetables	3.0	3.0	3.2	3.1	3.7	3.7	3.2	3.2	3.2	2.9	3.6	3.0	3.4	3.1	3.3	3.1
Wood Products	4.3	4.2	4.3	4.3	4.3	4.3	4.4	4.3	4.3	4.4	4.4	4.3	4.3	4.3	4.2	4.3
Total	4.2	4.2	4.2	4.6	4.4	4.3	4.3	4.5	4.5	4.4	4.3	4.7	4.5	4.1	4.5	4.4

Notes: Columns report the weighted IO-RoO Index.

Table 14: Summary Statistics on IO-RoO Indices

	IO-RoO				weighted IO-RoO			
	Mean	Sd	Min	Max	Mean	Sd	Min	Max
Animal Products	3.5	0.7	2.0	4.6	3.1	0.7	1.5	5.5
Chemicals	4.3	0.2	2.6	5.3	3.9	0.3	2.2	5.5
Foodstuffs	3.6	0.5	1.9	6.5	3.7	0.8	1.6	6.7
Footwear/Headgear	4.5	0.5	1.1	5.8	5.0	0.8	1.1	6.3
Machinery/Electrical	4.4	0.3	1.0	5.1	4.7	0.3	1.0	5.5
Metals	4.4	0.2	3.1	4.9	4.5	0.3	3.6	5.5
Mineral Products	4.2	0.3	3.6	4.7	3.8	0.5	2.9	4.7
Miscellaneous	4.4	0.2	3.1	5.0	4.5	0.5	3.4	5.5
Plastic/Rubbers	4.3	0.2	3.5	4.7	4.3	0.2	3.1	4.8
Raw Hides,Skins,Leathers	4.4	0.4	3.4	5.8	4.1	1.0	2.6	6.3
Stone/Glass	4.3	0.2	2.0	5.3	4.3	0.5	3.5	5.9
Textiles	4.9	0.4	3.3	7.0	5.6	0.6	2.6	7.0
Transportation	4.2	0.3	1.0	5.0	4.6	0.4	1.0	5.0
Vegetables	3.7	0.4	2.0	5.1	3.1	0.7	1.5	6.0
Wood Products	4.3	0.1	2.8	5.8	4.3	0.6	2.8	6.2
IO pairs	9,476,276							

Notes: Table 14 shows descriptive statistics on our two measures.

Table 15: Preferential agreements providing for diagonal cumulation

	Czech Republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania
EU	97	97	97	97	97	97	97
Czech Republic	—	97	97	97	97	97	97
Estonia	97	—	99	97	97	99	No FTA
Hungary	97	99	—	00	00	97	97
Lithuania	97	97	00	—	97	98	No FTA
Latvia	97	97	00	97	—	98	No FTA
Poland	97	99	97	98	98	—	97
Romania	97	No FTA	97	No FTA	No FTA	97	—

Notes: Table 15 reports the Commission notice (2002/C 100/05) concerning preferential agreements providing for diagonal cumulation of origin between the EU Community and our Spoke countries (Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania). No FTA indicates that no FTA was concluded between any two countries in the matrix up to 2002.

Table 16: Descriptive Statistics on Imports and Tariffs with EU15

In sample averages:	Avg Spoke imports from EU15		Avg Tariff applied to EU15	
	Pre PECS	Post PECS	Pre PECS	Post PECS
Animal Products	993,89	1041,86	8,75	10,34
Chemicals	2694,85	6867,22	5,07	2,68
Foodstuffs	3110,21	3799,87	14,85	17,60
Footwear/Headgear	1877,06	2554,19	9,52	4,75
Machinery/Electrical	4729,31	10675,35	5,52	2,70
Metals	1844,90	4542,45	5,69	3,24
Mineral Products	6403,22	10957,26	1,78	1,15
Miscellaneous	1901,86	2622,55	6,41	2,91
Plastic/Rubbers	3696,68	12256,86	6,85	3,81
Raw Hides,Skins,Leathers	2612,00	5863,74	7,43	3,29
Stone/Glass	1259,43	2472,97	6,80	4,38
Textiles	1422,53	2355,70	9,78	5,74
Transportation	9538,10	31909,23	6,65	3,86
Vegetables	1090,01	1491,98	7,17	6,83
Wood Products	2765,69	5412,01	6,01	3,18

Notes: Values are in thousands of US$. All tariffs are expressed in percentage terms. The tariff change uses the MFN tariff every time that we have a missing preferential tariff.

B Robustness Checks

Table 17 shows that our results are not altered when we the EFTA countries to the set of Spoke exporting countries.

Table 17: PECS and change in imports from RoW and Spokes (with only EFTA)

Dep Var:	Change in log Imports			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.095***	-0.119***		
	(0.008)	(0.015)		
IO-RoO$_j$			-0.050***	-0.059***
			(0.012)	(0.021)
$\Delta\tau_j$		-3.166***		-3.224***
		(0.508)		(0.512)
Observations	121,565	27,906	121,565	27,906
R-squared	0.076	0.122	0.075	0.121
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. Dependent variable is the difference between log change in Spokes' import of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change in imports from the other Spoke countries (including EFTA), $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the log change in preferential tariff (where we use MFN in case of missing preferential tariff). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania. The group of Spokes exporting countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Table 18 shows results when considering the change in imports from the extended group of Spoke exporting countries (with only EFTA) and the change in imports from the EU15. Results are similar to Table 8.

Table 18: PECS and change in imports from Spoke and EU 15 (with only EFTA)

Dep Var:	Change in log Imports			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.044**	0.094***		
	(0.018)	(0.019)		
IO-RoO$_j$			-0.060**	0.011
			(0.025)	(0.025)
$\Delta\tau_j$		0.108		0.346
		(0.450)		(0.455)
Observations	23,930	14,159	23,930	14,159
R-squared	0.025	0.031	0.025	0.030
Importer FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. In columns (1) and (2), the dependent variable represents changes in log imports of intermediate goods of each Spoke country from the rest of the Spoke countries compared to change of imports from the EU15. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Tables 19, 20, and 21 show results when we focus on RoO based on whether final goods face stringent value added requirements. Specifically, we consider only final good products associated to a RoO index from Cadot et al. (2006) equal or greater than 5. Results are similar to benchmark results discussed in Section 5.1.

Table 19: PECS and change in imports from RoW and Spokes: $RoO \geq 5$

Dep Var:	Change in log Imports: RoW and Spokes			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.208***	-0.257***		
	(0.031)	(0.056)		
IO-RoO$_j$			-0.047	-0.169**
			(0.047)	(0.084)
$\Delta\tau_j$		-3.880***		-3.881***
		(0.657)		(0.660)
Observations	117,877	25,890	117,877	25,890
R-squared	0.075	0.113	0.075	0.112
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of imports from the rest of Spoke countries, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively, computed considering $RoO \geq 5$. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Table 20: PECS and imports from RoW and EU15: $RoO \geq 5$

Dep Var:	Change in log Imports: RoW and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.109***	0.084*		
	(0.027)	(0.045)		
IO-RoO$_j$			-0.014	0.096
			(0.040)	(0.067)
$\Delta\tau_j$		-1.717***		-1.721***
		(0.317)		(0.317)
Observations	127,960	31,720	127,960	31,720
R-squared	0.103	0.163	0.103	0.163
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of log imports from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively, computed considering $RoO \geq 5$. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Table 21: PECS and imports from Spokes and EU15: $RoO \geq 5$

Dep Var:	Change in log Imports: Spokes and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.109*	0.209***		
	(0.064)	(0.069)		
IO-RoO$_j$			-0.289***	-0.049
			(0.094)	(0.100)
$\Delta\tau_j$		0.727		0.836
		(0.599)		(0.602)
Observations	22,364	12,484	22,364	12,484
R-squared	0.039	0.044	0.039	0.043
Importer FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable represents changes in log imports of intermediate goods of each Spoke country from the rest of the Spoke countries compared to change of imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively, computed considering $RoO \geq 5$. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

Tables 22 to 25 report results when we change the definition of our dependent variable. Similarly to export from the other Spoke countries and EU15, here we also aggregate RoW's exports to each Spoke by product and importer.

Table 22: PECS and change in imports from RoW and Spokes: Aggregation

Dep Var:	Change in log Imports: RoW and Spokes			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.042**	-0.008		
	(0.021)	(0.024)		
IO-RoO$_j$			0.062**	0.012
			(0.030)	(0.034)
$\Delta\tau_j$		-4.044***		-4.053***
		(0.799)		(0.799)
Observations	20,546	10,239	20,546	10,239
R-squared	0.034	0.060	0.034	0.060
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of imports from the rest of Spoke countries, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Table 23: PECS and change in imports from RoW and Spokes: Aggregation (excluding China)

Dep Var:	Change in log Imports: RoW and Spokes			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.001	-0.051**		
	(0.022)	(0.025)		
IO-RoO$_j$			0.020	-0.031
			(0.031)	(0.035)
$\Delta\tau_j$		-4.242***		-4.303***
		(0.803)		(0.805)
Observations	20,192	10,047	20,192	10,047
R-squared	0.033	0.060	0.033	0.060
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of imports from the rest of Spoke countries, $\Delta imp_{j,srow} - \Delta imp_{j,ss}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania and EFTA.

Table 24: PECS and imports from RoW and EU15: Aggregation

Dep Var:	Change in log Imports: RoW and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.111***	0.088***		
	(0.019)	(0.020)		
IO-RoO$_j$			0.021	0.035
			(0.025)	(0.026)
$\Delta\tau_j$		0.410		0.600
		(0.374)		(0.374)
Observations	24,770	14,816	24,770	14,816
R-squared	0.042	0.060	0.041	0.059
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of log imports from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

Table 25: PECS and imports from RoW and EU15: Aggregation (excluding China)

Dep Var:	Change in log Imports: RoW and EU15			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	0.085***	0.061***		
	(0.020)	(0.021)		
IO-RoO$_j$			-0.003	0.010
			(0.027)	(0.028)
$\Delta\tau_j$		-0.322		-0.160
		(0.449)		(0.446)
Observations	20,192	12,924	20,192	12,924
R-squared	0.048	0.067	0.047	0.066
Importer FE	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes

Notes: OLS estimation. The dependent variable is the difference between changes in log imports of intermediate j from non-participating countries between 1995 and 2002, and the corresponding change of log imports from the EU15, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. $\Delta\tau_j$ is the change in preferential tariff (where we use the applied MFN in case of missing preferential tariff information). IO-RoO$_j$ and weighted IO-RoO$_j$ represent our simple and weighted average measures of the restrictiveness in RoO respectively. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.