Diagonal Cumulation and Sourcing Decisions*

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Abstract

Products must fulfill predetermined rules of origin (RoOs) to be exported under the preferential access granted by a Free Trade Area (FTA) member. In turn, rules of cumulation (RoCs) establish which countries' inputs qualify when computing the extent of origin of a product. Recent literature shows that restrictive rules of origin affect sourcing decision by reducing imports of intermediate goods from third countries relative to FTA partners. This paper explores the effects of rules of cumulation on trade in intermediate goods using the introduction of the Pan-European Cumulation System (PECS) in 1997. PECS provided the EU FTA's peripheral partners ("Spokes") with the possibility of cumulating stages of production from a larger number of countries to qualify for preferential access to the EU market. Therefore, PECS might have altered EU-centric value chains organization of production resulted from RoOs and bilateral ROC. We estimate a triple difference in difference specification and exploit different control groups. Our results show that the effects of RoCs on trade in intermediates are larger, the stricter the RoO applied to the related final good. Specifically, when switching from bilateral to diagonal cumulation we find a reduction in Spokes' imports of intermediates from the rest of the world relative to those from Spokes themselves, reinforcing value chain connections within the cumulation zone. We also find a reduction in Spokes' imports from the EU15 relative to the rest of the world and the Spokes themselves. Our findings suggest that indeed PECS allowed a reassessment of sourcing decisions: thanks to the possibility to cumulate, peripheral countries re-organized global value chain links.

JEL classification: F12, F13, F14, F15.

Keywords: Intermediate Trade, rules of origin, rules of 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, are a well-documented phenomenon. Nowadays, GVC trade accounts for 60–67 percent of global trade in value-added terms (World Bank and the WTO, 2017), and in 2009 only 34 percent of world exports were final goods. Moreover, production networks appear broadly divided into three regional blocks: "factory Asia", "factory North America", and "factory Europe" (Baldwin and Lopez-Gonzalez, 2013).

The literature that analyzes the determinants behind the participation in GVCs has predominantly focused on countries' endowments and trade costs. Property rights influence participation in GVCs since firms face a trade-off between relationship-specific investments and contract enforcement. Antràs and Helpman (2008) propose a model in which contractual frictions affect the decision to offshore versus outsource, and Nunn (2007) provides empirical evidence about the role of the quality of contract-related institutions on comparative advantage in contract-intensive goods. Similarly, the distance of the export basket to final use (a measure of upstreamness) negatively correlates with a country's quality of institutions, skill endowment, and access to finance (see Antràs et al., 2012). Trade costs also matter. For example, Antràs and de Gortari (2017) show that the optimal location of production of a given stage in a GVC depends also on the proximity of that location to the preceding and the subsequent desired locations of production, and that it is optimal to locate relatively downstream stages of production in relatively central locations.

The role of government policies on the ability of a country to participate in GVCs has been less studied (see Conconi et al., 2018). Yet these policies matter. For example, Freund and Moran (2017) show how an efficient investment policy framework and a good practice investment promotion agency combined with key investment in infrastructures and dedicated vocational training helped attract foreign investors and transformed industries in Costa Rica, Malaysia, and Morocco. This enabled these countries to participate in selected value chains.

This paper contributes to this literature by analyzing the role of trade policies, and specifically the joint impact of restrictive Rules of Origins (henceforth RoOs) and Rules of Cumulations (henceforth RoCs), on sourcing decisions. RoOs and RoCs are a crucial part of Free Trade Areas (FTAs). By determining the origin of a product, RoOs define whether or not a good qualifies for preferential access. RoCs define 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. For its final product to qualify for preferential access with bilateral cumulation, a firm can either use the domestic intermediate good or the intermediate good produced in a country in the same FTA. With diagonal cumulation, a firm can use the intermediate good coming from any partners that have the same RoOs and RoCs, regardless of whether the countries belong to different FTAs. Alternatively, a preferential regime can allow for full cumulation. In this case all the intermediates coming from free trade area partners can be used, regardless of whether the imported products qualify for preferential access. The effects

of RoOs and RoCs are theoretically ambiguous as they can either prevent exporters from taking advantage of the preferential tariff, or they can divert trade.

We provide evidence that restrictive RoOs and the possibility of participating in the cumulation zone influenced the organization of production in EU-centric value chains. Since the cumulation zone was initially established among countries in the region, it contributed to the creation of a "factory Europe". Specifically, the analysis exploits the introduction of the Pan European system of cumulation (henceforth PECS). The system, introduced in 1997, allowed the majority of the European Union's free trade area partners in the region to cumulate stages of production and still have the resulting final good qualify for preferential access in the EU market. It provided an opportunity to split the value chain of production among several EU FTA partners since the final good could still benefit from the preferential tariffs. As a result, countries belonging to the zone enjoyed a cost advantage, which influenced the organization of value chains for goods destined to the EU market. We show that imports of intermediate goods increased among a homogeneous group of the EU FTA's peripheral partners, i.e. the Baltic Free Trade Area (BAFTA) and the Central Europe Free Trade Area (CEFTA) members (henceforth the Spoke countries), compared to the rest of the world.[1] Our results show that these countries benefited from diagonal cumulation compared to other countries (including the EU 15), and that these changes were larger, the stricter the rules of origin applied to the related final products. Moreover, we show that following diagonal cumulation, Spoke countries increased imports of intermediate goods from the non-participating countries (rest of the world, RoW) compared to the EU15. The evidence presented in this paper suggests that diagonal cumulation may have led to a reassessment of sourcing decisions established during the pre-PECS bilateral RoCs. Indeed, diagonal cumulation allows preferential access for exports of final goods that are produced with intermediates imported by a larger set of countries. Since ROOs do not typically require whole obtained originating status, the increase in sourcing choices may have led 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-RoOs on final goods affect intermediate goods. We show that the restrictiveness of rules of origin 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.

Second, we follow Conconi et al. (2018) and exploit input-output relations in a triple difference model where we analyze changes in Spokes' imports before and after PECS (between 1995 and 2002). Specifically, we compare changes in imports from countries non-participating

[1]BAFTA includes Estonia, Latvia, Lithuania. CEFTA includes: Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovak Republic and Slovenia.

in the EU FTA to changes in imports among Spoke countries. Differently from Conconi et al. (2018), we exploit an index developed by Cadot et al. (2005) to measure the restrictiveness of rules of origin applied to final goods to which an intermediate good contributes. This index is used to evaluate the effects of PECS, introduced in 1997, which facilitated imports from the EU peripheral countries (Spokes) compared to the RoW. Indeed, based on this strategy, we show that imports of intermediates from the RoW compared to imports from Spoke countries declined following the introduction of diagonal cumulation under the PECS. We find that the magnitude of this decline is positively associated with the extent of the restrictive RoOs 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 FTA agreements characterized by more stringent ("bilateral") rules of cumulation. On the one hand, this happens because firms in Spoke countries may now be able to exploit preferential tariffs and enter into the EU export market as diagonal cumulation expands sourcing possibilities. On the other hand, it might reflect the fact that exporting firms in Spoke countries change their supply chain linkages, by substituting intermediates from EU countries with cheaper intermediates coming from countries that joined the cumulation zone after 1997. In this latter case, since rules of origin in general do not require that products must be fully obtained within the cumulation zone to qualify for preferential access, 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 rest of the world, rather than the EU. To assess these mechanisms, we consider two alternative changes in Spokes' imports. First, we examine changes in Spokes' imports of intermediates from the RoW to changes in imports 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 from Spokes themselves 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 Spoke countries. These additional results highlight that Spokes countries reorganize their production process towards the Spokes themselves and RoW, and away from EU15. The magnitude of these effects continues to be positively associated with the extent of the restrictive RoOs applied to the associated final goods.

Our findings confirm the predictions of recent theoretical literature that looks at the role of preferential regimes on sourcing decisions. A strand of theoretical research has shown that FTAs can potentially lower trade costs if the benefits from preferential access outweigh the costs of fulfilling RoOs and RoCs, 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 RoOs. Modeling RoOs as an additional marginal and fixed cost, they show that firms that take advantage of the less restrictive EU RoOs 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 RoOs. In their model RoOs and RoCs affect sourcing decisions: switching from bilateral to diagonal cumulation relaxes the restrictiveness of RoOs, leading to an increase in trade among firms in the Spoke countries.

This paper further adds to recent empirical research that shows that RoOs affect sourcing decisions and, to the best of our knowledge, provides the first evidence that both RoOs and RoCs affect input choices, and that diagonal cumulation may help reverting trade diversion effects in intermediate goods. Existing empirical work shows that RoOs 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 RoOs-related administrative costs. Cadot et al. (2005) construct, for both NAFTA and EU-related preferences, an index of restrictiveness of RoOs at the six-digit level of the harmonized system. This index shows that RoOs tend to be more restrictive for activities with greater processing, that sectors with more RoOs have lower utilization rates, and that non-least developing countries face restrictive RoOs 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 sourcing decisions of BAFTA and CEFTA countries as an example of the participation of EU peripheral countries (Spokes) in GVCs under a hub-spoke setting. More closely related to our work is the recent analysis by Conconi et al. (2018). The authors show that, controlling for the size of the preference margin, NAFTA RoOs led to a sizeable reduction in 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 count 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 Conconi et al. (2018), we focus on EU-RoOs using the synthetic index developed by Cadot et al. (2005). Additionally, the nature of our experiment enables us to take advantage of different control groups to better disentangle the effect of RoCs on trade 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. The estimation results and robustness checks are discussed in Section 5. Section 6 concludes.

2 Preliminary Evidence on 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.[2] 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— RoOs are used in FTAs. Theoretically, for each FTA, a particular set of RoOs can be established, negotiated according to the trade, industrial, and economic interests of each party.

Historically, EU FTAs have been characterized by bilateral rules of cumulation, which implied that only inputs among the countries belonging to the FTA could have been cumulated to count towards the establishment of the origin of the product. For example, a country belonging to the Baltic Free Trade Area (BAFTA) agreement could cumulate inputs only from the EU or other BAFTA countries to obtain origin status for the related final good, and export it to the EU under preferential tariffs. Meanwhile, when the imported intermediate originated from countries of other FTAs, like the Central European Free Trade Agreement (CEFTA), these inputs would not have counted to fulfilling the EU-RoOs applied to the related final good. The existence of multiple FTAs led to a spaghetti bowl of preferential areas (and thus RoOs) that did not favor the slicing up of the value chain across Europe (Baldwin, 2006). To reduce the heterogeneity of RoOs 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 the pan-European cumulation system (PECS). While the PECS system was introduced in 1997, countries did not join immediately. Among the BAFTA and CEFTA countries, the system could be considered mainly in place as of 2002.[3]

Since this paper focuses on the impact of RoOs and RoCs 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 to Spoke countries before and after the introduction of PECS.[4] The vertical axis measures changes in imports to each Spoke country from RoW (non-participating countries). Notice that we exclude imports from Spokes themselves and from the EU15. The horizontal axis measures changes in imports to each Spoke country from

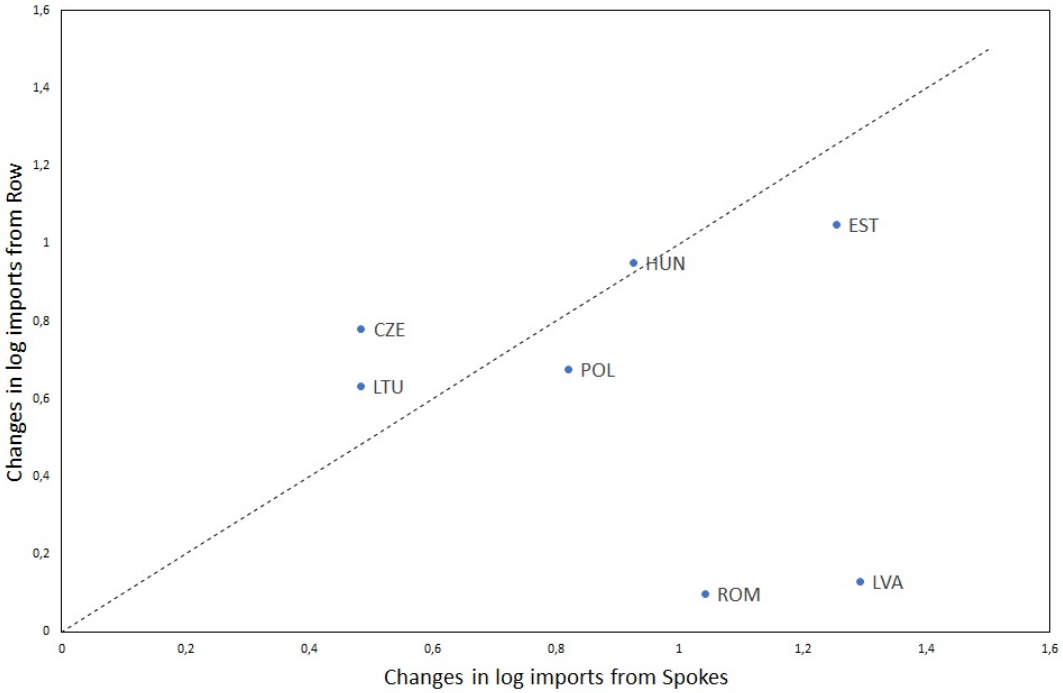
[2]For further information see http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

[3]The system was based on the EEA agreement (1994) between the EU, the EFTA countries, the CEEC (Central Eastern European Countries) and the Baltic States. Table 12 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.

[4]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. Section (3.2) provides additional details about trade and tariff data used.

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 from non-participating countries.

Figure 1: Change in Imports



Source: Authors' calculation using WITS Comtrade database

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 RoOs faced by the related final good. We follow Conconi et al. (2018) in constructing a data set that allows us to map 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 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 EU-RoO Index, 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.

Furthermore, we exploit the index of restrictiveness of EU-RoO developed by Cadot et al. (2005). 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. This index 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.[5] 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. (2005) seems more appropriate than counting the number of final goods products that use a specific intermediate.

To translate the EU-RoO for final goods in terms of intermediates, we combine the previous

[5]For further details see Table 2 in Cadot et al. (2005).

two data sets, i.e. the US IO1997 table with the EU-RoO index by Cadot et al. (2005). 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 our measure in equation (1) is that it gives all products using a specific intermediate the same importance. Therefore, 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 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.[6] This *weighted* IO-RoO Index is our preferred measure. We believe that it better reflects the production process common across countries and is less tied to US specificity, since it provides a more accurate proxy of the production technology.[7]

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.[8] 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 of 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.

To further stress the importance of considering the synthetic index rather than counting the IO relations, Tables 10 and 11 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

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

[7] 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.

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

into final goods. More precisely, Table 10 calculates the percentage of IO-relations at the HS2 sector 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 11 we compute the simple average RoO at the HS2 sector level. For instance, 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 10 and 11 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 RoOs that the final goods face. For instance, from Table 10 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 11). 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. Tables 10 and 11 underline that the sourcing restrictions strongly depend on the production process in which the intermediate is used. Therefore, in the case of Europe, where the RoOs are based on multiple criteria, counting how many final goods the intermediate contributes may overlook the importance of these restrictions.

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
Total	6.3	3.2	14.6	20.5	42.8	4.4	8.3	100	4.2	4.2

Notes: Columns 1 to 8 report the share of RoO restrictions (number 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 descriptive statistics for simple and weighted IO-RoO Index.

3.2 Tariffs and Imports Data

In the empirical part, we consider the effect of PECS, which relaxed EU-RoO among participating countries, on changes in Spokes' import flows from non-participating countries (RoW) relative to Spokes themselves. 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 tariff information.[9]

Our main 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. The set of exporting countries is divided into non-participating countries (RoW), EU15 countries, and Spoke countries. 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.[10] Table 2 presents descriptive statistics of Spoke countries' imports from RoW and among themselves. Looking at the total amounts, Spoke countries' imports from non-participating countries (RoW) increased by 77%. The increase in imports among Spoke countries is much larger, at about 161%.

In the empirical 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 our data set, imports from RoW retain the by-product's bilateral dimension, i.e. imports to Estonia at the HS6 level from each of the non-participating countries. Meanwhile, imports to each Spoke from the other Spokes lose the bilateral 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. Tables 8 and 9 in Appendix A provide a complete list of countries included in our analysis.

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. 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. Notice that the change in tariff between Spoke countries and RoW, $\Delta\tau_{j,srow}$, keeps a bilateral dimension (at the six-digit level of the HS), while the change in tariff among Spokes, $\Delta\tau_{j,ss}$, is constructed as a simple average of the HS6 tariff applied by each Spoke country to all the other Spoke countries.

[9] More details on tariffs data are provided below.

[10] Notice that we never include EFTA and Turkey in the Spokes importing group.

Table 2: Descriptive Statistics on Imports and Tariffs

In sample averages:	Avg Spoke imports from RoW		Avg Spoke imports from Spoke		Avg Tariff applied to RoW		Avg Tariff applied to Spoke	
	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.

4 Empirical Specification

We provide an empirical assessment of the impact of diagonal cumulation on sourcing decisions of intermediate goods, and therefore its role in shaping international supply chains. As a kind of natural experiment, we employ the introduction of the PECS, and we 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). Specifically, we compare changes in imports of intermediate goods to 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 2002, 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, of each Spoke country from the RoW between 1995 and 2002. IO-RoO$_j$ is our measure of the restrictiveness of the RoO facing each intermediate good (simple and weighted average). $\Delta\tau_{j,srow}$ is the change in log tariffs with respect to the RoW, and X_j are product level trends.[11] Finally γ_{srow} are bilateral time-variant fixed effects.

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

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

where $\Delta imp_{j,ss}$ is the change of log imports in intermediate good j, defined at the six-digit level of HS, to each Spoke country from all other Spoke countries between 1995 and 2002. As in equation (3), IO-RoO$_j$ is our measure of the restrictiveness of the RoO facing each intermediate good (simple and weighted average). $\Delta\tau_{j,ss}$ is the change in tariffs with respect to the rest of the Spoke countries. Finally, X_j are product-level trends and γ_{ss} is the time-variant bilateral fixed effect (which in this regression reduces to 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.[12] Since we assume that

[11] 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.

[12] 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 $\Delta\tau_{j,ss} = log(1 + \tau_{j,ss2002}) - log(1 + \tau_{j,ss1995})$.

product-level trends are the same for imports from RoW and from Spoke countries, X_j cancels out in equation (5).[13]

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).

Furthermore, 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 to a Spoke country from the RoW or from the other Spoke countries are the same 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.

Our main variable of interest is IO-RoO$_j$. 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.

Owing to the nature of the experiment, we further assess the role of diagonal cumulation in relaxing the restrictiveness of RoOs using alternative control groups. Firstly, we estimate the triple difference in equation (5), comparing changes in imports of each Spoke country from the RoW to those from the EU15 between 1995 and 2002, $\Delta imp_{j,srow} - \Delta imp_{j,sEU15}$. Then, we compare changes in imports to each Spoke country from the rest of the Spoke countries to the changes in imports from the EU15, $\Delta imp_{j,ss} - \Delta imp_{j,sEU15}$. 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 were able to reassess sourcing choices more in line with comparative advantage and still obtain preferential access for exports of the final good.

5 Empirical Results

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

[13] 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 $\Delta imp_{j,ss} = log(1 + Imp_{j,ss2002}) - log(1 + Imp_{j,ss1995})$.

5.1 Benchmark Specification

Table 3 reports OLS estimates of equation (5), which compares changes in imports to 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 and instead increased Spokes' imports from PECS countries.

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$_j$	-0.112***	-0.137***		
	(0.008)	(0.016)		
IO-RoO$_j$			-0.064***	-0.083***
			(0.012)	(0.021)
$\Delta\tau_j$		-3.836***		-3.942***
		(0.649)		(0.656)
Observations	120,568	26,204	120,568	26,204
R-squared	0.078	0.114	0.077	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. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and Romania.

Tables 4 and 5 propose OLS estimates of equation (5) using alternative control groups. Table 4 shows changes in imports of intermediate j of each Spoke country from the RoW compared to changes in imports from the EU15. 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 rules of origin 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

other Spoke countries as well as the RoW, rather than the EU. 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***	0.032**		
	(0.007)	(0.013)		
IO-RoO$_j$			0.012	0.037**
			(0.010)	(0.018)
$\Delta\tau_j$		-1.773***		-1.749***
		(0.314)		(0.314)
Observations	130,894	32,117	130,894	32,117
R-squared	0.106	0.163	0.105	0.162
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 comparative advantage reasons. Before the introduction of PECS, producers could cumulate inputs only from their original FTA and the EU15 to obtain preferential access for their final good in the EU15 market. Following PECS, producers could cumulate inputs from a larger set of countries to fulfill rules of origin and obtain 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. The coefficient of the weighted average IO-RoO index is positive and significant, while the coefficient of the simple average Io-RoO Index is positive but not significant when controlling for tariffs, and is negative and not significant when changes in tariffs are not controlled for. Concerning the coefficient of the change in tariff, $\Delta\tau_j$, this is always positive but not significant.

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 Robustness and Sensitivity Analysis

In this section we run some robustness checks to overcome possible limitations of the analysis. Firstly, we run a similar regression as in equation (5), but enlarging the set of exporting countries. In the period under analysis, the pan-European cumulation system also included EFTA countries and Turkey.[14] To maintain a homogenous group of countries, our benchmark regressions do not consider these countries among the Spoke countries. These countries are also not included in the sample of the RoW countries, since they belong to the cumulation zone. Nevertheless, to verify that our results are not altered by this exclusion, we now include in the set of Spoke exporting countries EFTA countries and Turkey. Table 6 shows that our results are not affected by their inclusion. The coefficients of both IO-RoO indices continue to be negative and significant, and the coefficient of the change in tariff is negative and significant.[15]

[14]EFTA countries include: Switzerland, Norway, and Iceland. 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.

[15]In Appendix B, table 13 reports the results with only EFTA countries.

Table 6: 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$_j$	-0.138***	-0.139***		
	(0.008)	(0.014)		
IO-RoO$_j$			-0.099***	-0.084***
			(0.011)	(0.020)
$\Delta\tau_j$		-2.773***		-2.821***
		(0.485)		(0.489)
Observations	125,392	28,710	125,392	28,710
R-squared	0.078	0.121	0.076	0.119
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 when considering the change in imports from the extended group of Spoke exporting countries (with EFTA and Turkey) and the change in imports from the EU15. Now the coefficient of the simple average IO-RoO is always positive and significant. The same happens to the coefficient for the relative change in tariffs. Table 7 reports the results.

Table 7: 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.

6 Conclusion

Between 1950 and 2017, 288 Regional Trade Agreements entered into force with FTAs representing the clear majority of the category. RoOs and RoCs are a crucial part of EU-FTA. RoOs, by determining the origin of a product, define whether a good qualifies for preferential access. RoCs 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.

From the theoretical point of view, various papers have already shown the distortionary

effect of RoOs (see Grossman, 1981, Falvey and Reed, 1998, Demidova et al., 2012 among others). In the context of the EU-FTA, Bombarda and Gamberoni (2013) show that RoCs mitigate the effect of RoOs since they increase the number of exporters able to take advantage of preferential access and raise the volume of trade under preferential access between EU and Spoke countries. Using this framework, Bombarda and Gamberoni (2013) argue that as a consequence of the integration between EU and PECS countries, exporters in non-participating countries should find it more difficult to supply the countries belonging to the cumulation zone.

This paper provides evidence that restrictive RoOs and the possibility of participating in the cumulation zone influenced the organization of production and contributed to the creation of a factory Europe. We use the introduction of the Pan European system of cumulation (PECS) in 1997 as a kind of natural experiment to analyze the joint impact of restrictive RoOs and RoCs on sourcing decisions. PECS allowed the majority of the European Union's free trade area partners in the region to cumulate stages of production and still have the resulting final goods qualify for preferential access in the EU market. It provided an opportunity to split the value chain of production among several EU FTA's peripheral partners, since the final good could still benefit from preferential tariffs.

Exploiting input-output relations, we obtain a measure of sourcing restrictions at the intermediate level which enables us to analyze changes in Spokes' imports of intermediates before and after PECS (between 1995 and 2002). Then, we follow Conconi et al. (2018) and use a triple difference estimation. Our results show that trade in intermediate goods increased among a homogeneous group of EU FTA's peripheral partners, BAFTA and CEFTA (Spoke countries). The Spoke countries benefit from diagonal cumulation compared to other countries (including the EU15), and their changes in imports were larger, the stricter the rules of origin applied to the related final products. Owing to the nature of the experiment, we further assess the role of diagonal cumulation in relaxing the restrictiveness of RoOs using alternative control groups. Our results using these alternative control groups suggest that PECS may have led to a reorganization of production as Spoke countries reduced their imports of intermediates from the EU15 relative to imports from other Spoke countries and from RoW. These latter results are indicative of a re-alignment of GVC more likely to be in line with comparative advantages compared to the period before the introduction of diagonal cumulation.

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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 8 and 9 show the list of countries included in our empirical analysis. From the group of countries, we exclude those with missing trade information. Tables 10 and 11 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 8: List of partner countries

Spoke Importing	Spoke 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 9: 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	Israel	Panama	
Brazil	Jamaica	Peru	
Brunei Darussalam	Jordan	Philippines	
Bhutan	Japan	Papua New Guinea	
Botswana	Kazakhstan	Korea, Rep.	
Central African Republic	Kenya	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	Moldova	Chad	
Egypt, Arab Rep.	Madagascar	Togo	
Eritrea	Mexico	Thailand	
Ethiopia	North Macedonia	Tajikistan	
Gabon	Mali	Turkmenistan	
Georgia	Malta	East Timor	
Ghana	Myanmar	Tonga	

Notes: Table 9 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.

Table 10: 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 10 shows descriptive statistics on our main control variable. Columns report the number of IO relationships.

Table 11: 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 12: 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 12 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.

B Robustness Checks

Table 13 shows that our results are not altered if we only add the EFTA countries to the set of Spoke exporting countries.

Table 13: PECS and change in Spokes' imports (with EFTA)

Dep Var:	Change in log Imports			
	(1)	(2)	(3)	(4)
weighted IO-RoO$_j$	-0.090***	-0.119***		
	(0.008)	(0.015)		
IO-RoO$_j$			-0.043***	-0.057***
			(0.012)	(0.020)
$\Delta\tau_j$		-3.206***		-3.261***
		(0.505)		(0.509)
Observations	124,336	28,251	124,336	28,251
R-squared	0.077	0.121	0.076	0.120
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 14 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 7.

Table 14: PECS and Control Group (Spoke and EU 15)

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.