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Abstract

Free trade agreements (FTAs) incorporate regulations regarding rules of origin (RoO) and cumulation. RoO regulations, by restricting the use of inputs outside the FTA, can affect the flow of intermediates in supply chains. We construct a new database to assess the effects of RoO, enabling us to explore two major events that led to RoO relaxation in the European context: PECS, which provided the possibility of cumulating stages of production across the European Union's FTA peripheral partners, and EU enlargement, which eliminated RoO altogether. Our results show that the progressive reduction in RoO had a sizeable impact on reshaping regional and international supply chains. Across both episodes, we estimate consistent elasticities, indicating that a 1% increase in the value requirement restriction before relaxation corresponds to an intermediate import increase ranging from 0.3% to 0.7% from countries where RoO restrictions have been lifted.

JEL classification: F12, F13, F14, F15.

Keywords: Intermediate inputs trade, rules of origin, cumulation, PECS, EU enlargement, input-output tables.

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1 Introduction

Global Value Chains (GVCs) have transformed the way production is organized across nations, and in turn, have significant implications on international trade flows. The World Bank (2020) reports that trade within GVCs as a share of global trade grew very rapidly in the 1990s, from less than 43% in 1995 to more than 50% at the beginning of the 2000s. Despite the proliferation of GVCs, supply linkages within Europe, the Americas, Asia, and the rest of the world from 1995 to 2015 are predominantly organized at the regional level (World Bank and the WTO, 2017). Recent disruptions caused by COVID-19 and rising international tensions have prompted some countries to prioritize further strengthening of regionalization and friend-shoring trade links (Javorcik et al., 2022).

Free trade agreements (FTAs) represent a tool for bolstering regional integration. However, several studies have shown the potential price distortions and reduced efficiency in allocation associated with FTAs (Grossman, 1981 and Krishna, 2005). One crucial factor contributing to allocative inefficiency within FTAs is the local content requirements, which are determined by rules of origin and cumulation system. Rules of origin define which intermediate goods allow a product to qualify for preferential access, while the cumulation system allows materials in another country to be considered as originating to fulfill the rule of origin. Recently, several studies analyzing rules of origin (RoO) have highlighted their role in shaping value chains among member and non-member countries, and their effect on welfare (Ornelas and Turner, 2022, Conconi et al., 2018 among others). Additionally, RoO have also been at the heart of current trade discussions, such as Brexit and the United States-Mexico-Canada Agreement, highlighting their divisive political nature (Antràs, 2020).

This study examines an unexplored mechanism - the effect of changing cumulation systems and the relaxation of European Union rules of origin on the supply chains of Central Eastern European Countries (CEECs).[1] Specifically, we focus on two events that resulted in a reduction in the restrictiveness of RoO: the implementation of the Pan-European Cumulation System (PECS) in 1997, which allowed for diagonal cumulation of RoO, and the introduction of full cumulation (elimination of RoO) for CEECs that joined the EU Customs Union following the European enlargement in 2004.[2] These two episodes are analyzed in a theoretical framework that delivers gravity equations for intermediates where the restrictiveness of RoO is included as a multiplicative component of trade barriers. This component will reflect the type of RoO and cumulation system considered and will affect the intensity of regional integration. To estimate the elasticity of intermediate import flows in response to changes in cumulation systems, we develop a novel measure of the restrictiveness of RoO that

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

[2] There are three types of Cumulation System of origin rules: bilateral, diagonal, and full. Bilateral cumulation occurs between two countries and allows producers in either country to use intermediates from the other country as if they originated in their own. Diagonal cumulation involves more than two countries and requires them to be bound together by bilateral FTAs with identical RoO. Full cumulation, which is only used between European Economic Area (EEA) partners, allows all stages of production from FTA partners to be counted towards achieving origin status, regardless of whether the processing is sufficient to confer originating status.

captures the average local content requirement needed for an input to guarantee originating status, which we refer to as the EU-RoO measure.

The context of Europe in the 1990s provides an excellent case study. The proliferation of various FTAs in Europe following the collapse of the Soviet Union created a complicated environment for countries involved in, or seeking to be involved in, the value chain division. To address this complex network of FTAs in Europe, commonly known as the "Spaghetti Bowl", the European Union (EU) introduced the Pan-European Cumulation System (PECS) in 1997. PECS standardized the rules of origin protocols among the PECS signatories and introduced diagonal cumulation.[3] The latter allowed the use of intermediate goods from the other PECS signatories without affecting the origin status and preferential treatment of the final product. Subsequently, some PECS signatories joined the EU Customs Union, which permitted full cumulation and eliminated the use of RoO among members. The elimination of RoO is an important development for the newly joined peripheral countries (also referred to as Spokes) as it is expected to expand their sourcing possibilities when seeking for intermediates.

There are two primary challenges encountered when evaluating the impact of the relaxation of RoO on Spokes' international supply chains. Firstly, it should be noted that our period of analysis witnessed significant changes, such as the rapid development of these countries as newly emerging market economies and their gradual integration into the EU. These factors could have influenced the sourcing strategies pursued by Spokes countries, regardless of the type of cumulation system incorporated in the FTA with the EU. To overcome this issue, we exploit the significant heterogeneity of the European RoO across products and the distinct stages of integration of the cumulation systems.[4] This enables us to identify their impacts on sourcing strategies for different groups of partner countries. The second challenge arises from the complexity of quantifying the restrictiveness of RoO embedded in trade agreements. We addressed this issue by developing a specific database and employing text analysis techniques to categorize and quantify the various types of RoO restrictions at a granular level of disaggregation across products.

Our analysis is conducted in four steps. First, we discuss the institutional framework in which the relaxation of European RoO occurred, and provide preliminary evidence on the changes in supply chains, both at regional and international levels, for the Spokes countries under consideration. We show that there is extensive variation across sectors in import growth rates sourced within the PECS area as compared to outside. Furthermore, when we compare differences in import growth between the two stages of RoO relaxation, we observe a relative promotion of international links instead of regional ones following accession to the EU.

Second, we propose a simple theoretical framework to rationalize a mechanism through which RoO affect the pattern of production. By determining the origin of a product, RoO de-

[3]Due to data availability, we consider a subset of PECS signatories, to which we refer as Spoke peripheral countries.

[4]As a matter of comparison, Table 2 in Cadot et al. (2006) reports that less than 17% of RoO are uniquely based on Change of Tariff Classification (CTC), against 89% of NAFTA RoO. A larger portion, 26% of tariff lines, are based on different combinations of CTC and Value Added requirements.

fine whether a good qualifies for preferential access. Since this depends on the content of the imported intermediates that must originate from the FTA zone, RoO work as a restriction on imported intermediate inputs. We use the Eaton and Kortum (2002) model of Ricardian comparative advantage to establish a framework in which RoO affect the choice of intermediates used. Specifically, to capture the heterogeneity across products, our RoO measure at the intermediate level (EU-RoO) is modeled as an additional multiplicative trade cost that, depending on the intensity of the rule and the sourcing country, may affect intermediate import flows. This framework is necessary for building the identification design required for our experiment, which involves cross-country group comparisons over time windows around changes in cumulation systems.

Our third step involves creating a metric to establish an empirical counterpart to EU-RoO. Inspired by Conconi et al. (2018), this is accomplished by encoding the content of EU-FTAs treaties pre- and post-PECS and examining the RoO restrictions for each final good product listed in these documents. Then, to determine the intermediate goods that each rule restricts and the extent of the restrictions, we use text analysis techniques. We interpreted each rule as a percentage restriction on the value of intermediates that could be used outside the FTA. Finally, we use input-output (IO) tables to incorporate the actual importance of each intermediate in the final product's production. As a result, our EU-RoO measure is a weighted average of the value requirement restrictions that an input faces in the production of final goods, allowing us to assess the impact of RoO on intermediates.

In the final stage of our analysis, we employ our EU-RoO measure to estimate the effects of progressively relaxing EU-RoO on intermediate goods imports. Drawing on our theoretical gravity equations, we analyze changes in the cumulation system on Spokes' intermediate imports from various origin countries, including Spoke countries that signed PECS, the rest of the world (RoW) countries with which Spokes had no FTA, and EU15 countries.[5] We evaluate this variation over the two periods of RoO relaxation, the transition from bilateral to diagonal cumulation between 1995-2002 and the full cumulation via European enlargement between 2002-2006. Due to the product-specific nature of RoO, the variation of our EU-RoO measure is not bilateral across Spoke import partners. However, it exhibits distinct temporal variations depending on the group of exporting countries under consideration. In order to estimate the impact of EU-RoO on changes in intermediate imports, we employ changes in the cumulation system as the basis of our identification strategy. This allows us to exploit the variation in products over time across different partners.

According to our results, a 1% larger EU-RoO measure is linked to an increase ranging from 0.3% to 0.7% in intermediate imports sourced from countries that see restrictions lifted. These elasticities remain consistent across both relaxation episodes. Specifically, our findings show that PECS facilitated a regional reassessment of sourcing decisions for Spoke countries, as it encouraged the import of intermediates from these countries relative to both the RoW and EU15. In contrast, when we examine Spokes' integration into the customs union, we observe that full cumulation allowed regional supply chains to become more global. By

[5]EU15 refers to countries that joined the EU until 1995.

eliminating the need for RoO, EU enlargement enabled Spokes to overcome the restrictions on intermediates use from third-party countries (RoW). Therefore, for those intermediates that were significantly restricted by EU-RoO before 2004, we observe a substantial increase in imports from RoW relative to either the other Spokes or the EU15. As such, our study contributes to the literature by analyzing the impact of the gradual relaxation of RoO on regional and international supply chains and providing evidence that this can lead to a multilateralization of regionalism (Baldwin, 2006).

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.

Related Literature

The theoretical literature on regional trade agreements and fragmentation of the production process is vast (Ornelas et al., 2021, 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) examines the impact of trade policy on firm sorting in a heterogeneous firm setting and finds evidence that only the more productive Bangladeshi firms choose to meet RoO when they are binding. 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. Ornelas and Turner (2022) propose a model with incomplete contracts and relationship-specific investment to show how stricter RoO may solve the problem of under-investment. Head et al. (2022) develop an Eaton and Kortum framework that reveals how RoO, in the form of local content requirements, can influence the relocation of production within and outside the FTA zone, leading to a so-called RoO Laffer curve.[6] We propose a many-industry version of the EK model to obtain gravity equations for intermediate import flows in a world with multiple countries. This framework enables us to compare shares of intermediate imports under different cumulation systems.

The empirical literature on the impact of RoO is limited, mainly due to the complexity of RoO regulations. Synthetic indices, such as those developed by Estevadeordal and Suominem (2006) and Cadot et al. (2006), have been used in most of these studies, but they do not consider the vertical linkages between goods. In order to fill this gap, Conconi et al. (2018) created a unique dataset that captures input-output relationships within NAFTA RoO. By calculating the number of final goods subject to RoO-associated restrictions for each intermediate good, they quantify the restrictiveness of RoO along supply chains. On the contrary, our approach takes into account the fact that European RoO are largely based on value content requirements, rather than primarily relying on changes of tariff classification (Cadot et al., 2006). We offer a novel metric that interprets restrictions in terms of

[6]This curve shows that a sufficiently low level of RoO can boost intermediate production inside the region, but further increases in RoO stringency reverse this effect, pushing production outside the region. Focusing on the car sector, they calibrate their model to assess the 2020 revision in NAFTA RoO (USMCA).

local content requirements, which better aligns with the characteristics of European RoO. Additionally, we propose a methodology to encode the content of EU-Free Trade Agreement treaties both pre- and post-PECS, enabling us to discern between the effects of changes in product RoO restrictions and those from alterations in the cumulation system on Spokes' supply chains of intermediates.

Our study contributes to the limited existing literature on the impact of cumulation systems on trade. To the best of our knowledge, the only related work is the one by Augier et al. (2005). Using aggregated data, they show that the absence of diagonal cumulation before PECS hindered trade by 10% to 50% depending on the time period and group of countries considered. Our study differs from Augier et al. (2005) in that we take into account the specific nature of RoO and their corresponding cumulation regulations, which enables us to more accurately identify the trade elasticities of these policies. Specifically, we have coded the trade agreements, which allows us to measure the restrictiveness of RoO. Our new EU-RoO measure allows us to assess the effect of changing cumulation systems by exploiting and comparing two events, PECS and EU enlargement. In addition, differently from their work, we focus on evaluating the impact of RoO on trade along global value chains. Our research provides novel evidence that diagonal cumulation of origin rules influences input choices within the PECS area and that full cumulation may help alleviate trade diversion effects in intermediate goods.

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 NAFTA RoO led to a sizeable reduction in Mexico's imports of intermediate goods from third countries relative to NAFTA partners. Differently from Caliendo and Parro (2015) and Conconi et al. (2018), we analyse whether progressive relaxation of RoO reverts sourcing decisions that may have resulted from the introduction of a FTA.

The paper is structured as follows. Section 2 presents preliminary evidence on the two episodes considered and their role in influencing sourcing decisions. Section 3 proposes the conceptual framework. Section 4 describes the construction of our EU-RoO measure and the data used. Section 5 presents the empirical strategy, and the possible identification threats. The estimation results and robustness checks are discussed in Section 6. Section 7 concludes.

2 Institutional Framework

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 is operated between two partners. This implies that producers in either partner country can use intermediates originating in the other country as if they originated in their own country. However, when intermediates from a third country are used, the realized product could lose preferential access to the FTA.[7] Bilateral cumulation was thus limiting the fragmentation of the production process among the EU and CEECs.

To reduce the heterogeneity of RoO in the Euro-Mediterranean region, the EU and a subset of CEEC countries 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). The PECS system was based on the EEA agreement (1994) between the EU, the EFTA (European Free Trade Association), and the CEECs (BAFTA and CEFTA countries).[8] PECS harmonized the rules of origin protocols of all the underlying FTAs and introduced diagonal cumulation, allowing countries in the PECS agreement to use intermediate goods from other PECS partners without jeopardizing the origin status and preferential treatment of the final product. For example, with diagonal cumulation, Hungarian shirt-makers could use Polish cloth to meet the rules of origin without losing access to the EU with preferential tariffs (Baldwin, 2013). While the PECS system was introduced in 1997, countries did not join immediately. However, among the BAFTA and CEFTA countries considered in our study, PECS was finalized by the end of 1997.

PECS, by fostering the interconnection of peripheral countries, encouraged the emergence of regional supply chains. However, the enlargement of the EU in 2004 brought new challenges to the economic geography of supply chains in the area due to the elimination of RoO for those CEEC countries joining the EU Customs Union. With the full cumulation that accompanied the EU enlargement, newly joined Spoke countries were able to utilize intermediates from anywhere without facing any RoO restrictions. This progressive relaxation of RoO is expected to impact the production structures of the new EU member states, which can now access a broader and more global set of intermediates. Using our previous example, full cumulation allows the Hungarian shirt-makers to use not only Polish cloth but also cloth from the RoW without any limitations when exporting to EU members.

Figure 1 offers initial evidence illustrating the evolution of regional and global supply chains during the relevant time period. It does this by displaying variations in Spoke's im-

[7] As an example, consider the bilateral FTAs between the European Union (EU) and Hungary and Poland in the 1990s. If rules of origin (RoO) on cloth require that all shirts imported duty-free into the EU be made from either EU cloth or locally-produced cloth, Hungarian shirt producers may need to switch from using Polish cloth to EU cloth in order to qualify for preferential treatment in the EU market. Bilateral cumulation, combined with RoO, can thus function like a Hungarian tariff on Polish cloth, limiting the fragmentation of the production process within the region, particularly between the EU and Central and Eastern European countries.

[8] Table 15 in Appendix A provides further details about the dates of preferential agreements providing for diagonal cumulation between EU community and our set of 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.

ports by Harmonized System at the 2-digit level (HS2), before and after the implementation of PECS (represented in red) and the EU enlargement (represented in blue).[9] The horizontal axis displays the average changes in imports each Spoke country receives from the Rest of the World (RoW). In contrast, the vertical axis represents the average import change from other peripheral Spoke countries.

Almost all products, as per the HS2 classification, lie above the diagonal in the figure. This signifies a comparatively faster increase in Spoke's imports from other Spokes relative to imports from RoW countries during the PECS period from 1995 to 2002 (red dots). This trend is consistent with the progressive liberalization of RoO enacted by PECS, which eliminated RoO across Spokes.

After joining the EU Customs Union, we anticipate a rise in imports from the RoW for peripheral Spoke countries. This is due to the elimination of all restrictions related to RoO. This expectation is indeed reflected in Figure 1, which shows a reduction in the average distance from the 45 degree line during the EU enlargement phase (blue dots) as compared to the PECS phase. Notable variations in the evolution of imports across different HS2 sectors can be observed during both phases.

In the subsequent section, we introduce a theoretical framework that accounts for the heterogeneity of RoO across products. This framework equips us with gravity equations in order to systematically examine the impact of RoO relaxation during these two distinct episodes.

Figure 1: Change in Spoke's imports from other Spoke Countries vs. RoW by HS2

[9]Our analysis centers around the imports of BAFTA and CEFTA countries, excluding Bulgaria, the Slovak Republic, and Slovenia due to insufficient tariff data during the pertinent periods. Further details on the countries in our analysis and the trade and tariff data used are provided in Table 12 in Appendix A and Section 4.2, respectively.

3 Theoretical Framework

In this section, we propose the theoretical framework that underpins our identification design for comparing changes in Spokes' intermediate imports across different cumulation scenarios. Our analysis is framed from the perspective of a Spoke country, j, that becomes a member of the PECS bloc in 1997 and later joins the EU in 2004. We consider a perfectly competitive framework in which the Spoke country j imports intermediate goods from a variety of potential sources. These imported intermediates are subsequently assembled into a final product that can be exported.

When this final product is exported to FTA members, such as the EU market in our scenario, it can benefit from preferential access, provided that it complies with the specific RoO detailed in the FTA. These rules govern the extent to which the Spoke country can import intermediate goods from non-FTA regions while still preserving the originating status of its final product, thereby guaranteeing preferential access to the EU market. Since RoO determines the proportion of imported intermediates that must be sourced from within the FTA region, it effectively restricts the use of intermediate goods sourced from non-partner countries.

In the subsequent section, we will disregard the decision-making process of country j regarding the potential markets for its final product. We will presume that it exclusively caters to the European market under preferential access conditions, and thus takes into account the restrictiveness of RoO when defining its sourcing strategy.

3.1 Setup

We follow Eaton and Kortum (2002) (EK hereafter) to obtain gravity equations for intermediate import flows in a world with multiple countries, trade costs, and comparative advantage associated to technology differences across countries. Using the many-industry version of the EK model in Costinot et al. (2011), we can write the productivity z of an exporting country i that produces a commodity in industry k as determined by the following Fréchet distribution:

$$F_{ik}(z) = exp\{-T_{ik}z^{-\theta}\}, \tag{1}$$

where $T_{ik} > 0$ is a measure of productivity of country i in industry k, and $\theta > 1$ is the shape parameter which is common across all countries. Buyers, who in this setting are firms buying intermediate inputs, have CES preferences over product varieties within an industry k, and buy from the lowest cost provider.

Thus, the fraction of sector k intermediates imported by country j from country i is given by:

$$\pi_{ijk} = \frac{T_{ik}(c_{ik}t_{ijk})^{-\theta}}{\Phi_{jk}}, \tag{2}$$

where c_{ik} is the cost of labor in country i industry k, and $\Phi_{jk} = \sum_i^N T_{ik}(c_{ik}t_{ijk})^{-\theta}$, with N being the number of countries. Φ_{jk} summarizes how technology in sector k, input costs, and geographic barriers around the world govern prices in each importing country j. We

model bilateral trade frictions as a log-linear function of observable trade costs, such as $t_{ijk} = \tau_{ijk} r_{ijk}^{\rho}$.[10] $\tau_{ijk} \geq 1$ represents industry k tariffs imposed by j on i's exports, while $r_{ijk}^{\rho} \geq 1$ captures the restrictiveness of RoO at the intermediate level, with $\rho > 0$. Similarly to tariffs, r_{ijk} has both a product and a country bilateral dimension. The country-pairs dimension of r_{ijk} is due to the fact that RoO applies in a discriminatory way by limiting access only to those inputs imported from countries outside the cumulation area. The parameter ρ captures the sensitivity of imports to RoO restrictions at the intermediate level.[11]

Therefore, expenditure of country j on sector k intermediates imported from country i is obtained as:

$$X_{ijk} = \pi_{ijk} Y_j \tag{3}$$

where Y_j is income in country j.

3.2 Trade Policy Scenarios

This section discusses the evolution in intermediate imports of country j from two potential source nations when a set of countries transitions from being outside to being included in a cumulation area. We start by comparing the imports of j from a country that is a member of the cumulation zone versus a country that isn't, which we denote as i and i' respectively. The ratio of j's expenditure on import k from a member country compared to a non-member country can be expressed as follows:

$$\left(\frac{X_{ijk}}{X_{i'jk}}\right) = \left(\frac{\pi_{ijk}}{\pi_{i'jk}}\right) = \frac{T_{ik}(c_{ik}t_{ijk})^{-\theta}}{T_{i'jk}(c_{i'jk}t_{i'jk})^{-\theta}}, \tag{4}$$

which we log-linearize to get:

$$\log\left(\frac{X_{ijk}}{X_{i'jk}}\right) = \log T_{ik}c_{ik}^{-\theta} - \theta \log t_{ijk} - \log T_{i'k}c_{i'k}^{-\theta} + \theta \log t_{i'jk} \tag{5}$$

We define $t-1$ and t to represent two consecutive periods, and use the properties of logarithms to derive a straightforward specification for the change in relative demand for intermediate imports in sector k over time. For the sake of simplicity, and to prevent potential confusion, we will not explicitly refer to the product category, k, in the subsequent discussion. Nonetheless, it's important to remember that our gravity equation characterizes intermediate import flows of a specific industry k. The log change in imports of product k from country i compared to country i' can be expressed as follows:

[10] Head et al. (2022) also model the intensity of local content requirements as a multiplicative component of trade costs.

[11] In line with this setup, in section 4.1 we propose a measure of RoO built at the intermediate level.

$$\Delta \log \left(\frac{X_{ijt}}{X_{i'jt}}\right) = \Delta \log \left(\frac{T_{it}c_{it}}{T_{i't}c_{i't}}\right)^{-\theta} - \theta\Delta \log \left(\frac{t_{ijt}}{t_{i'jt}}\right) \tag{6}$$
$$= \log \frac{T_{it}c_{it}^{-\theta}}{T_{i,t-1}c_{i,t-1}^{-\theta}} - \log \frac{T_{i't}c_{i't}^{-\theta}}{T_{i',t-1}c_{i',t-1}^{-\theta}} - \theta \log \frac{t_{ijt}}{t_{ij,t-1}} + \theta \log \frac{t_{i'jt}}{t_{i'j,t-1}},$$

Expressing the trade frictions into its components, $t_{ijt} = \tau_{ijt} r_{ijt}^{\rho}$, and summarizing technology factors into $\delta_{it} = \log \frac{T_{it}c_{it}^{-\theta}}{T_{i,t-1}c_{i,t-1}^{-\theta}}$, and $\delta_{i't} = \log \frac{T_{i't}c_{i't}^{-\theta}}{T_{i',t-1}c_{i't-1}^{-\theta}}$, we get:

$$\Delta \log \left(\frac{X_{ijt}}{X_{i'jt}}\right) = \delta_{it} - \delta_{i't} - \theta \left(\log \frac{\tau_{ijt}}{\tau_{ijt-1}} \frac{\tau_{i'jt-1}}{\tau_{i'jt}} + \rho \log \frac{r_{ijt}}{r_{ijt-1}} \frac{r_{i'jt-1}}{r_{i'jt}} \right), \tag{7}$$

where r_{ijt} and $r_{i'jt}$ refer to RoO restrictions at the intermediate level applied from the importer j to i and i'.

Equation (7) is convenient to identify the effects of RoO relaxation on supply networks of intermediates. Despite our EU-RoO measure being identical for each product k across sourcing countries that belongs to the same cumulation regime, it evolves differently over time for sourcing countries that moves from being restricted to not being restricted by RoO. In the next paragraphs, we exploit two subsequent events that lifted restricions of RoO overt two different groups of sourcing countries, first the other Spokes countries and later the Rest of the world, to identify variation over sourcing startegies

Transition from Bilateral to Diagonal to Cumulation. Bilateral cumulation characterizes the situation before PECS. Under bilateral cumulation, to access duty-free the EU market, only a restricted bundle of intermediates coming from other peripheral countries and other non-partner countries (RoW) can be used, while having no restriction on the use of intermediates from the EU market (and from the country itself). Diagonal cumulation characterizes a situation after the entering into force of PECS. Under diagonal cumulation, to access duty-free the EU market, the spoke country faces no restriction in the use of intermediates from the other Spoke countries (signatories of PECS) and from the EU market, but it can only access a restricted bundle of intermediates coming from other non-partner countries (RoW). Moving from bilateral to diagonal cumulation implies, therefore, a change in r_{ij}, where j is an importer spoke country and i is an exporter spoke country, such that $r_{ijt-1} \geq 1$ under bilateral cumulation, while $r_{ijt} = 1$ under diagonal cumulation. Denoting with t the scenario with diagonal cumulation, and with $t-1$ the one with bilateral cumulation, equation (7) becomes:

$$\Delta \log \left(\frac{X_{ijt}}{X_{i'jt}}\right) = \delta_{it} - \delta_{i't} - \theta \left(\Delta \log \frac{\tau_{ijt}}{\tau_{i'jt}} - \rho \log r_{ijt-1} - \rho \log \frac{r_{i'jt}}{r_{i'jt-1}} \right), \tag{8}$$

In this equation, we consider i' as a non-member of PECS, meaning that it either belongs to the EU15 or falls under the Rest of the World category. Given that both ρ and θ are greater than zero, the transition from bilateral to diagonal cumulation results in a relative rise in

the flow of intermediate imports among PECS members, particularly in sectors where RoO were notably restrictive at the intermediate level before. It's important to point out that the final term on the right hand side captures the change in RoO restrictiveness towards the non-PECS member. This term is zero for imports sourced from EU15 since they are unrestricted in both periods. Conversely, this value might differ from zero for non-member countries, reflecting changes in RoO due to treaty revisions.

Transition from Diagonal to Full Cumulation. Full cumulation pertains to the situation post-2004, when our selected Spoke countries were fully integrated into the EU's economic union, thus adopting the full cumulation regime. This union, comprising a shared market and a customs union, lifts any RoO restrictions on sourcing countries as the final goods are able to circulate duty-free throughout the common market. We use t to represent the full cumulation scenario and $t-1$ to symbolize the preceding state under diagonal cumulation. Any RoO restrictions on intermediate imports from the Rest of the World (RoW) are removed, or to put it differently, $r_{i'jt-1} \geq r_{i'jt} = 1$, where i' exclusively denotes RoW sourcing countries. Concurrently, imports from PECS members or from the EU15 continue to be unrestricted in both situations, thus $r_{ijt} = r_{ijt-1} = 1$. In this case, i refers to either another Spoke country or a member of the EU15. Under these circumstances, we can invert equation (7) to keep at the numerator those sourcing countries from which restrictions are lifted and rewrite it as follows :

$$\Delta \log \left(\frac{X_{i'jt}}{X_{ijt}} \right) = \delta_{i't} - \delta_{it} - \theta \left(\Delta \log \frac{\tau_{i'jt}}{\tau_{ijt}} - \rho \log r_{i'jt-1} \right). \tag{9}$$

Given that $\rho > 0$ and $\theta > 0$, full cumulation is expected to result in intermediate imports from RoW countries growing more rapidly compared to imports from non-RoW nations in sectors where intermediate-level RoO was previously more restrictive.

4 Data

In Section 4.1, we describe how we process the legal texts and classify RoO to build an index of restrictiveness of RoO that accounts for vertical linkages. We then discuss the data that we use to incorporate the importance of each intermediate in the final good's production. Then, we provide some descriptive evidence of the heterogeneity of our EU-RoO measure across HS2 sections within each trade agreement, as well as differences across the agreements considered. In Section 4.2, we describe tariffs and trade data used in the empirical analysis.

4.1 Construction of the EU-RoO Index

Our sources of data are three legal texts: the Trade Agreements of the European Communities with member countries of BAFTA and CEFTA signed in 1994, and the PECS Agreement, which amended Protocol 4, signed in 1997.[12] In all three agreements used, to

[12]BAFTA and CEFTA members individually signed FTA with the European Community in 1994. These FTAs embody RoO which are identical within BAFTA and CEFTA participants. Additionally, our analysis

which we refer as EU-CEFTA, EU-BAFTA and EU-PECS, the RoO are specified at the level of the finished product. The granularity of these rules can be defined at the level of a Chapter (HS2), a Heading (HS4), or a Subheading (HS6). The RoO are essentially textual guidelines that define the "work or processing that must be performed on non-originating materials to achieve originating status". Essentially, they specify which intermediate inputs are restricted and to what extent those restrictions apply.

Before discussing the construction of our EU-RoO measure which will capture RoO restrictions at the intermediate level, 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 to such an arrangement, for example, entry of products into the European Community at a preferential tariff rate. 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, sufficiently worked, or processed with wholly or partly imported materials (see Articles 5, 6, and 7 of Protocol 4 in each Treaty used). 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: Regional Value Content, Change of Tariff Classification, and Technical Requirements. Regional Value Content requires that the value of all or some of the non-originating material - 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 final product. Finally, Technical requirements demand the final good producer perform specific stages of production within the FTA. For instance, the final good producer must usually start from a very early stage of production and perform all the successive downward stages. Considering the case of a t-shirt, firms may be required to start from yarn, i.e. they must perform all stages that involve spinning, dyeing and weaving of yarn, within the FTA.

In what follows we describe the procedure to build our EU-RoO measure, which will capture rules of origins accounting for vertical linkages. This procedure consists in 5 steps, which we proceed as follows:

1. We codify each rule at the most granular level of aggregation, i.e. at the HS6 level. Whenever a rule applies at the Chapter level (HS2), we assign it to all HS6 products of that Chapter. Likewise, whenever the rule applies at the heading level (HS4). There are instead instances in which the rule is specified to apply only to some subheadings

also shows that the pre-PECS RoO were largely identical betweeen BAFTA and CEFTA. In our estimating sample, this difference is less than 0.4%, with the average EU-RoO for CEFTA being 46.42% while being 46.78% for BAFTA. Thus, the pre-PECS Treaties we use are those signed with Hungary (for CEFTA), and Lithuania (for BAFTA), which can be found on the Eur-Lex website here and here. The PECS treaty used is the one signed with the Czech Republic and is available here. For all three Treaties, rules are reported in Annex II. Note that Annex I clarifies the interpretation of the rules.

of an HS4. In these cases, the HS6 products are not listed but a text description is provided. We use word matching to assign these text descriptions to HS6 categories.[13]

2. We classify the text content of rules into five classes: Regional Value Content, Change in Tariff Classification, Technical Requirement, Wholly Obtained, and No Rule. To perform this classification, we use regular expressions, a sequence of characters that specifies a search pattern in the text. Table 1 shows some examples of the text used. Each class is further divided into sub-classes, depending on the scope of the restriction. For example, within the Change in Tariff Classification, we distinguish a *Change in Chapter* from a *Change in Heading*. Table 14 in Appendix shows the empirical frequencies of these rules in the three Trade Agreements used. Note that a rule can belong to multiple classes. For example, it might require a Change of Heading, and at the same time, impose a minimum Regional Value Content on the Value of Materials used. For instance, in the PECS Treaty, a sub-heading of product "ex 2008" requires "all the materials used are classified within a heading other than that of the product" (CTC), and "the value of any materials of Chapter 17 used does not exceed 30% of the ex-works price of the product" (Regional Value content).

3. We identify the set of HS6 products that are potentially restricted by each rule. This is straightforward for most of the sub-classes. For example, *Value of Material Used* restricts potentially the use of all HS6. On the other hand, rules in the class *Value Material of Other Heading* restrict the use of only some headings specified in the text (as shown in Table 1). To identify them, we use a local search for sequences of numeric characters.[14] Sometimes, the rule provides only a textual description of the restricted products, e.g. "Textile products". For these cases, we employ the dictionary provided by WITS, to assign the relative HS codes.[15] Lastly, since Technical Requirements usually require the producer to perform the entire production process, we assume that they can potentially restrict all the HS6 products.

4. We then assign a % restriction to each rule, which we call Value Requirement, as displayed in Table 2. This is straightforward for the Regional Value Content rules: the Value Requirement specifies the minimum value added within the FTA's territory as a percentage of the final product's value. In the case of a *Change in Tariff Classification* and *Wholly Obtained* rules, the Value Requirement is expressed as a percentage of the input's value that must be produced within the FTA. For example, if the rule of origin calls for a *Change of Chapter*, this implies that all intermediates which belong to the same Chapter as the final product and originate from outside the FTA cannot

[13]Word matching is performed between the description of HS6 products in the HS classification as well as in the CN European Classification and the description of the product in the treaty. String matching is performed using the fuzz.token_set_ratio() from the FuzzyWuzzy Library of Python. This function computes the Levenshtein distance similarity ratio between the two strings (sequences) after having tokenized the strings, changed capitals to lowercase, and removed punctuation to it. Manual checks were performed whenever more than one HS6

[14]Local search means that the search is performed within a string around a position identified by some text key, such as "of the Chapter" or "of the heading N.".

[15]The dictionary is available at the link here.

be used. We therefore assign a 100% restriction to the intermediates belonging to the same Chapter. Similarly, if the rule of origin requires a Change in Heading, all the inputs' values belonging to the subheadings (HS6) in the same heading (HS4) as the final product must originate entirely from the FTA. Also in this case, as shown in Table 2, we assign a 100%. Let's consider our previous example for the product "ex 2008" in the PECS Treaty. A sub-heading of this product requires that "all the materials used are classified within a heading other than that of the product", which is a CTC, to which we assign a 100% restriction. Then, another sub-heading states "the value of any materials of Chapter 17 used does not exceed 30% of the ex-works price of the product," which is a Regional Value content, to which we assign a 30% restriction. Lastly, we assign the largest Value Requirement to technical requirements, as all stages and their inputs must occur within the FTA, as previously mentioned.[16] After assigning these value requirements to each rule, we utilize an IO matrix (as discussed below) to convert them into the final product's value.

5. Not all potentially restricted HS6 enter a final good's production process. We account for IO linkages, by making use of the direct requirements that come from the IO table. In particular, we define our EU-RoO at the intermediate level k as the weighted average value requirement that an intermediate k faces in the production of a final good f:

$$\text{EU-RoO}_k = \sum_f \left(\text{VR}_{fk} \frac{dr_{fk}}{\sum_f dr_{fk}} \right) \tag{10}$$

where the weight dr_{fk}, is the direct requirement coefficient, i.e. the portion of the expenditures in the use of the input k that goes to produce \$1 of the output f.[17] VR_{fk} is the value requirement we assigned to each rule (discussed in point 4), which is defined at the final product f, and that restricts the use of input k. Note that $0 \geq \text{EU-RoO}_k \geq 100$. Thus, our final EU-RoO measure, EU-RoO_k, represents a weighted average of the value content obligations that the intermediary encounters while producing a final product, where the weights correspond to the relative importance of that input for the production of each output.

[16] In a robustness test, we verify if our results are stable to other possible choices in treating these types of goods.

[17] In section Input-Output Data, we provide more details about the direct requirement.

Table 1: Taxonomy of rules and examples of text used to identify them

Class	Sub-Class	Text Pattern in Annex II
Regional Value Content	Value Material Used (VMU)	Manufacture in which the value of all the materials used does not exceed X% of the ex-works price of the product
	Value Material of the Heading (VMH)	Manufacture in which materials from the same heading can be used provided their value does not exceed X%
	Value Material of Other Heading (VMOH)	Materials which are classified in heading N. Y may be used provided their value does not exceed X%
	Value Material Originating (VMNOM)	Manufacture in which the value of non-originating materials used does not exceed the value of the orig. materials
Change in Tariff Class.	Change in Chapter (CC)	Any heading except those of Chapter Y might be used
	Change in Heading (CH)	All the materials used are classified in a heading other than that of the product
	Change in Subheading (CS)	Manufacture from materials of any heading, including other materials of heading N. Y
	Heading Exception (HE)	Manufacture from materials of any heading except prepared or preserved vegetables of heading N. Y
Technical Requirement		Manufacture from materials of heading N. Y
Wholly obtained		Manufacture in which all the materials used must already be originating
No Rule		Manufacture from materials of any heading

Notes: Table 1 reports a sample of RoO taken from our treaties. RoO are text strings indicating the processing required on non-originating materials in order that the product realized receive originating status. This text information is then used to classify RoO. X and Y are numeric elements, the first refers to the value content while the second to HS categories.

Table 2: Assignment to Inputs and Value Requirement by Rule Class

Class	Sub-Class	Value Requirement	Restricted HS
Regional Value Content	Value Material Used	100-X%	All HS6
	Value Material of the Heading	100-X%	All HS6 in the HS4 of the rule
	Value Material of Other Heading	100-X%	All HS6 in the HS4 specified (Y)
	Value Material Originating	50%	All HS6
Change in Tariff Class.	Change of Chapter	100%	All HS6 in the Chapter specified (Y)
	Change of Heading	100%	All HS6 in the HS4 of the rule
	Change of Subheading	100%	The HS6 of the rule
	Heading Exception	100%	All HS6 in the HS4 specified
Technical Requirement		100%	All HS6
Wholly obtained		100%	All HS6 (unless specified)
No Rule		0%	All HS6

Notes: The X% value refers to the content of each specific rule belonging to the Class "Regional Value Content", as described in Table 1. Y denotes one or multiple HS products (Chapters, HS4 or HS6), and it is used to identify the inputs that are specified in rules of classes such as Change of Tariff Classification, as displayed in Table 1.

Input-Output Data. To calculate our EU-RoO measure in equation (10), we use direct requirements sourced from the US IO1997 table, which we convert into the six-digit classification system of 1988/1992 Harmonized System, HS6 (as detailed in Conconi et al., 2018). Although we focus on several peripheral European countries, we use US IO tables for two reasons. Firstly, it allows us to maintain the same level of disaggregation in the trade data, namely HS6. Secondly, it aligns with the methodology of Rajan and Zingales (1998), who constructed a measure of an industry's reliance on external funds in the US and applied this measure to other countries. The authors assume that there are technical reasons why some industries depend more on external financing than others and that these reasons are consistent across countries. We adopt a similar approach and use the US IO tables to identify a more efficient production process that is less susceptible to distortions such as product market restrictions, and thus can be viewed as being driven by technological factors. To avoid any potential endogeneity issues related to production process changes, we use the same US IO1997 table to calculate both the EU-RoO index pre and post-pecs, thereby ensuring that any variation captured is solely due to changes in RoO restrictions rather than changes in production processes.

Validation of the EU-RoO Index. In order to assess the validity of our EU-RoO measure, we compare it with the index proposed by Cadot et al. (2006). In this paper, Cadot et al. (2006) proposes a synthetic index to measure RoO in NAFTA and in EU. Their index applies to final goods classified at the HS6 level, and varies from 1 to 7, with 7 representing the most restrictive RoO applied by the EU. The idea behind the index proposed by Cadot et al. (2006) is that the more complex the RoO, in terms of the number of requirements imposed or level of restriction within the requirement, the larger the value assigned.[18] With respect to our data which is built at the input-output level, their index does not account for the extent to which each final goods affect different individual group of inputs. In order to make our index comparable with the one in Cadot et al. (2006), we use a simple average of our index at the final good level $RoO_f = \sum_k \text{EU-RoO}_{fk}/n_f$ where n_f is the number of intermediates used in final good f. We find that our measure correlates positively and significantly with the index proposed by Cadot et al. (2006), with a p-value < 0.001 for Kendall's rank correlation test under the Alternative Hypothesis of true correlation not equal to zero.

Descriptive Statistics on the EU-RoO Index. We now provide some statistics concerning our EU-RoO measure presented in equation (10). Table 3 reports the average EU-RoO index for different products categorized by their Harmonized System (HS) classification at the HS Section level. According to our measure, intermediate products, on average, contribute to the production of final products that require approximately 40% of their added value to be produced within the FTA region. This percentage remains consistent across all three treaties analyzed, namely EU-BAFTA (with Lithuania as the reference), EU-CEFTA (with Hungary as the reference), and EU-PECS. By examining the average EU-RoO across rows in Table 3, we observe that also the ranking of industries is relatively consistent across the three trade agreements. This is particularly evident when comparing the EU-RoO values for EU-BAFTA and EU-CEFTA treaties, suggesting that the EU's RoO was standardized across FTAs with CEECs prior to the 1997 trade agreements. In all three treaties, we observe a significant variation in EU-RoO among different products. In the textile industry, for instance, textile intermediates are used in the production of final products that necessitates a minimum local value content of at least 70%. This seems to suggest that textile intermediates are often employed as inputs in the production of final goods which demands high-value requirements. This is in line with what Cadot et al. (2006) document that the apparel industry has the strictest regulations applied at the final good within the PECS Agreement.

[18] Regarding the number of restrictions, RoO can, in fact, combine different type of restrictions. Thus, Cadot et al. (2006) consider that, for instance, a Change of Heading combined with a max Value Content on the Chapter is more restrictive than only a Change of Heading. With respect to the level of restriction within a requirement, Cadot et al. (2006) assigns a more restrictive index when, for instance, the max Value Material Used is 30% rather than 40%. For further details on the product-specific rules of origin see Table 2 in Cadot et al. (2006).

Table 3: Summary Statistics on EU-RoO Indices (%) at HS Section

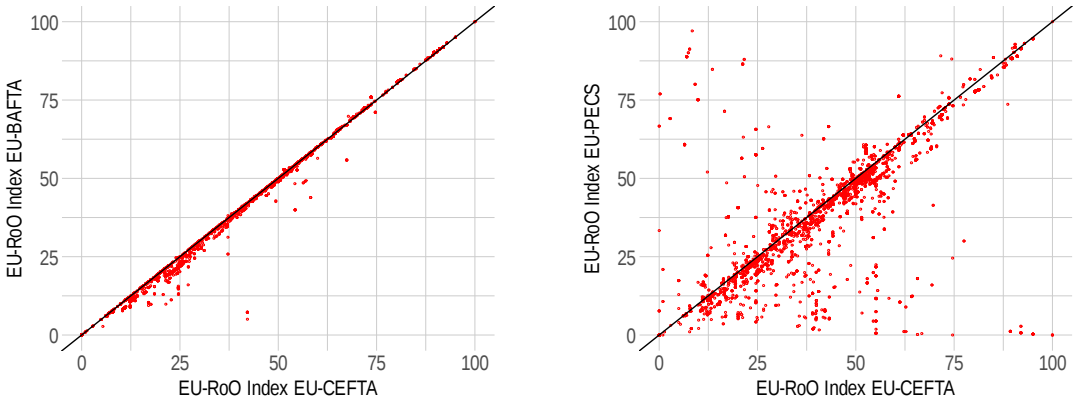
SECTOR	EU-RoO$_k$ (EU-BAFTA)	(EU-CEFTA)	(EU-PECS)
Animal Products	53.83	53.83	64.32
	(32.93)	(32.92)	(27.34)
Chemicals	21.62	23.85	20.38
	(12.65)	(12.50)	(12.06)
Foodstuffs	45.64	45.73	16.49
	(24.25)	(24.18)	(19.71)
Footwear/Headgear	26.64	26.69	26.31
	(25.67)	(25.71)	(25.47)
Machinery/Electrical	49.98	50.47	43.40
	(17.63)	(17.26)	(17.11)
Metals	44.12	44.30	41.87
	(11.03)	(11.05)	(11.12)
Mineral Products	23.87	27.51	23.78
	(16.54)	(15.77)	(16.67)
Miscellaneous	41.88	42.37	39.69
	(14.02)	(14.13)	(13.38)
Plastic/Rubbers	39.09	39.70	36.54
	(9.45)	(9.57)	(10.62)
Raw Hides,Skins,Leathers	38.54	38.27	33.94
	(19.15)	(18.94)	(20.33)
Stone/Glass	38.92	39.45	42.77
	(15.31)	(14.87)	(16.45)
Textiles	73.70	73.35	70.94
	(15.12)	(14.98)	(15.78)
Transportation	47.79	48.00	44.60
	(16.83)	(16.68)	(17.11)
Vegetables	34.04	34.27	27.85
	(18.44)	(18.32)	(19.24)
Wood Products	34.31	35.00	32.65
	(12.60)	(12.51)	(12.43)
Total	44.3	44.9	42.6
	(23.0)	(22.4)	(23.2)

Table 3 reports averages of our EU-RoO measures (at the intermediate level) constructed from each of the treaty considered. Standard deviations in parentheses.

In order to systematically analyze and compare the rules of origin across different trade agreements, we illustrate in panel (a) of Figure 2 the EU-RoO values for the EU-BAFTA vs. EU-CEFTA agreements (pre-PECS). In panel (b), we show the EU-RoO values for the EU-BAFTA vs. EU-PECS agreement. Each data point within these plots corresponds to an HS6 product.

From panel (a), it can be observed that nearly all data points align along the 45-degree line, implying a high degree of similarity in our EU-RoO measure across pre-PECS trade agreements. Likewise, panel (b) demonstrates a considerable number of data points clustered near the 45-degree line, which suggests that the changes in product rules introduced with the new PECS agreements are not considerable. On average, the data points tend to lie slightly beneath the diagonal line, which indicates a reduction in the stringency of the EU-RoO measure following 1997.

Figure 2: Comparison of EU-RoO measures across trade agreements



(a) EU-RoO pre-PECS (b) EU-RoO pre- and post-PECS

Source: Authors' computation using EU-RoO measures.

4.2 Sample Selection

In the empirical analysis, we consider the effect of the progressive relaxation of EU-RoO on changes in Spokes' imports. We consider two episodes: the introduction of the PECS system and the EU enlargement in 2004. For this purpose, we consider the years 1995, 2002 and 2006, which correspond to pre- and post-PECS years, and pre-and post-EU Integration years.

Our group of importing countries is composed of the BAFTA and CEFTA members.[19] Because of missing tariff observations for the pre-PECS period, the Slovak Republic and Slovenia are included in the sample only for the analysis of the EU enlargement.[20] Thus Spoke countries consist in the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, and uniquely for the EU enlargement episode, the Slovak Republic and Slovenia.

Depending on the specification used, the group of exporting countries is divided into non-participating countries (RoW), EU15 countries, and Spoke countries. The RoW category includes countries that didn't have free trade agreements with our Spoke nations during the time period under study. Tables 12 and 13 in Appendix A provide a comprehensive list of countries included in our research. A point to consider in our specification is the treatment of imports from other Spoke exporters. Given that some partial diagonal cumulation was already possible across BAFTA and a subset of CEFTA nations even before PECS, we only examine changes in imports originating from Spoke countries that were part of a different FTA. For instance, we consider BAFTA nations and their imports from CEFTA, and vice versa.[21]

[19]Romania and Bulgaria, even if members of CEFTA, joined the PECS only in 1999, and they did not enter the EU Customs Union in 2004, thus are not included in our analysis.

[20]We also run an estimation where we exclude these two countries also for the EU enlargement phase, and show that their exclusion does not have any significant effect on the coefficients. Results are available upon request.

[21]We also conducted a falsification check where we only considered imports from within FTA, i.e. either

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 RoW country. Meanwhile, imports of each Spoke from the other Spokes (not belonging to the same FTA) and from EU15, lose the exporter-importer dimension and are aggregated at the HS6 level. For instance, we compute Estonia's total imports of a particular HS6 line from the sub-set of CEFTA countries considered (the same is true for Estonia's imports from EU15). The rationale behind this aggregation choice is to capture the third-country effects compared to the cumulation zone effect. Furthermore, we only keep imports from RoW countries and 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.

In the period under study, members of EFTA (Iceland, Liechtenstein, Norway, and Switzerland) and Turkey (for the subset of industrial goods) also joined the PECS. To assess the impact of progressive relaxation of RoO on a 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 a robustness check.[22]

4.3 Trade and Tariff Data

We use trade data from the World Integrated Trade Solution (WITS) for 1995, 2002, and 2006, which we combine with tariff-level data from UNCTAD Trade Analysis Information System (TRAINS), which provides an 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). We compute the tariff change using both preferential tariffs and most favored nation (MFN) tariffs. Specifically, we use MFN tariff every time we have a missing preferential tariff. If the MFN tariff is missing for a particular product destination, we apply the MFN tariff applied by the importer on that product toward another destination, in the case both destinations are WTO members. Notice that the change in import tariff from RoW, keeps a bilateral dimension (at the six-digit level of the HS), while the change in tariff from the other Spokes, and EU15 countries, are constructed as a simple average of the HS6 tariff applied by each Spoke country to the other Spokes, and EU15 countries. Table 16 and Table 17 present descriptive statistics of Spoke countries' imports and average tariff levels from other Spokes, from RoW countries, and from EU15.

5 Identification Strategy

Exploiting the gravity equations formulated in Section 3, we now propose our identification strategy to examine the two episodes of RoO relaxation, PECS and the accession to the European Union. We estimate the impact of these episodes by leveraging our EU-RoO measure to capture the varying degrees of policy exposure faced by intermediates imported

within BAFTA (or CEFTA) imports. Results show that our EU-RoO measure is no longer significant, aligning with the fact that diagonal cumulation was already possible pre-PECS within BAFTA (and within some CEFTA) members, as discussed in Driessen and Graafsma (1999).

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

from different origins. To analyze the effects of RoO on regional and international supply chains, we categorize origin countries into three groups, Spoke countries, RoW, and EU15. In the upcoming sections, we provide a detailed description of our econometric specifications for both scenarios.

5.1 Bilateral to Diagonal Cumulation

This section describes the identification strategy adopted to study the effect of PECS on supply chains. Specifically, the trade policy change from bilateral to diagonal cumulation is captured by considering pre- and post-PECS periods. Since PECS was introduced in 1997 and all Spoke countries considered in our analysis joined PECS in 1997, we look at changes in their imports between 1995 and 2002.

We start by comparing changes in each Spoke's intermediate imports from the other Spokes to imports from RoW countries. We use equation (8), and replace $i = SP$ to indicate the cluster of exporting Spokes, and $i' = RoW$ to indicate exports from each RoW country. The term r_{ijt-1} in equation (8) refers here to the period before the PECS and is therefore relabeled as $r_{SPjk}^{PRE-PECS}$. Similarly, we relabel the ratio $r_{i'jt}/r_{i'jt-1}$ with $r_{RoWjt}/r_{RoWjt-1}$, facilitating the transcription of the natural logarithm of this ratio as $\Delta \log r_{RoWjk}$ (where we have omitted the time subscript). Therefore, allowing for measurement error in trade data, we can introduce a disturbance term into the gravity equation, and convert equation (8) into a linear regression model as follows:

$$\begin{aligned}\Delta \log\left(\frac{X_{SPjk}}{X_{RoWjk}}\right) =& \delta_{SPk} + \delta_{RoWk} + \beta_1 \Delta \log\left(\frac{\tau_{SPjk}}{\tau_{RoWjk}}\right) + \\ &+ \beta_2 \log r_{SPjk}^{PRE-PECS} + \beta_3 \Delta \log r_{RoWjk} + \epsilon_{SP,RoWjk}. \end{aligned} \tag{11}$$

The dependent variable in equation (11) captures the product-level changes in imports of Spoke j from other Spokes, relative to the changes in imports from a RoW country.[23] δ_{SPk} and δ_{RoWk} represent exporter-product fixed effects, which account for specific temporal trends for product and country pairs. Note that since imports from other Spokes exporters is aggregated by group of FTA, δ_{SPk} captures all product characteristics that are common to exporters by group (CEFTA or BAFTA). τ_{SPjk} represents country j's average tariff applied to the other Spokes, and τ_{RoWjk} is country j's bilateral tariff applied to the RoW country.[24]

The empirical counterpart of $r_{SPjk}^{PRE-PECS}$ is our EU-RoO measure computed using the two treaties preceding PECS (EU-CEFTA and EU-BAFTA as explained in Section 4.1). Thus, the values of $r_{SPjk}^{PRE-PECS}$ rely on whether the importing country j is part of BAFTA or CEFTA. For instance, when j is a BAFTA country, the EU-RoO measure reflects the

[23] Notice that we account for the fact that even before PECS there were already some trial of diagonal cumulation. These trials involved countries within each FTA considered, BAFTA and CEFTA. Thus, to account for that, when considering imports of a BAFTA country we aggregate imports only coming from other Spokes in CEFTA, and the same for each CEFTA's importing country.

[24] The change in tariff is computed as $\Delta \log \tau_{SPjk} - \Delta \log \tau_{RoWjk}$, where $\Delta \log \tau_{SPjk} = log(1+\tau_{SPjk2002}) - log(1+\tau_{SPjk1995})$, and $\Delta \log \tau_{RoWjk} = log(1+\tau_{RoWjk2002}) - log(1+\tau_{RoWjk1995})$. A similar definition for the change in tariff is applied in the other specifications.

RoO restrictions outlined in the 1994 EU-BAFTA agreement. Conversely, when j is a CEFTA country, the EU-RoO measure is based on the 1994 EU-CEFTA agreement. It is important to note, however, that the values of EU-RoO in these two treaties are remarkably similar. In our estimating sample, this difference is less than 0.4%, with the average EU-RoO for CEFTA being 46.42% while being 46.78% for BAFTA. Hence, to further clarify the identification issues we encounter, we will refer to this variable dropping the j dimension, i.e., $r_{SPk}^{PRE-PECS}$. Moreover, it's crucial to emphasize that, in line with our theoretical framework, trade costs (RoO and tariffs) enter multiplicatively. Therefore, in all specifications, we apply to our EU-RoO measure the typical transformation used for iceberg costs, i.e., $\log r = \log(1 + \text{EU-RoO}/100)$.

Our second variable of interest, $\Delta \log r_{RoWjk}$, represents the percentage variation in the restriction level between the EU-RoO before and after the implementation of PECS for sourcing from RoW exporters. This variable captures the fact that the PECS Agreement introduced common rules for all Spokes j, which only restrict intermediates from RoW countries. Note that since the pre-PECS variations in RoO across Spokes j are practically insignificant due to the similarity between BAFTA and CEFTA rules in 1994, and then with PECS rules become common across j, we can drop the j subscript and replace $\Delta \log r_{RoWjk}$ with $\Delta \log r_{RoWk}$.

Once again, RoO are defined at the product level, and set by the FTAs with the EU so that they apply to all our importers j and limit inputs solely from those sourcing countries that are not part of the cumulation zone. For this reason, our empirical EU-RoO measure holds a particular type of importer-exporter bilateral dimension. Specifically, within each group of exporters, such as the RoW, Spokes, or EU15 countries, and a specific cumulation regime, pre or post-PECS, the value of the EU-RoO restriction is constant across importer-exporter pairs.[25] This means that while equation (11) may be our ideal specification, it is not feasible to separately estimate $\log r_{SPk}^{PRE-PECS}$ from δ_{SPk}, nor $\Delta \log r_{RoWjk}$ from δ_{RoWk}. To circumvent this, we suggest two solutions. We could adopt the approach of Conconi et al. (2018) and presume common product trends across exporters, which would allow us to omit the product dimension in the fixed effects.[26] Alternatively, we can relax this assumption and include exporter-sector fixed effects, where sectors should be defined at a broader level than HS6. For the sake of a clear discussion, in what follows, we will maintain the identification strategy following the solution proposed by Conconi et al. (2018). The second solution is instead implemented in robustness checks by using exporter-sector fixed effect at the ISIC level, which allows us to keep our RoO measure since its variation is at the HS6 level.[27]

[25] In principle this is true only among group of importers that shared the same RoO, i.e. among members of BAFTA and CEFTA. In practice, as we have discussed earlier, RoO are almost equivalent in BAFTA and CEFTA treaties.

[26] Note that this results from treating product and exporter dimension separately. Then, under the assumption of similar product trends, we can drop the product k FE. Alternatively, we can drop the product dimension under the assumption that comparative advantages fluctuate differently across countries but remain constant across sectors within a single country. Considering Hanson et al. (2005)'s finding of a mean reversion in export capabilities, this assumption appears reasonable when analysing medium-term (variations over a seven-year span) changes.

[27] In this case, the underlying assumptions regarding our model is that comparative advantages evolve similarly across products within the same sector.

Therefore, under common product trends, we can replace δ_{RoWk} and δ_{SPk} with δ_{RoW} and δ_{SP}, which control for exporter fixed effect for RoW countries and BAFTA respectively (or CEFTA, depending on the j importing country). This yields the following simplified specification:

$$\Delta\log\left(\frac{X_{SPjk}}{X_{RoWjk}}\right) = \delta_{SP} + \delta_{RoW} + \beta_1\Delta\log\left(\frac{\tau_{SPjk}}{\tau_{RoWjk}}\right) + \\ + \beta_2 \log r_{SPk}^{PRE-PECS} + \beta_3\Delta \log r_{RoWk} + \epsilon_{SPRoWjk}, \tag{12}$$

where the coefficient β_1 estimates $-\theta$, as indicated in equation (8), and it is expected to be negative. The negative coefficient of β_1 tells us that the larger the relative increase in the import tariff wedge between Spokes and RoW sourcing partners, the smaller will be the expected increase in imports from other Spokes relative to RoW. The coefficient β_2 is estimating $\theta\rho$, and it is expected to be positive. The intuition is that the more product k was subject to RoO restriction in the pre-PECS period, the relatively easier it will become after PECS to import this product k from the other Spokes relative to RoW countries. Finally, the coefficient β_3 is estimating $\theta\rho$ and it is also expected to be positive, this is because the larger the increase in RoO due to PECS, which now only restricts intermediates from RoW partners, the more difficult it becomes to export from RoW with respect to the other Spokes.

The identification strategy adopted in equation (12) will be maintained for the other comparison groups. In general, this specification allow us to identify, for a specific product k imported by each Spoke j, the time variation in the ratio of imports originating from the two groups of exporting countries compared. The triple differences allow us to account for importer-product-level trends, such as GDP and demand for imports k. In each specification, we also control for exporter-country time trends and leverage the variability in product exposure to EU-RoO and its changes over time to identify the effects of diagonal cumulation and changes in RoO restrictions brought about by the PECS.[28]

The second comparison group refers to changes in Spoke's intermediate imports from the other Spokes, $i = SP$, with respect to imports from the EU15 bloc, $i' = RoW$. Notice that in this framework our r_{ijt-1} in equation (8) is again $r_{SPjk}^{PRE-PECS}$, while $r_{i'jt}/r_{i'jt-1}$ become $r_{EUjk}^{PRE-PECS}/r_{EUjk}^{PECS}$. Since Spoke's intermediate imports from the EU15 were never limited by RoO, which means $r_{EUjk}^{PRE-PECS} = r_{EUjk}^{PECS} = 1$, and then the last term in equation (8) disappears. Consequently, by omitting the time dimension, along with the j dimension on our RoO variable for the same reasons outlined previously, equation (8) evolves into:

$$\Delta\log\left(\frac{X_{SPjk}}{X_{EUjk}}\right) = \delta_{SP} + \delta_{EU} + \beta_1\Delta\log\left(\frac{\tau_{SPjk}}{\tau_{EUjk}}\right) + \beta_2 \log r_{SPk}^{PRE-PECS} + \epsilon_{SP,EUjk}, \tag{13}$$

where δ_{EU} and δ_{SP} represent the exporter fixed effect for EU bloc and, depending on the j importing country considered, the exporter fixed effect for BAFTA or CEFTA.

In equation (13), β_2 is estimating $\theta\rho$, and we expect it to be positive. In other words, the greater was the $r_{SPjk}^{PRE-PECS}$ restriction, the larger is the expected increase in j's import

[28] A similar approach is also adopted for quantify the effect of full cumulation.

from the other Spokes relative to EU15. The intuition is that the more intermediate k was subject to RoO restriction in the pre-PECS period, the easier it will become after PECS the import of this product k from the other Spokes relative to the EU15 bloc.

Finally, in the last comparison, we consider changes in Spoke's intermediate imports from RoW, $i = RoW$, with respect to imports from the EU15 bloc, $i' = EU$. Notice that in this framework the logarithm of r_{ijt}/r_{ijt-1} is called $\Delta \log r_{RoWjk}$. As in equation (13), $r_{i'jt}/r_{i'jt-1}$ becomes $r_{EUjk}^{PRE-PECS}/r_{EUjk}^{PECS}$, and since $r_{EUjk}^{PRE-PECS} = r_{EUjk}^{PECS} = 1$, we drop the last term to obtain the following specification:

$$\Delta \log \left(\frac{X_{RoWjk}}{X_{EUjk}} \right) = \delta_{RoW} + \delta_{EU} + \beta_1 \Delta \log \left(\frac{\tau_{RoWjk}}{\tau_{EUjk}} \right) + \beta_2 \Delta \log r_{RoWk} + \epsilon_{RoW,EU,jk}, \quad (14)$$

where δ_{RoW} represents exporter fixed effect for the RoW, and δ_{EU} is the exporter fixed effect for EU bloc. In equation (14), β_2 is an estimate of $\theta\rho$, and it is expected to be negative. This is because an increase in the EU-RoO measure brought about the new rules of PECS (which only restrict intermediates from RoW partners) makes it harder for the Spoke country to import from RoW relative to EU15.

5.2 Diagonal to Full Cumulation

This section focuses on identifying the impact of acquiring the full cumulation regime as a result of EU accession on sourcing. We use equation (9) to analyze the changes in Spokes' intermediate imports between 2006 and 2002. In this context, the index t represents full cumulation, while $t-1$ corresponds to PECS with diagonal cumulation. We start by comparing imports from the RoW, $i' = RoW$, with imports from other Spoke countries, $i = SP$. It is convenient to remind that RoO restrictions with respect to RoW were lifted with the accession into the EU, meaning that $r_{ijt} = 1$, while before the EU enlargement, RoO restrictions are those implemented under the PECS treaty, denoted as $r_{ijt-1} = r_{RoWjk}^{PECS}$. Differently, imports from the other Spokes face no RoO limitations during either period. Lastly, note that the RoO were established by a joint agreement with the Spoke nations under PECS, indicating that r_{RoWjk}^{PECS} is constant across all j importers, and therefore we will omit the j index. We thus rewrite equation (9) as follows:

$$\Delta \log \left(\frac{X_{RoWjk}}{X_{SPjk}} \right) = \delta_{SP} + \delta_{RoW} + \beta_1 \Delta \log \left(\frac{\tau_{RoWjk}}{\tau_{SPjk}} \right) + \beta_2 \log r_{RoWk}^{PECS} + \epsilon_{SP,RoW,jk}, \quad (15)$$

where δ_{RoW} represents the exporter fixed effects for RoW, while δ_{SP} captures the exporter fixed effect for the Spoke countries as a whole. Note that here δ_{SP} will be captured by a constant since all the imports from other Spokes are treated as a group, given their simultaneous inclusion in PECS and accession to the EU15. Within equation (15), we anticipate a positive coefficient for β_2. This positive coefficient is associated with the fact that products with higher restrictions on RoO during the PECS phase, which were primarily applicable to products originating outside the PECS countries (i.e., products from RoW countries), become relatively easier to import from the RoW compared to other Spoke countries after the EU enlargement. This is because, thanks to the full cumulation inherited

from entering the EU market, intermediate imports from the RoW are no longer subject to RoO limitations.

The second comparison considers changes in each Spoke's intermediate imports from RoW with respect to imports from EU15 bloc, i.e. $i = EU$. Thus, equation (9) turns into:

$$\Delta \log \left(\frac{X_{RoWjk}}{X_{EUjk}} \right) = \delta_{SP} + \delta_{RoW} + \beta_1 \Delta \log \left(\frac{\tau_{RoWjk}}{\tau_{EUjk}} \right) + \beta_2 \log r^{PECS}_{RoWk} + \epsilon_{RoW,EU,jk}, \tag{16}$$

where δ_{RoW} represents the exporter fixed effect for the RoW, and δ_{SP} is the exporter fixed for the Spoke countries as a whole, which is captured by the constant. In equation (16), we expect β_2 to be positive. The logic is analogous to the one mentioned earlier: the stricter the RoO on intermediate k during PECS (which were hitting products from RoW countries), the relatively easier it will get importing this product k from RoW countries rather than EU15 after the EU enlargement.

Notice that when examining the EU enlargement episode, we do not consider the comparison between imports from other Spokes, $i = SP$, and imports from EU15, $i' = EU$. This is because both groups of exporting countries face no RoO restrictions in either of the periods, causing all terms related to RoO in the equation (16) to cancel out. As a result, there is no identifiable effect of RoOs in this context.

5.3 Threats to Identification

When examining the impact of trade policy changes, it is crucial to account for issues stemming from reverse causality. Should trade policy arise as a response to pre-existing economic conditions, such as shifts in trade patterns already in progress, it can result in biased estimations, thereby either overestimating or underestimating the effect of trade policy on trade flows. For instance, if a policy change merely follows trade changes that have already occurred, the effect may be downplayed, whereas if nations anticipate an increase in trade due to a trade agreement, the effect may be overstated (Goldberg and Pavcnik, 2016). Consequently, these factors can impede the generalizability of the findings.

In relation to our paper, several studies have highlighted that the fragmentation of the production process generates an incentive for firms to influence trade policy (Blanchard, 2007, Blanchard et al., 2016, and Blanchard and Matschke, 2015). Following the collapse of the iron curtain in Europe, a process of production unbundling occurred whereby parts and components were frequently transported across borders before being sold to consumers (Baldwin, 2013). The implementation of PECS was eagerly anticipated by several final good producers within the EU market who had either relocated or were willing to relocate some of their production to Spoke countries. Since in this study, we adopt the perspective of various Spoke countries where producers played a less active role in relation to PECS than firms in the EU member states, the issue of endogeneity of trade policy should be less problematic.

Furthermore, the implementation of the PECS was a component of the larger process of European integration, which was primarily driven by political motivations. In general, the goals of European integration were mainly motivated by regional geopolitical factors, such as preventing instability in the European region, sharing integration with newly democratic

nations, and lastly the EU enlargement (see Berlingieri et al., 2018 among others). These objectives were attained through economic means, i.e. trade agreements (re)-negotiated by the EC with several peripheral countries.

Another compelling argument alleviating endogeneity concerns is that our estimates would be biased only if the level of RoO restrictiveness is linked to omitted factors that shape the trade policy changes being examined and affect sourcing decisions. While changes in cumulation systems are likely to be influenced by various political and economic factors, the consistency and stability of RoO across different treaties suggest that their content and technicalities have not been a matter of negotiation. In fact, as shown by our EU-RoO measures in Figure 2, rules have remained largely unchanged over time.

To validate further these arguments, we test whether products with different RoO exposure were undergoing different trends before changing the cumulation systems. This is presented in Section 6.4 where we estimate a similar specification to our baselines using different pre-PECS periods, i.e. 1992-1993. Since trade flow data prior to 1995 is only available for Hungary, we concentrate on this country as an importer.

6 Empirical Results

The following sections present two sets of results associated to each scenario. The last part proposes some robustness and sensitivity analysis.

6.1 PECS Scenario

Table 4 presents the OLS estimates of equation (12), which analyzes the changes in each Spoke's imports from other Spoke countries relative to imports from RoW countries. Column (1) contains only the logarithm of our EU-RoO measure, with exporter characteristics being controlled for. Column (2) introduces the difference in the change of tariffs.

The positive and statistically significant coefficient of $\log r_{SPk}^{PRE-PECS}$ implies that intermediate goods, which were subjected to stricter RoO restrictions during the pre-PECS phase, significantly benefited from the PECS implementation in the form of improved regional supply chains. More specifically, a larger EU-RoO measure in the pre-PECS period is associated with a greater increase in imports from other Spoke countries compared to RoW countries. Put differently, inputs previously constrained by stringent RoO, for which diagonal cumulation introduced by PECS eliminated the RoO among signatory countries, saw a more substantial increase in intra-PECS imports.

Column (2) quantifies this effect: a 1% larger EU-RoO measure based on pre-PECS treaty is associated to approximately a 0.3% increase in imports from other Spokes compared to RoW, attributed to the easing of these restrictions. The coefficient of the change in tariffs is negative and significant, indicating that a 1% relative increase in the tariff applied to other Spoke countries compared to the RoW leads to an approximately 5% relative decrease in imports from Spoke countries. Notably, this import elasticity aligns with estimates from existing literature that use HS6 product level trade data (Imbs and Mejean, 2017).

In column (3), we incorporate the variation in our EU-RoO measure, $\Delta \log r_{RoWk}$, which captures the variations in product rules between the PECS and pre-PECS treaties. These changes in restrictiveness of RoO, driven by a revision in the rules brought about by the new PECS treaty of 1997, only impact imports from RoW countries. The coefficient for this measure is not statistically significant, likely due to the minor variations observed in RoO restrictions within products between 1995 and 2002, making it challenging to discern the impact of $\Delta \log r_{RoWk}$ on the reshaping of sourcing strategies (as also demonstrated in Figure 2). Indeed, in our estimating sample, the average EU-RoO measure, now applicable exclusively to RoW countries, diminished by less than 2% following product rule changes introduced by PECS. This implies that while the alteration in the cumulation system - which removed RoO restrictions on products originating from the Spokes - was significant, the changes in the restrictiveness of RoO from the pre-PECS period to post-PECS (the latter affecting only RoW countries), did not substantially affect the development of supply chains of PECS importers.

Table 4: PECS and change in imports, Spokes vs. RoW

DEP. VAR.	$\Delta\log\left(\frac{X_{SPjk}}{X_{RoWjk}}\right)$		
	(1)	(2)	(3)
$\log r_{SPk}^{PRE-PECS}$	0.511***	0.354**	0.299*
	(0.141)	(0.164)	(0.170)
$\Delta\log\left(\frac{\tau_{SPjk}}{\tau_{RoWjk}}\right)$		-4.832***	-4.830***
		(0.721)	(0.723)
$\Delta \log r_{RoWjk}$			-0.455
			(0.297)
Observations	101,234	77,686	77,686
R-squared	0.055	0.068	0.069
Exporters FE	Yes	Yes	Yes

Notes: OLS estimation. Changes refer to the period 2002-1995. The dependent variable is the difference between changes in log imports of intermediate k from the other Spoke countries and the RoW between 1995 and 2002. $\Delta \log \tau_{jk}$ is the change in applied tariff. $\log r_k^{PRE-PECS} = log(1 + \text{EU-RoO}_k/100)$ Importing countries include the Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland. Cluster standard errors at the (HS6-importer) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 shows OLS estimates using the alternative groups of countries. Columns (1) and (2) present OLS estimation of equation (13), which considers the impact of diagonal cumulation on changes in imports of each Spoke country from the other Spokes compared to changes in imports from the EU15. Similarly to Table 4, column (1) includes only the logarithm of our EU-RoO measure applied pre-PECS, while column (2) also controls for the differences in the change of tariffs. The coefficient of $\log r_{SPk}^{PRE-PECS}$ is positive and statistically significant. This suggests that the greater our EU-RoO measure in the pre-PECS period, the larger the expected change in country j's import from the other Spoke countries relative to EU15. Specifically, a 1% larger EU-RoO measure based on pre-PECS

treaties is associated with a 0.7% higher increase in imports from other Spoke countries relative to EU15. This increase can be attributed to the relaxation of the RoO restrictions via PECS.

Columns (3) and (4) in Table 5 correspond to equation (14), which focuses on the changes in intermediate imports of each Spoke from the RoW compared to imports from the EU15. In line with equation (14), column (3) only includes the variation in our EU-RoO measure, $\Delta \log r_{RoWk}$. This measure accounts for modifications in product rules between PECS and pre-PECS treaties that after PECS only hit products originating in RoW countries. Notice that in equation (14), the EU-RoO measure is not present because there were no restrictions on intermediate imports from EU15 in neither periods, while RoO affects inputs from RoW in both periods. Specifically, $r_{EUjk}^{PRE-PECS} = r_{EUk}^{PECS} = 1$, indicating the absence of RoO limitations. In column (4), we add the differences in the relative change of tariffs.

Consistently with the results in Table 4, the coefficient of $\Delta \log r_{RoWjk}$ is not statistically significant. As previously mentioned, since RoO pre- and post-PECS did not undergo substantial changes, their change might not have played a relevant role in the reshaping of supply chain away from the RoW countries $\Delta \log r_{RoWjk}$.

Table 5: PECS and change in imports, Spokes vs. EU15 and RoW vs. EU15

DEP. VAR:	$\Delta\log\left(\frac{X_{SPjk}}{X_{EUjk}}\right)$		DEP. VAR:	$\Delta\log\left(\frac{X_{RoWjk}}{X_{EUjk}}\right)$	
	(1)	(2)		(3)	(4)
$\log r_{SPk}^{PRE-PECS}$	0.437***	0.708***	$\Delta \log r_{RoWk}$	0.096	0.129
	(0.149)	(0.158)		(0.185)	(0.203)
$\Delta\log\left(\frac{\tau_{SPjk}}{\tau_{EUjk}}\right)$		-1.421**	$\Delta\log\left(\frac{\tau_{RoWjk}}{\tau_{EUjk}}\right)$		-1.651***
		(0.604)			(0.557)
Observations	16,224	10,169		110,840	96,352
R-squared	0.070	0.075		0.086	0.091
Exporters FE	Yes	Yes		Yes	Yes

Notes: OLS estimation. Changes refer to the period 2002-1995. In columns (1) and (2) the dependent variable represents changes in log imports of intermediate k of each Spoke country from the other Spokes compared to change of imports from the EU15. In columns (3) and (4) the dependent variable represents changes in log imports of intermediate goods of each Spoke country from the RoW compared to the change of imports from the EU15. $\log r_k^{PRE-PECS} = log(1 + \text{EU-RoO}_k/100)$, and $\Delta \log \tau_{jk}$ is the change in applied tariff. Importing countries include Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland. Cluster standard errors at the (HS6-importer). *** p<0.01, ** p<0.05, * p<0.1.

6.2 Full Cumulation Scenario

In this section, we examine the impact of the EU enlargement on the supply chains of our group of Spoke countries. The results are presented in Table 6, which is divided into two panels presenting the OLS estimates of equations (15) and (16), respectively. Specifically, columns (1) and (2) analyze the changes in imports by each Spoke country from the other Spokes compared to imports from the RoW. In column (1), we only include the logarithm of our measure of EU-RoO based on EU-PECS treaty, while controlling for exporter characteristics. Column (2) incorporates the differences in the change of tariffs.

The coefficient of $\log r^{PECS}_{RoWk}$ is positive and has statistical significance. This indicates that when intermediates faced higher RoO restrictions during the PECS period, they experienced greater advantages in terms of international supply chains after the Spokes entered the EU. Indeed, the EU enlargement entailed the elimination of RoO for imports originating from the RoW countries. Specifically, the higher the EU-RoO measure for a specific intermediate k, the larger the increase in imports from the RoW relative to the other Spokes for that specific product k with EU enlargement. To be more precise, a 1% larger EU-RoO measure during PECS is associated with a 0.5% greater change in imports from the RoW compared to the other Spokes. The coefficient of the change in tariff is negative and significant, as anticipated. This suggests that an increase in relative tariffs towards RoW countries is expected to reduce imports from the RoW compared from other Spokes.

Columns (3) and (4) in Table 6 estimate our structural gravity model presented in equation (16). This model examines the changes in intermediate imports of each Spoke country from the RoW compared to imports from the EU15. In Column (3), we include only the logarithm of our EU-RoO measure, while controlling for exporter-fixed effects. Column (4) adds the differences in the change of tariffs as an additional variable. The coefficient of $\log r^{PECS}_{RoWk}$ is positive and statistically significant. This finding confirms our intuition discussed in equation (16): the higher the level of restriction imposed on product k prior to EU enlargement, the easier it becomes to import this product from the RoW relative to the EU15 after the EU enlargement. To be more precise, a 1% larger EU-RoO measure during PECS is associated with a 0.3% increase in imports from RoW compared to the EU15. The coefficient of the change in tariff remains negative and significant, as expected. This indicates that a relative increase in tariffs towards other Spokes impedes the relative imports from these origins.

The findings presented in Table 6 suggest that EU enlargement has had a relatively positive impact on global supply chains. It has allowed Spoke producers to reassess sourcing decisions without facing any restrictions and thus focusing on cost minimization. Consequently, there has been a shift in sourcing strategies compared to the PECS period, favoring RoW countries, rather than the PECS peripheral countries or the EU15. The underlying mechanism behind these results is related to the integration into the European Union, which eliminated RoO and expanded the range of countries from which intermediates can be obtained.

Table 6: Full cumulation and change in imports, Spokes vs. RoW and RoW vs. EU15

DEP. VAR:	$\Delta\log\left(\frac{X_{RoWjk}}{X_{SPjk}}\right)$		DEP. VAR:	$\Delta\log\left(\frac{X_{RoWjk}}{X_{EUjk}}\right)$	
	(1)	(2)		(3)	(4)
$\log r^{PECS}_{RoWk}$	0.653***	0.515***	$\log r^{PECS}_{RoWk}$	0.324***	0.330***
	(0.106)	(0.108)		(0.078)	(0.075)
$\Delta\log\left(\frac{\tau_{RoWjk}}{\tau_{EUjk}}\right)$		-1.613***	$\Delta\log\left(\frac{\tau_{RoWjk}}{\tau_{SPjk}}\right)$		-4.522***
		(0.494)			(0.178)
Observations	192,560	166,302	Observations	214,894	199,055
R-squared	0.027	0.033	R-squared	0.030	0.053
Exporters FE	Yes	Yes	Exporter FE	Yes	Yes

Notes: Changes refers to the period 2002-2006. OLS Estimation. In columns (1) and (2) the dependent variable is the difference between changes in log imports of intermediate k from the other Spokes with respect to the RoW. In columns (3) and (4) the dependent variable represents changes in log imports from the RoW and the corresponding change of imports from the EU15. $\Delta \log \tau_{jk}$ is the change in applied tariff. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovak Republic and Slovenia. Cluster standard errors at the (HS6-importer). *** p<0.01, ** p<0.05, * p<0.1.

6.3 Quantification

In this section we aim at quantifying the effect of the two episodes considered. For this purpose, we summarize in Table 7 the estimated coefficients for the variables of interest. Specifically, we report the estimated magnitude of $\log r_{SPk}^{PRE-PECS}$, as indicated in Tables 4 and 5 for the PECS episode, as well as the estimated magnitude of $\log r_{RoWk}^{PECS}$ for the EU enlargement, as displayed in Table 6. Furthermore, Table 7 provides the average $r_{SPk}^{PRE-PECS}$ and r_{RoWk}^{PECS} for each estimating sample, which we employ to quantify each episode in relation to the average intermediate input, in terms of the restrictiveness of RoO.

Examining the impact of diagonal cumulation introduced by PECS, which which left RoO only for RoW countries, we use the estimated coefficient from our EU-RoO measure, reported in column (3) of Table 4. Considering the average $r_{SPk}^{PRE-PECS}$ for the corresponding sample in Table 4, it implies that for Spokes countries transitioning from bilateral to diagonal cumulation, they move from a value of 1.45, representing an EU-RoO of 42.6%, to 1, indicating a 0% value restriction. However, restrictions towards RoW sources remain nearly unchanged at the pre-PECS level. We use our estimated elasticities to translate these changes in RoO restrictions in terms of imports growth rates. Our analysis reveals that for an intermediate facing an average $r_{SPk}^{PRE-PECS}$, diagonal cumulation increases imports of that intermediate from other Spokes countries relative to RoW by 11.7%.[29] This represents 65% of the average actual change in imports from Spokes countries relative to RoW.[30] This tells us that the elimination of RoO among PECS signatories results in a 65% increase in intermediate imports from Spokes. Our results can be compared to what has been found in the literature within the context of NAFTA. In particular, Conconi et al. (2018) found that NAFTA RoO reduced Mexican imports of intermediates from third countries relative to NAFTA countries by approximately 38%, which accounts for 44.209% of their average change in imports.

In contrast, when examining the average $r_{SPk}^{PRE-PECS}$ on the estimation sample used for the regression analysis comparing Spokes and EU15, our findings indicate that for an intermediate subject to the average RoO restriction, the implementation of diagonal cumulation results in an almost 29.7% increase in imports of that intermediate from other Spokes countries compared to EU15. This increase represents approximately 58.2% of the total relative growth in imports from these two sources.

Considering the EU enlargement episode and adopting a similar approach as described earlier, we find that using the average r_{RoWk}^{PECS} between RoW and Spokes, our estimations indicate that for an intermediate facing $\bar{r}_{RoWk}^{PECS}$, full cumulation leads to a 20.3% increase in imports of that intermediate from RoW countries compared to other Spokes countries. However, this figure represents a smaller proportion, 27%, of the total change in imports from

[29] Since we have a log-log model, we employ the formula $[(\bar{r}^{PRE-PECS}SPk)^{\hat{\beta}_2} - 1] \times 100$ to quantify the impact of cumulation on import growth rates. This calculation is performed for the product with the average level of restriction, denoted as $\bar{r}_{SPk}^{PRE-PECS}$.

[30] This is found by using the average logarithmic change in imports (which serves as dependent variable in equation 12) transformed into a percentage change: $[\exp(\Delta\log(X_{SPjk}) - \Delta\log(X_{RoWjk})) - 1] \times 100 = 18\%$. Subsequently, $\frac{11.7\%}{18\%} = 0.65$.

RoW countries relative to Spokes, in comparison to the estimates observed for the PECS episode. One potential explanation for this result is that the EU enlargement, compared to the introduction of diagonal cumulation via PECS, introduced a richer set of trade policies, other than changes in RoO, that affected the evolution of sourcing strategies.

In conclusion, when considering an intermediate facing the average r_{RoWk}^{PECS} on the estimation sample used for the regression analysis comparing RoW and EU15, full cumulation results in a 12.4% increase in imports of that intermediate from RoW countries relative to EU15. Interestingly, this represents a negative 23% of the average actual change in imports from RoW relative to EU15. This implies that on average, imports from the EU15 have experienced a faster growth rate following the EU enlargement compared to imports from RoW countries. This indicates that the impact of eliminating RoO via EU enlargement, which might have favored global supply chains, has been counterbalanced by factors that have also reinforced sourcing from countries within the EU15.

Table 7: Statistics for the Quantification

	PECS (diagonal cumulation)	
Exp 1 \ Exp 2	*RoW*	*EU*15
Spokes	$\hat{\beta}_2 = 0.299$, $\bar{r}_{SPk}^{PRE-PECS} = 1.450$	$\hat{\beta}_2 = 0.716$, $\bar{r}_{SPk}^{PRE-PECS} = 1.439$
	EU enlargement (full cumulation)	
Exp 1 \ Exp 2	*Spokes*	*EU*15
RoW	$\hat{\beta}_2 = 0.515$, $\bar{r}_{RoWk}^{PECS} = 1.432$	$\hat{\beta}_2 = 0.330$, $\bar{r}_{RoWk}^{PECS} = 1.426$

Notes: This table reports the magnitude of the elasticities associated to the diagonal cumlation (PECS) and full cumulation (EU enlargement). Exporter 1 and 2 refer to the comparison group of exporters under consideration. The $\bar{r}$ refers to the average r for each regression, thus avg(1 + EU-RoO/100).

6.4 Pre-Trends

In this section, we address potential endogeneity issues related to changes in trade policies by analyzing pre-trends. We retain a similar methodological specification as before, but shift our focus to the phase before RoO were implemented, particularly the 1992-1993 period.

During this timeframe, the EU had individual FTAs in place that did not incorporate RoO. However, starting from 1994, the EU began almost uniformly implementing RoO bilaterally between EU participants and the Spokes countries. These rules, included in the 1994 FTAs between the EU and several countries within BAFTA and CEFTA, imposed restrictions on inputs from other Spokes countries, as well as from the Rest of the World sources. Our aim is to investigate whether the severity of these RoO restrictions, characterized by the bilateral cumulation, significantly correlates with the trend of sourcing prior to the introduction of PECS. If such a correlation exists, it could introduce bias to our PECS event estimates if not properly accounted for.

However, our analysis is somewhat limited by the constraints of data availability, specifically relating to import flows and tariffs, confining our study to imports by Hungary. Hungary is the only country for which import flow data is reported for any period before 1995. Furthermore, our trade data for Hungary only begins in 1992, which limit our ability to track the evolution only over the 1992-1993 period.

To enable comparison of our pre-trend findings with those from a dataset that only includes Hungary, the lower section of Table 8 also presents results for the 1995-2002 period with Hungary as the sole importing country. Columns (1) and (2) reveal the results for changes in imports from RoW and Spokes, while the remaining columns correspond to the other comparison groups considered. Specifically, columns (3) and (4) depict the results for changes in imports from the Spokes countries and the EU15, as indicated by equation (13). Finally, columns (5) and (6) illustrate the results for changes in imports from RoW and EU15, as stated in equation (14). In each estimation, we use our EU-RoO measure constructed from the RoO restrictions included in the EU-Hungary trade treaty of 1994, as well as the relative changes in tariffs across groups. To consolidate results into a single table, we employ the universal notation $\Delta \log \tau_{jk}$, which nonetheless corresponds to changes in tariffs that are contingent on the countries under comparison.

The coefficients in the upper part of Table 8 relate to the sub-period 1992-1993 and should be contrasted with the coefficients in the lower part of the table, which refers to the sample period around PECS, i.e., 1995-2002. For the sub-period preceding PECS, the coefficients on $r_k^{PRE-PECS}$ are never statistically significant. This observation helps alleviate concerns about the potential impact of other confounding variables on the determination of how restrictive RoO had to be established for goods.

Table 8: Pre-Trends for the Case of Hungary

Dep Var:	Imports from Spoke vs. RoW		Imports from Spoke vs. EU15		Imports from RoW vs. EU15	
	(1)	(2)	(3)	(4)	(5)	(6)
Subsample$_{1992-1993}$						
$\log r_{ik}^{PRE-PECS}$	0.147	-0.001	-0.085	-0.128	-0.020	0.107
	(0.336)	(0.570)	(0.229)	(0.474)	(0.157)	(0.157)
$\Delta \log \tau_{jk}$		0.681		-0.867		0.040
		(1.711)		(3.096)		(0.490)
Observations	16,264	6,664	4,447	958	16,215	14,951
R-squared	0.268	0.339	0.000	0.000	0.353	0.367
Subsample$_{1995-2002}$						
$\log r_{SPk}^{PRE-PECS}$	1.291***	1.189***	0.249*	0.505***	-0.133	-0.284**
	(0.257)	(0.306)	(0.136)	(0.141)	(0.176)	(0.174)
$\Delta \log \tau_{jk}$	-6.085***	-6.042***		-3.416***		-1.699***
	(1.344)	(1.345)		(0.428)		(0.437)
$\Delta \log r_{RoWk}$		-0.307				
		(0.526)				
Observations	17,247	17,247	19,050	11,767	110,840	96,352
R-squared	0.070	0.070	0.000	0.001	0.087	0.091

Notes: OLS estimation using only Hungary as importing country with respect to our three groups of sourcing countries. In columns (1) and (2) we consider the difference between changes in log of intermediate imports from the rest of Spoke countries and the corresponding change of imports from the RoW. In columns (3) and (4), we consider the difference between changes in log of intermediate imports from the rest of the Spoke countries compared to changes of imports from the EU15. Finally in columns (5) and (6) we show the changes in log imports from the RoW relative to EU15. Columns (2), (4), and (6) add the control for $\Delta \log \tau_{jk}$, which represents the log changes in tariffs applied between the countries under comparison. The group of Spokes exporting countries includes: Czech Republic, Estonia, Lithuania, Latvia, and Poland.

6.5 Robustness and Sensitivity Analysis

In the following section, we present robustness checks to address potential limitations of our analysis. First, we change the set of Spoke sourcing countries, then we relax the assumption about sectoral trends.

To begin with, we modify the group of Spokes' exporting countries and only consider EFTA countries and Turkey, which were also part of the PECS during the period under analysis.[31] These countries were also excluded from the RoW exporting countries since they belong to the cumulation zone. Table 9 displays the results using as Spoke exporting countries and using instead only EFTA countries and Turkey, replacing then X_{SPjk} with X_{ETjk}. Specifically, columns (1) to (2) of Table 9 replicate Table 4, while columns (3) and (4) replicate Table 5. The coefficient of $r_{ETk}^{PRE-PECS}$ remains positive as in the regressions presented in Tables 4 and 5, while $\Delta \log r_{RoWk}$ remains statistically insignificant. We also conducted a separate analysis for industrial goods, which were explicitly part of the Agreement between Turkey and the EU, as Turkey did not join the Agreement for agricultural goods. The results for industrial products are consistent with our previous estimates, with elasticities being higher, which is in line with the larger substitution observed in previous studies for these types of goods.

[31] In 1999 the PECS system was widened to industrial products originating in Turkey (1999).

Table 9: PECS and change in imports, EFTA and Turkey vs RoW and vs EU

DEP. VAR:	$\Delta\log\left(\frac{X_{ETjk}}{X_{RoWjk}}\right)$		DEP. VAR:	$\Delta\log\left(\frac{X_{ETjk}}{X_{EUjk}}\right)$	
Products:	All	Industrial		All	Industrial
	(1)	(2)		(3)	(4)
$\log r_{ETk}^{PRE-PECS}$	0.799***	1.284***	$\log r_{ETk}^{PRE-PECS}$	1.214***	1.303***
	(0.196)	(0.171)		(0.168)	(0.189)
$\Delta\log\left(\frac{\tau_{ETjk}}{\tau_{RoWjk}}\right)$	-6.145***	-5.324***	$\Delta\log\left(\frac{\tau_{ETjk}}{\tau_{EUjk}}\right)$	-3.767***	-3.951***
	(1.133)	(1.898)		(0.885)	(1.077)
$\Delta\log r_{RoWk}$	0.376	-0.088			
	(0.408)	(0.965)			
Obs.	63,182	28,926	Obs.	7,735	7,277
R-squared	0.063	0.074	R-squared	0.008	0.008
Exporter FE	Yes	Yes	Exporter FE	Yes	Yes

Notes: OLS estimation. In columns (1) and (2) the dependent variable represents changes in log imports of intermediate k of each Spoke country from EFTA countries and Turkey compared to the change of imports from the RoW. In columns (3) and (4) the dependent variable represents changes in log imports of intermediate goods of each Spoke country from the RoW compared to the change of imports from the EU15. $\Delta\tau_j k$ is the change in applied tariff . Importing countries include: the Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland. Cluster standard errors at the (HS6-importer). * p<0.01, ** p<0.05, * p<0.1.

In Tables 10 and 11, we relax the assumption about technologies evolving with similar trends across products within each group of exporters, discussed in Section 5.1, and present robustness checks using exporter-sector fixed effects. Sectors are defined using the International standard industrial classification of all economic activities (ISIC) at the most granular level, i.e. 4-digits, which identifies 98 different activities involved in the production of manufacturing goods. This approach allows us to test the stability of our results by relaxing the assumption that comparative advantages are static, i.e., sectoral trends are similar within countries. Specifically, we allow product trends to vary across classes such as "Manufacture of aircraft and spacecraft" and "Manufacture of motor vehicles" among others. Table 10 replicates Tables 4 using exporter-sector fixed effects. The estimates reported in Tables 10 and 11 are consistent with those reported in Tables 4 and 6 respectively.

To further ensure the robustness of our estimates, in Table 18 of Appendix B we replace the exporter fixed effects (FE) with GDP growth rates. Additionally, we replace the exporter-sector fixed effects with GDP growth rates interacted with sectoral dummies. The coefficients of the GDP growth rates exhibit the expected signs, consistent with Equation 7 in our theoretical background. Note that the results remain stable, with elasticities ranging between 0.3% and 0.7%, even after introducing controls for differential sectoral-GDP growth rates, further supporting the reliability of our estimates.

Table 10: PECS and change in imports, Controlling for Sectoral-Exporter FE

DEP. VAR:	$\Delta\log\left(\frac{X_{SPjk}}{X_{RoWjk}}\right)$		$\Delta\log\left(\frac{X_{SPjk}}{X_{EUjk}}\right)$	$\Delta\log\left(\frac{X_{RoWjk}}{X_{EUjk}}\right)$
	(1)	(2)	(4)	(5)
$\log r_{SPk}^{PRE-PECS}$	0.752***	0.676**	0.178	
	(0.258)	(0.278)	(0.259)	
$\Delta \log r_{RoWk}$		-0.334		0.105
		(0.364)		(0.267)
$\Delta \log \tau_{jk}$	-4.192***	-4.231***	-0.662	-2.349***
	(0.718)	(0.720)	(0.574)	(0.431)
Observations	76,463	76,463	10,169	95,097
R-squared	0.153	0.153	0.037	0.178
Exp.× Sec. FE	Yes	Yes	Yes	Yes

Notes: Table 10 presents PECS results for the different comparison groups controlling for sector-exporter FE. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland. Cluster standard errors at the (HS6-importer). * p<0.01, ** p<0.05, * p<0.1. OLS estimation.

Table 11: Full cumulation, controlling for Sectoral-Exporter FE

DEP. VAR:	$\Delta\log\left(\frac{X_{RoWjk}}{X_{SPjk}}\right)$	$\Delta\log\left(\frac{X_{RoWjk}}{X_{EUjk}}\right)$
	(1)	(2)
$\log r_{RoWk}^{PECS}$	0.444***	0.583***
	(0.173)	(0.117)
$\Delta \log \tau_{jk}$	-0.955***	-4.775***
	(0.253)	(0.182)
Observations	164,791	197,512
R-squared	0.089	0.109
Exp.× Sec. FE	Yes	Yes

Notes: Table 11 presents results for the EU enlargement controlling for sector-exporter FE. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland, Slovak Republic and Slovenia. Cluster standard errors at the (HS6-importer). * p<0.01, ** p<0.05, * p<0.1. OLS estimation.

7 Conclusion

Preferential trade agreements have boomed in recent years. At the heart of FTAs there are RoO, and their corresponding cumulation rules. By determining the origin of a product, RoO defines whether a good qualifies for preferential access. Cumulation of origin rules defines whether a firm can use imported intermediate goods from a non-partner country without losing the preferential access to the FTA.

While the existing empirical literature has focused on the entry into force of FTAs and their RoO, this paper exploits the European context to evaluate the role of subsequent reductions in the restrictiveness of RoO. We focus on two events that resulted in a reduction in the restrictiveness of RoO: the implementation of the Pan-European Cumulation System (PECS) in 1997, which allowed for diagonal cumulation of RoO, and the introduction of full cumulation (elimination of RoO) for CEECs that joined the EU Customs Union following the European enlargement in 2004. Our results shed light on the regional and international supply chain effects by proposing a theoretical framework to guide our econometric approach.

We construct a new measure of RoO at the intermediate level from textual analysis of EU-FTAs agreements. Then, we analyze empirically the implications of a subsequent reduction in RoO restrictiveness at the intermediate level across HS6 intermediates considering various origin groups. Guided by our theoretical gravity equations, we can identify the effects of EU-RoO relaxation on Spokes' imports from different origin countries.

Our estimates suggest that a 1% larger value requirement is associated with a growth in intermediate imports from countries where restrictions are lifted, ranging from 0.3% to 0.7%. These increases can be attributed to the relaxation of RoO restrictions. Consequently, the shift in cumulation systems, initially facilitated by the PECS and later through the EU enlargement, has prompted a reassessment of sourcing decisions. The PECS strengthened regional production structures, while EU enlargement facilitated a smoother transition toward a global network of supply chains. This dynamic restructuring of supply chains highlights the significant impact that policy changes can have on global trade configurations.

The implications of our results are significant, especially in the context of the ongoing discourse around FTA and RoO. They suggest that a greater degree of flexibility in RoO may catalyze supply chain transformation and potentially enhance allocative efficiency.

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Appendix

Appendix A provides additional details on our data.

A Additional data and figures

Tables 12 and 13 show the list of countries included in our empirical analysis. From the group of countries, we exclude those with missing trade information.

Table 12: 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
Slovak Reb.	Slovenia	Greece
Slovenia	Slovakia	Ireland
	EFTA	Italy
		Luxembourg
		Netherlands
		Portugal
		Sweden
		Spain
		United Kingdom

Notes: Romania is not included in our sample of importing countries because it did not sign PECS with BAFTA. Similarly, we exclude Bulgaria, because it did not sign PECS with Latvia. Differently, Slovak Republic and Slovenia are not included in our sample of importing countries because of missing tariffs (1995-2001), but instead are included as importers for the EU enlargement episode. EFTA countries considered includes: Iceland, Norway, and Switzerland.

Table 13: 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 13 lists all the countries included in our empirical analysis. These are countries from which the Spoke countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Romania) reported positive imports in 1995 and/or 2002 and/or 2006. and with which our Spokes did not have free trade agreement (FTA) during our sample period.

Table 14: Frequencies of Rules by Classes

Rule Type	EU-BAFTA	EU-CEFTA	EU-PECS
VMU	588	592	2132
TECH	1178	1268	1135
CH	51	51	897
WHOLLY_OBT	166	159	447
CH, VMU	180	180	164
TECH, VMC	114	114	77
VMH	63	63	66
WHOLLY_OBT, VMC	2	2	61
TECH, CH, VMH	0	0	60
NO_rule	114	114	52
CH, VMC	40	40	51
CH, VMH	656	586	26
WHOLLY_OBT, CH	0	0	18
TECH, CH	20	20	18
HE	44	28	14
WHOLLY_OBT, VMU	0	0	13
CH, VMH, VMOH, VMU	14	14	12
TECH, VMOH	1	1	11
VMOH	18	18	8
WHOLLY_OBT, HE, VMOH	0	0	8
VMC	57	57	7
CS, VMS	5	5	7
CS	16	16	6
CC	0	0	5
WHOLLY_OBT, HE, VMC	0	0	3
TECH, CH, VMC	0	0	2
CH, VMH, VMOH	0	0	2
TECH, VMU	1	1	1
WHOLLY_OBT, TECH, VMC	2	2	0
CH, VMOH	2	2	0
CS, VMH	21	21	0
VMH, VMOH	39	39	0
VMH, VMU	563	555	0
VMU, VMC	60	60	0
VMOH, VMU	105	105	0
VMH, VMOH, VMU	11	11	0
CH, VMH, VMU	0	8	0

Notes: The figures reported are the number of HS6 covered by Rule Type in the three differents Trade Agreements analyside: EU-BAFTA, EU-CEFTA, EU-PECS.

Table 15: Preferential agreements providing for diagonal cumulation

	Czech Rep.	Estonia	Hungary	Latvia	Lithuania	Poland	Slovak Rep.	Slovenia
EU	97	97	97	97	97	97	96	97
Czech Rep.	—	97	97	97	97	97	97	97
Estonia	97	—	99	97	97	97	96	97
Hungary	97	99	—	00	00	97	97	97
Latvia	97	97	00	—	97	98	96	96
Lithuania	97	97	00	97	—	98	97	97
Poland	97	99	97	98	98	—	97	97
Slovak Rep.	97	96	97	97	97	97	—	97
Slovenia	97	96	97	97	97	97	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. Note that Slovak Republic and Slovenia are not included in our sample of importing countries in 1995 because of missing tariffs.

Table 16: Descriptive Statistics on Imports

	$Imports_{SP,SP}$			$Imports_{SP,RoW}$			$Imports_{SP,EU15}$		
	1995	2002	2006	1995	2002	2006	1995	2002	2006
Animal Products	180	315	1117	153	224	422	994	1042	2881
Chemicals	698	1202	2672	114	184	287	2695	6867	12091
Foodstuffs	684	1739	4130	200	256	371	3110	3800	7845
Footwear/Headgear	340	792	1506	59	130	258	1877	2554	4110
Machinery/Electrical	394	1077	3768	90	343	716	4729	10675	23348
Metals	530	959	2841	70	141	297	1845	4542	10990
Mineral Products	3675	12660	22524	3511	6073	13922	6403	10957	24439
Miscellaneous	207	570	1413	46	95	204	1902	2623	5437
Plastic/Rubbers	858	1775	4718	73	130	275	3697	12257	21948
Raw Hides,Skins,Leathers	202	519	919	63	104	189	2612	5864	8018
Stone/Glass	337	668	1454	31	62	144	1259	2473	3998
Textiles	164	396	674	38	72	116	1423	2356	2926
Transportation	1235	3244	11545	185	532	1042	9538	31909	63439
Vegetables	346	354	817	138	129	191	1090	1492	3345
Wood Products	847	1729	2908	67	109	209	2766	5412	8355

Notes: Values are in thousands of US$. $Import_{SP,SP}$, $Import_{SP,RoW}$, $Import_{SP,EU15}$ refer to average Spokes' imports from themselves, from the RoW, and from the EU15 respectively.

Table 17: Descriptive Statistics on Tariffs

	Avg. τ to Spoke			Avg. τ to RoW			Avg. τ to EU15		
	1995	2002	2006	1995	2002	2006	1995	2002	2006
Animal Products	9.8	12.0	6.5	10.2	14.5	2.4	9.9	12.5	2.9
Chemicals	6.3	5.0	3.3	5.0	4.3	1.5	5.6	2.6	1.8
Foodstuffs	16.6	20.7	12.3	15.7	19.0	5.5	16.3	18.9	5.9
Footwear/Headgear	11.5	10.2	5.6	10.0	6.8	2.8	10.4	5.0	2.9
Machinery/Electrical	7.0	4.8	2.1	5.9	4.0	1.5	6.1	2.7	1.5
Metals	6.7	6.0	3.0	5.8	5.2	2.2	6.4	3.3	2.3
Mineral Products	2.7	2.1	0.9	2.0	2.0	0.7	2.4	1.1	0.8
Miscellaneous	7.6	5.7	2.4	6.1	4.3	1.7	6.7	3.0	1.8
Plastic/Rubbers	8.6	6.8	3.9	7.2	5.8	2.3	7.6	3.8	2.3
Raw Hides,Skins,Leathers	8.9	7.5	3.2	7.9	5.0	2.2	8.4	3.4	2.2
Stone/Glass	8.4	7.1	2.9	7.3	6.1	1.6	7.5	4.6	1.7
Textiles	11.2	10.9	6.3	9.2	8.1	3.1	10.2	6.2	3.2
Transportation	8.1	7.3	4.1	7.1	6.3	2.5	8.0	4.1	2.6
Vegetables	8.4	8.7	5.0	7.6	8.4	1.6	8.4	7.5	1.9
Wood Products	7.5	5.8	1.8	6.1	4.8	1.8	6.5	3.2	1.8

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 Additional Robustness Checks

In Table 18 we replace the exporter fixed effects (FE) with GDP growth rates in columns (1), (3), (5), and (7). Additionally, we replace the exporter-sector fixed effects with GDP growth rates interacted with sectoral dummies in columns (2), (4), (6), and (8). The coef-

ficients of the GDP growth rates exhibit the expected signs, consistent with Equation 7 in our theoretical background. These coefficients can be seen as proxies for the technological evolution. For instance, when comparing imports from PECS countries to imports from countries outside the region (RoW), we observe that the former increases with logarithmic changes in GDP of the Spokes countries, while decreasing with changes in GDP from RoW countries.

Table 18: PECS and EU Enlargement change in imports, Controlling for GDP growth

	PECS (diagonal cumulation)				**EU Enlargement (full cumulation)**			
Comp. Groups	Sp. vs Row		Sp. vs EU15		RoW vs Sp		RoW vs EU15	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\log r_{ik}$	0.324**	0.669**	0.437***	0.233	0.702***	0.407**	0.341***	0.627***
	(0.149)	(0.293)	(0.149)	(0.259)	(0.108)	(0.173)	(0.080)	(0.122)
$\Delta \log r_{ik}$	-0.219	-0.417						
	(0.264)	(0.372)						
$\Delta log(GDP_{SP})$	0.571***		-1.537***		-			
	(0.167)		(0.071)		-			
$\Delta log(GDP_{RoW})$	-0.892***				0.243***		0.272***	
	(0.029)				(0.024)		(0.021)	
$\Delta log(GDP_{EU})$			-				-	
			-				-	
$\Delta \log \tau_{jk}$		-3.883***		-0.766		-0.871***		-4.090***
		(0.749)		(0.574)		(0.223)		(0.574)
$SEC \times \Delta log(GDP_{RoW})$	No	Yes	No	No	No	Yes	No	Yes
$SEC \times \Delta log(GDP_{SP})$	No	Yes	No	Yes	No	Yes	No	No
$SEC \times \Delta log(GDP_{EU})$	No	No	No	Yes	No	No	No	Yes
Observations	99,571	76,232	16,224	10,169	188,596	162,597	210,637	194,942
R-squared	0.012	0.037	0.023	0.068	0.040	0.036	0.012	0.039

Notes: This Table presents results for different comparison groups controlling for GDP growth rates in columns (1), (3), (5) and (7) and for GDP growth rates interacted with sectoral dummies in columns (2), (4), (6) and (8). Comparison groups are listed at the top. The dependent variable is changes in log imports between the comparison groups. Several explanatory variables hold a simplified notation. In particular $\log r_{ik}$ is $\log r_{SPk}^{PRE-PECS}$ for PECS, while $\log r_{RoWk}^{PECS}$ for the EU Enlargement. $\Delta \log \tau_{ii'jk}$ represents the log changes in tariffs applied between the countries under comparison. We use the symbol "-" to specify which variable are omitted. In particular, log GDP changes are omitted for the EU and Spokes counties when they are aggregated as a unique group. Importing countries include: Czech Republic, Estonia, Hungary, Lithuania, Latvia, and Poland, Slovak Republic and Slovenia. Slovak Republic and Slovenia have missing tariff information and thus are not included in the analysis of PECS. Sectors are ISIC Industries at 4 digits. Cluster standard errors at the (HS6-importer). * p<0.01, ** p<0.05, * p<0.1. OLS estimation.