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Food Value Chains in Landlocked Developing Countries:

Measuring Trade Costs and Barriers

Integrating **Landlocked**
Commodity Dependent Developing Countries
into **Regional and Global Value Chains**

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Abstract

This study analyses the comparative trade costs faced by landlocked developing countries (LLDCs) using both non-parametric and parametric techniques. The trade cost is analysed for one commodity in each of the four LLDCs covered: Lao People's Democratic Republic (maize); Ethiopia (coffee); Mongolia (meat); and Uzbekistan (processed fruits). The study also explores the sectoral trade costs for the agriculture sector of LLDCs. The analysis finds that (i) the international markets for each of these individual products is different in terms of size and openness; and (ii) landlocked countries typically have higher trade costs that other countries, but the impact of such costs on trade competitiveness varies depending on the product exported and the geographic pattern of trade of each country. These results imply that integration into regional trade areas and active use of trade policy by the authorities of LLDCs could be a fundamental tool to reduce the negative effect of geography in these countries.

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Acronyms and abbreviations

ASEAN ..... Association of Southeast Asian Nations

FTA..... Free trade agreement

HS..... Harmonized System

ISIC..... International Standard Industrial Classification of All Economic Activities

ISO ..... International Organization for Standardization

ITPD ..... International Trade and Production Database

ITPD-E..... International Trade and Production Database for Estimation

LLDC ..... Landlocked developing country

MFN..... Most Favoured Nation

PPML..... Pseudo-maximum likelihood Poisson estimator

PTA..... Preferential trade agreement

SGTM ..... Structural gravity trade model

UNCTAD..... United Nations Conference on Trade and Development

WITS..... World Integrated Trade Solution

WTO ..... World Trade Organization

1 Introduction

Landlocked developing countries (LLDCs) face unique challenges to their insertion in international value chains. These challenges are partly due to the fact that many LLDCs are commodity-dependent, in addition to their geographical location with no access to the sea. In particular, the latter factor substantially increases international trade costs, adding additional trade barriers to the tariff and non-tariff barriers faced by many developing countries (Carrere and Grigoriou 2011).

This study places LLDCs within the international trading context by exploring the trade costs for four commodities in four countries: coffee in Ethiopia; maize in Lao People's Democratic Republic (Lao People's Democratic Republic); meat in Mongolia; and processed fruit in Uzbekistan.[1] The particular geographic location of LLDCs, including commodity-dependent ones, adds to their trade costs. It is important to analyse the mechanisms through which trade costs influence these countries' international competitiveness. The specificity of LLDCs is captured in this study by estimating trade costs with a combined strategy that employs both non-parametric and parametric techniques.

Bilateral trade between a country of origin and a country of destination depends on two types of factors: first, the size of the economy that sells (supply, measured by the value of production) and the size of the economy that buys (demand, measured by the value of expenditure); and second, bilateral trade costs relative to domestic (within-country) trade costs. Additionally, these costs influence the selling and buying alternatives, respectively, of the seller and the buyer, which is called their "multilateral resistance." These measures show how close a country is to other markets to which it sells or from which it buys. The structural gravity model these two types of factors (size and trade costs) into a system that is capable of measuring trade costs using observed trade flows (Anderson and van Wincoop 2004; Yotov et al. 2016). Based on this general theoretical structure, non-parametric indicators are also developed to estimate the costs of trading, using observed data on bilateral trade flows.

The study of trade costs is conventional in the international trade literature. For this, non-parametric and parametric methods are used. The nonparametric strategy often used for measuring trade costs is based on Novy (2013). Arvis, Shepherd, Duval, Utoktham, and Raj (2015) implement the methodology using data from UN Comtrade.[2] Non-parametric methodologies are extensively used in different previous efforts to measure trade cost, in

[1] Processed fruit, which is sector 14 of the International Trade and Production Database, includes dried fruits (see Appendix A).

[2] The most recent version (July 2019) of the database used is available at: https://www.unescap.org/resources/escap-world-bank-trade-cost-database.

particular for developing countries. Examples of this are Jacks et al (2008), Moïsé E. and Sorescu (2008), Chen and Novy (2012), Xu and Liang (2017), and Utoktham and Duval (2020).

Parametric models provide a measure of the bilateral trade costs that each country or sector under study faces, accounting for their particular geography, in the form of multilateral resistances (Average Export and Import Prices). In this study, estimation of the gravitational models follows the methods used by Yotov et al. (2016). The methodological strategy is pursued at two levels of aggregation. First, estimation of trade costs of each country under analysis is conducted at the sectoral level for the agriculture sector (using data from sector A and B ISIC Rev. 3). Second, trade costs are estimated using trade data with a greater level of disaggregation and data for the product/sectors of interest: maize, coffee, meat, and processed fruit. Estimation of trade costs at the country-product level of disaggregation complements other work on market access carried out on each of these products within the framework of the UNCTAD project "Integrating Landlocked Commodity Dependent Developing Countries into Regional and Global Value Chains."[3]

Using these empirical methods, this study identifies the specific variables that affect trade costs in the four country-products under study. First, the study finds that markets for the four products of focus are different in terms of size and trade openness. Second, it confirms that landlocked countries have typically higher trade costs, but that their magnitudes vary depending on the product and trade pattern of different countries. If landlocked countries are part of a region with high levels of trade integration (i.e. low trade costs), they benefit from this and themselves are integrated, as is the case with European (developed) landlocked countries. Trade policy could also be a fundamental tool to help in reducing the negative effect of geography in LLDCs.

The next two sections present and apply the nonparametric methodology of Novy (2013) to the entire agriculture sector. The fourth section focuses on measuring trade costs of the four selected country-product pairs under study using the same non-parametric technique. Section five develops a parametric estimation at the aggregate and sectoral level for the four country-pairs. The final section summarizes results and highlights the main policy implications that emerge from the analysis.

[3] See Ferro (2021) for roasted coffee in Ethiopia, Cárcamo-Díaz (2020) for maize in Lao People's Democratic Republic, Gatulga (2021) for meat in Mongolia and Cárcamo-Díaz et al. (2021) for dried fruit in Uzbekistan.

2 Methodology for the non-parametric approach to estimating trade costs

2.1 Sectoral level

Sections 3 and 4 estimate trade costs using a non-parametric strategy based on Novy (2013) and its recent application in Arvis et al. (2015). The objective is to characterize intra- and extra-regional trade costs in the agriculture sector.[4]

The estimation in this section is based on the measured bilateral trade flows (x_{ijt}) from a country of origin (*i*) to a destination country (*j*) in a given year (*t*). In particular, it requires having information on domestic trade flows (x_{iit}). Symmetrical (*s*) proximities (ϕ^s_{ijt}) are calculated as the geometric average of bilateral flows $(x_{ijt}$ and $x_{jit})$, standardized by domestic trade $(x_{iit}$ and $x_{jjt})$. The calculation is as follows:

$$\phi^s_{ijt} = \left(\frac{x_{ijt}x_{jit}}{x_{iit}x_{jjt}}\right)^{\frac{1}{2}} = \left(\frac{\phi_{ijt}\phi_{jit}}{\phi_{iit}\phi_{jjt}}\right)^{\frac{1}{2}} \quad .(1)$$

To switch from symmetrical proximities to symmetrical costs of trade, the first indicator needs to be transformed using the elasticity of trade $(\theta = \sigma - 1)$.[5] This is a function of the elasticity of substitution among different origins (σ). Expressing symmetrical trade costs as an ad valorem tariff equivalent (τ^s_{ij}):

$$\phi^s_{ijt} = \left(1 + \tau^s_{ijt}\right)^{-\theta} = \left(1 + \tau^s_{ijt}\right)^{1-\sigma} \Leftrightarrow \tau^s_{ijt} = \left(\phi^s_{ijt}\right)^{\frac{1}{1-\sigma}} - 1. \quad (2)$$

The empirical estimation of trade costs uses a value of trade elasticity of 6, a value close to that reported by Head and Mayer (2015) as the average of a set of structural model estimates. Trade costs include the ad valorem tariff component (t^s_{ijt}) and other trade costs

(i.e. non-tariffs) $(\underline{\tau}^s_{ijt})$, as detailed in the following equation:[6]

$$\left(1 + \tau^s_{ijt}\right) = \left(1 + t'^s_{ijt}\right)\left(1 + \underline{\tau}^s_{ijt}\right). \quad (3)$$

---

[4] See table A1 in Appendix A for the definition of each region of the world.

[5] See Appendix C for the connection between the Novy index and the gravity trade model.

[6] See that $\left(1 + t'^s_{ijt}\right) = \left(1 + t^s_{ij}\right)^{\frac{-\sigma}{(1-\sigma)}} = \left(\left(1 + t_{ijt}\right)\left(1 + t_{jit}\right)\right)^{\frac{-\sigma}{2(1-\sigma)}}$ and $\left(1 + \underline{\tau}^s_{ijt}\right) = \left(\frac{(1+\underline{\tau}_{ijt})(1+\underline{\tau}_{jit})}{(1+\tau_{iit})(1+\tau_{jjt})}\right)^{1/2}$. The derivation of the equation is explained in equation C11 in Appendix C.

The results obtained allow for a description of the intra- and extra-regional integration levels from a comparative perspective. Moreover, it is feasible to disaggregate trade costs (or proximities) into their tariff and non-tariff components (see equation 3), which are presented in ad valorem equivalent terms.

The measure of trade costs presented takes into account both horizontal heterogeneity (differences among regions) and changes over time. Typically, proximity should display a range of variation between zero and one (see equation 1), and, by construction, if one of the bilateral flows is zero the indicator collapses to zero. The indicator reaches its maximum when the origin equals destination (intra-national trade).[7] Novy´s index assumes a certain degree of balance in bilateral trade, which tends to be satisfied when working at the aggregate level. Nevertheless, caution is advised when working with a single sector or product. Because of this last characteristic, the next section proposes a new indicator at the product level.

Despite the analytical and conceptual richness of the indicator introduced by Novy (2013), some weaknesses arise from the assumptions on which it is based. In particular, the requirement of (near) balanced trade on a bilateral basis and the consequent penalization of unbalanced flows mean that a higher productive and commercial specialization is associated with less relative proximity to other countries. In such cases, the restriction of symmetrical proximities between countries of a given pair is lifted. These caveats are considered in the analysis at the product level and the parametric analysis, where the symmetry assumption is not applied.

2.2 Product level

In order to calculate trade costs at the product level when there are no trade flows in both directions, this section modifies the Novy index of trade costs in order to deal with cases where there are exports but not imports. The objective is to use a non-parametric measure that approximates trade costs in a more general situation of unbalanced flows. It is based on the trade intensity indicator obtained using bilateral trade as a proportion of the importer's expenditure $\left(\frac{x_{ijt}}{x_{jt}}\right)$ in relation to the exporter's share of world production $\left(\frac{y_{it}}{y_{wt}}\right)$. Trade intensity (TI) is defined as follows:

$$TI_{ijt} = \frac{x_{ijt}/x_{jt}}{y_{it}/y_{wt}}. \quad (4)$$

In the gravity trade model literature (Agnosteva et al. 2014), a similar index is defined and referred to by the authors as constructed trade bias (*CTB*):

[7] We refer to "intra-national" trade when talking about internal sales within an individual economy.

$$CTB_{ijt} = \frac{\hat{x}_{ijt}/x_{jt}}{y_{it}/y_{wt}} = \frac{\phi_{ijt}}{\Omega_{it}\Phi_{jt}}, \quad (5)$$

where Ω_{it} is the multilateral resistance of the exporter, and Φ_{jt} is the multilateral resistance of the importer.

The only difference between TI and CTB is that the latter uses estimated bilateral trade flows employing a gravity model instead of observed flows.[8] In a frictionless world (without trade costs), the index must be one because the share of bilateral trade in the expenditure of the buyer country (x_{ijt}/x_{jt}) is equal to the share of the production of the seller in world supply (y_{it}/y_{wt}).

In particular, one can define the country's trading intensity to sell in its own market $\left(TIti_{iit} = \frac{x_{iit}/x_{it}}{y_{it}/y_w}\right)$. Each exporter's bilateral relationship can be expressed as a proportion of the trade intensity with its own domestic market. This index is called the expenditure dependence (ED) ratio, which is a ratio of the two shares: sales from country *i* to country *j* in total expenditure of country *j*, and sales from country *i* to country *i* in total expenditure of country *i*. This can be interpreted using the gravity model.[9] It is equal to the relative proximity of the exporter *i* to importer j normalized by own-exporter *i* trade costs $\left(\phi_{ijt}/\phi_{iit}\right)$ as a proportion of relative multilateral resistance as buyers $\left(\Phi_{jt}/\Phi_{it}\right)$:

$$ED_{ijt} = \frac{TI_{ijt}}{TI_{iit}} = \frac{x_{ijt}/x_{jt}}{x_{iit}/x_{it}} = \frac{\phi_{ijt}/\phi_{iit}}{\Phi_{jt}/\Phi_{it}} \quad .(6)$$

[8] Then the relation between the two is the following: $TI_{ijt} = CTB_{ijt}\eta_{ijt}$, where η_{ijt} is the stochastic error term in the estimation of the gravity trade model.

[9] Agnosteva et al. (2014) define a similar index, which they call a constructed interregional bias (CIB): $CIB_{ijt} = \frac{CIB_{ijt}}{CIB_{iit}} = \frac{\hat{x}_{ijt}/x_{jt}}{\hat{x}_{iit}/x_{it}}$. The rationale for the denomination is that they are working in the context of intra-regional differences inside a country.

3 Agriculture trade costs

3.1 Results for agriculture, aggregated by region

The proximity indicator is applied to international trade, [10] and the corresponding trade costs are applied as an ad valorem tariff equivalent for the agriculture sector.[11] The distribution and heterogeneity between countries and regions according to proximity indicators can be observed in figure B1 in Appendix B.

For easy comparison and display of the indicator, an ordinal ranking is used that decreases in proximity for both countries and regions. The value 1 of the ranking is the country (region) with the highest value on the proximity index (lower trade costs).

Table 1. Proximity ranking by region, 2015

Ranking	Agriculture		
	Total	Intra-regional	Extra-regional
1	NAM	NAM	NAM
2	EUR	EUR	CAM
3	CAM	ERS	SEA
4	SEA	PAC	ERS
5	ERS	CAM	SAM
6	SAM	MEA	EAS
7	EAS	SEA	PAC
8	PAC	EAS	EUR
9	SAS	SAM	CAR
10	MEA	SAS	AFR
11	CAR	CAR	SAS
12	AFR	AFR	MEA
13	CAS	CAS	CAS

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), and South East Asia (SEA). See table A1 in Appendix A.

[10] All the proximity indicators presented in this section are trade-weighted averages. See equations C13 to C16 in Appendix C.

[11] The range of values for the estimated total proximity indicator, considering the entire period (1995–2015), are from a minimum of 0.000018 (787 per cent in ad-valorem tariff equivalent) to a maximum of 0.061255 (177 per cent in ad-valorem tariff equivalent). See Appendix A for a definition of the agriculture sector.

Table 1 illustrates the positions of each region among the 13 regions used according to their global, intra-regional and extra-regional proximity as of 2015. The region with the closest proximity (considering intra- and extra-regional trade together) is North America. It is number one in the ranking both in global and intra-regional terms and second when extra-regional trade is considered. Europe has the second highest degree of proximity or relative integration. Regional integration is particularly strong there compared to its relative position outside the region. This may be explained by the high protection of the agriculture sector in the European Union. This study pays particular attention to regions (highlighted in green in table 1) where landlocked countries of interest are located: Mongolia in East Asia, Lao People's Democratic Republic in South East Asia, Uzbekistan in Central Asia, and Ethiopia in the Africa.

Note that the third closest region globally is Central America, due to its high level of integration with the economy of the United States. Central America is also the second-highest ranked region in extra-regional proximity. The rankings of these three regions as the most integrated with the world remain constant during the entire period under review (1995–2015). The rest of the regions are located in lower positions with similar magnitudes and without important changes over time.

The world improved its global proximity (i.e. experienced a reduction in its trade costs) during the period under study, as during this period of 21 years the global proximity indicator grew by 3 per cent.[12] South East Asia is the fourth region in the ranking, and during the sample period it reduced its global proximity by 3 per cent (it became less integrated), mainly in intra-regional terms. Eurasia, 5th in the ranking, grew 67 per cent, and is also ranked in the third position in terms of intra-regional proximity. South Asia grew 84 per cent in its proximity, but is still very low in comparison with other regions. Importantly, some of the regions of interest (i.e. those containing the targeted landlocked countries) had a poor performance. While East Asia increased its proximity by 38 per cent and ranks 7th in the overall ranking, Africa and Central Asia are both at the bottom of the ranking, with the highest trade costs and with a reduction of proximity over time of -21 per cent (Africa) and -48 per cent (Central Asia) (see table B.1 in Appendix B).

As shown in equation 2, the close relationship between proximity and trade costs, and the disaggregation of the latter into their tariff and non-tariff component, allows for extracting several salient and policy-relevant findings from the empirical analysis.

First, the analysis indicates that the average applied tariff in 2015 for the agriculture sector worldwide was 15.7 per cent, while non-tariff costs amounted to 248.6 per cent worldwide (table 2). Trade costs are measured relative to intra-national trade costs, including all those

[12] Global proximity is computed in a similar way as regional indicators weighting national proximity by trade (see equation C16 in Appendix C).

factors that explain the differences between domestic and international trade costs, identified by Anderson and van Wincoop (2003) as the "border effect."

The reduction of tariff costs was fairly homogeneous at a horizontal level (among regions), with South East Asia and Africa being the regions with the largest reductions (-57.5 and -53.1 per cent). In contrast, Eurasia showed a small increase of 1.3 per cent. On average, the world reduced tariff costs by -33.2 per cent between 2015 and 1995 (table 2).

As presented in the last column of table 2, the behaviour of non-tariff costs was also homogenous. On average at the global level, non-tariff costs increased by 11.9 per cent.[13]

Table 2. Breakdown of trade cost tariff and non-tariff barriers, 1995 and 2015
(per cent)

Region [a)]	1995			2015			Variation		
	Tariff	Non_T	Total	Tariff	Non_T	Total	Tariff	Non_T	Total
NAM	16.1	156.0	206.4	10.8	164.7	199.2	-33.4	5.6	-3.4
EUR	15.4	184.0	237.5	10.3	194.6	231.4	-33.2	5.8	-2.6
CAM	19.0	209.2	281.3	11.8	238.4	287.1	-37.9	14.0	2.1
SEA	31.6	181.2	285.1	13.4	234.5	287.5	-57.5	29.4	0.9
ERS	18.4	252.9	332.1	18.6	219.2	289.9	1.3	-13.3	-12.7
SAM	18.1	227.7	299.9	13.3	241.3	296.2	-26.5	6.0	-1.2
EAS	29.8	216.3	330.2	18.4	230.2	303.1	-38.5	6.5	-8.2
PAC	14.9	247.9	310.9	8.7	274.6	313.8	-41.8	10.8	0.9
SAS	50.1	221.9	416.2	27.6	245.2	358.1	-44.9	10.5	-14.0
MEA	38.0	235.7	375.2	19.7	274.5	360.3	-48.1	16.5	-4.0
CAR	17.4	257.4	332.3	14.7	291.7	360.7	-15.7	13.3	8.5
AFR	36.9	220.4	348.1	17.3	287.2	369.8	-53.1	30.3	6.2
CAS	20.8	282.3	375.4	20.1	335.7	442.4	-3.0	18.9	17.9
Total	**25.1**	**222.5**	**317.7**	**15.7**	**248.6**	**315.4**	**-33.2**	**11.9**	**-0.7**

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

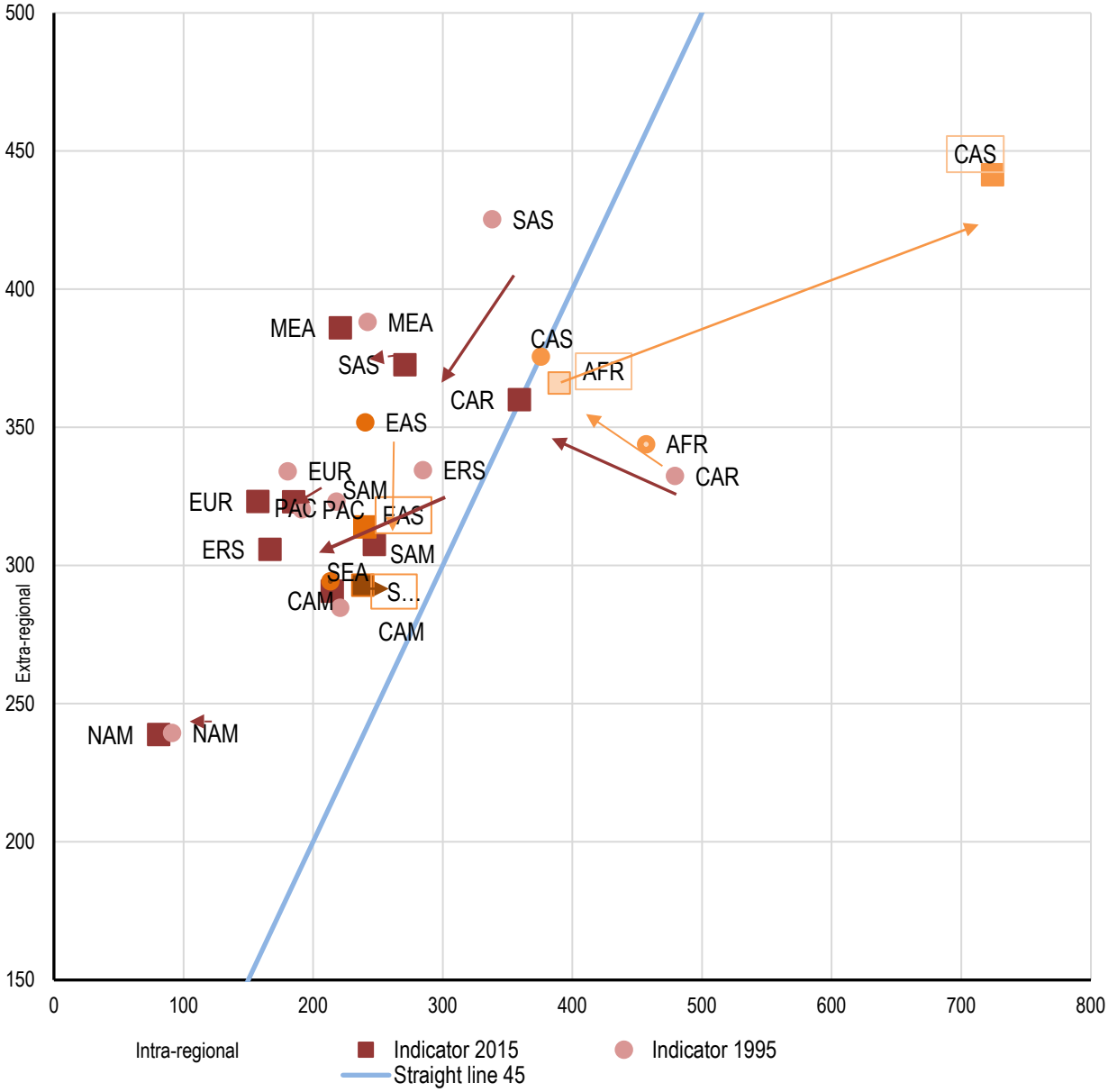
Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), and South East Asia (SEA). See table A1 in Appendix A.

Figure 1 shows the changes in intra- and extra-regional trade costs between 1995 and 2015 across the different regions. North America was the most integrated region (lower trade costs) at the beginning of the study period, and its integration increased over the years, especially at the intra-regional level. Europe was the second most integrated region at the beginning of the

[13] Part of the lower reduction in East Asia is due to the high levels of the indicator expressed as ad valorem equivalents. Eurasia is the only region that reduced non-tariff costs (-13.3 per cent), while Africa, South East Asia and Central Asia had the highest increase in non-tariff costs (30.3 per cent, 29.4 per cent, and 18.9 per cent, respectively).

period and deepened that process with greater intra-regional integration. In contrast, South East Asia reduced its integration over time, especially within the region itself.

Figure 1. Intra- and extra-regional trade costs in ad valorem equivalents by region, 1995 and 2015
(per cent)



Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), South East Asia (SEA). See table A1 in Appendix A. Extra-regional axis starts from 150, for a better visualization.

Regions that include landlocked countries of interest (South East Asia, East Asia, Central Asia and Africa) have differences in both their position (green squares for 2015 and circles for 1995 trade costs in figure 1) and their behaviour over time (arrows represent changes from 1995 to

2015). Importantly, the behaviour of intra- and extra-regional proximity is heterogeneous among them. South East Asia has a relatively high extra-regional proximity (third in the ranking worldwide), while the other regions are in the middle of the ranking (East Asia), or even in the lowest ranking (Africa and Central Asia) (table 1). This is because South East Asia and East Asia are shaped by bigger and diversified economies such as China, Japan and the Republic of Korea, which favours regional integration for Lao People's Democratic Republic and Mongolia. On the other end of the spectrum, Central Asia and Africa are among the least-integrated regions in the world. Central Asia is made up of three countries (Uzbekistan, Kazakhstan and Turkmenistan) that were part of the former Union of Soviet Socialist Republics.

In the sample, the Africa region is composed of 23 countries that cover the African continent as a whole. Several structural and historically persistent challenges, including those of a political, social and geographical nature, have negatively impacted the degree of intra-regional integration in Africa. Finally, South East Asia includes Lao People's Democratic Republic and another five countries (Indonesia, Philippines, Thailand, Viet Nam and Singapore)

As explained previously, among these four regions, South East Asia has the greatest extra-regional proximity for the agricultural sector, followed by East Asia and Africa (see column 3 of table 1). As South East Asia has one of the largest potential food markets in the world, at the extra-regional level this region has the highest proximity after Central and North American countries.

The behaviour is analysed over time for the period from 1995 to 2015. Central Asia is the most isolated region that also increased its trade costs in both components: extra-regional by 17 per cent and intra-regional by 93 per cent (see table B1 in Appendix B). Although Africa is also remote, especially intra-regionally, it reduced its intra-regional trade costs (-15 per cent) while its extra-regional trade costs increased (6 per cent). East Asia reduced extra-regional trade costs by -11 per cent and saw no change in intra-regional trade costs. The performance of South East Asia is different: extra-regional trade costs declined slightly during the period by 1 per cent but intra-regional trade costs increased by 12 per cent.[14]

3.2 Dissagregated results: individual economies

The previous analysis of trade costs of the agriculture sector, which focused on differences across world regions, is enhanced by looking at the behaviour of each individual economy. In particular, it is interesting to study selected landlocked countries by applying the same indicators and ranking to the 114 individual economies that make up the sample. Table B2 in

[14] For a graphic visualization of figure 1 and its values, see table B3 in Appendix B.

Appendix B also presents the global, intra-regional and extra-regional rankings, as well as the best-located economies (i.e. closest) by region.

Figure 2 illustrates the relative positions in the ranking of intra- and extra-regional trade costs for selected economies in the different regions.[15] The figure provides elements in favour of the central hypothesis that poor performance in terms of intra-regional trade is explained by less proximity (resulting in high trade costs). Abstracting from permanent trade costs (physical distance, common language, geographic continuity) and the existence of trade agreements, the remaining intra-regional trade costs are considerably high, and have trended that way over the past two decades without any consistent downward dynamic.

For the overall agriculture sector, North America has the closest extra-regional proximity. Mexico is the number one country in the ranking due to its high degree of integration with the United States economy. The United States itself and Canada are among the 10 most integrated countries, according to the global proximity ranking (see table B2 in Appendix B). Among the 20 economies with greater proximity (low trade costs) 14 are in Europe, with three European countries among the top five. Hong Kong (China) from the East Asia region is 10th in the ranking, Costa Rica (Central America) is 15th, and Viet Nam (South East Asia) is 16th.

This result can be attributed to two factors. First, intra-regional proximity dominates over extra-regional proximity. Second, when some countries show significant levels of both intra- and extra-regional proximity, it is due to their strong links to one of the major hubs of world trade (i.e. United States, European Union, China).

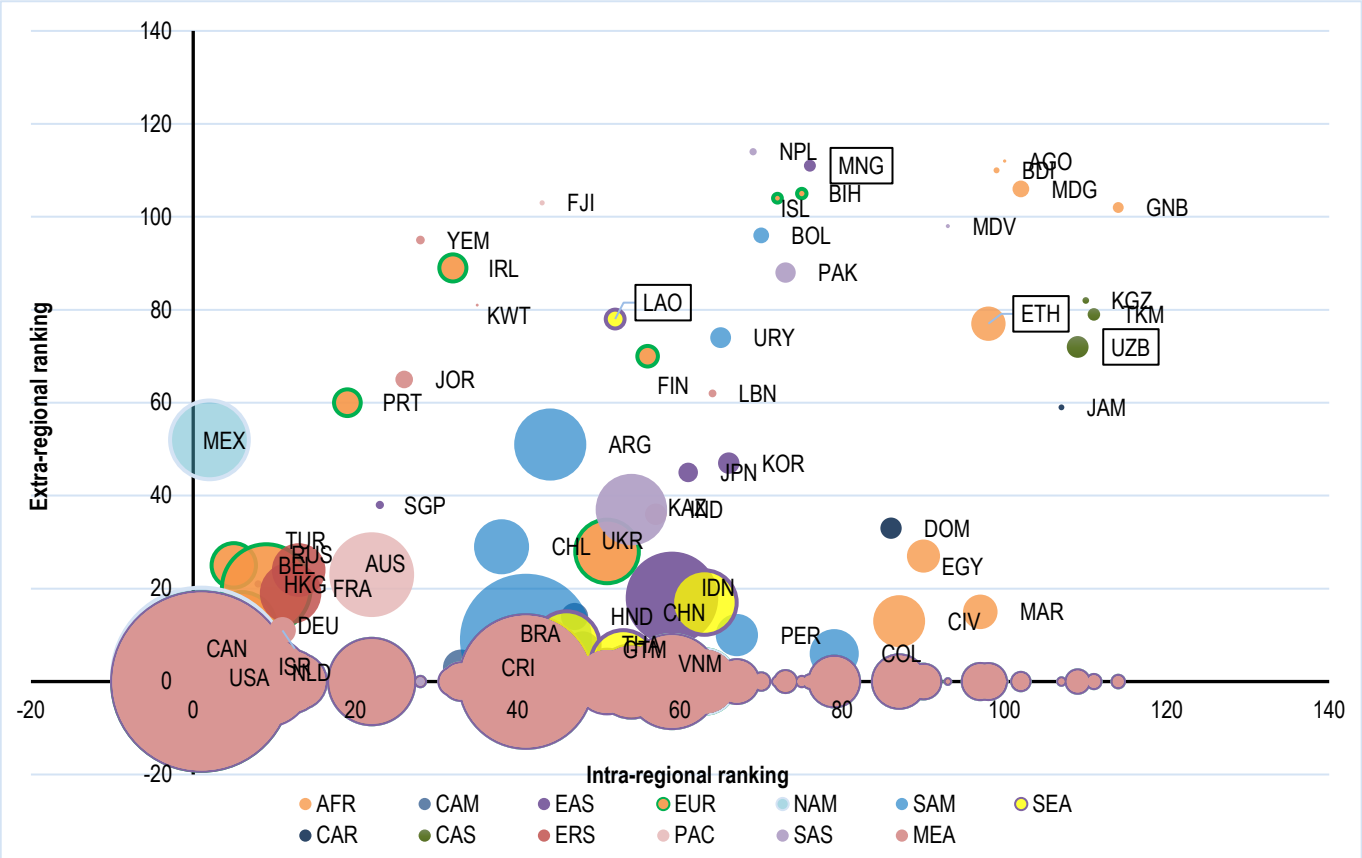
The first evidence of both factors is that countries in high positions in the total rankings are also in high positions in the intra-regional ranking (e.g. Mexico). Second, countries in regions that do not include one of the large hubs tend to have more extra-regional than intra-regional proximity. For example, Colombia, Brazil and Peru (South America) have greater extra-regional proximity. Costa Rica, Guatemala and Honduras (Central America) also have high extra-regional proximity because of strong links with the United States. Morocco, Ivory Coast (Africa), and Israel (Middle East) have strong links with Europe, and Thailand and Viet Nam (South East Asia) have strong links with China (figure 2).

The Russian Federation is another main pole of attraction for regional trade, with close trade ties with countries that previously belonged to the USSR, such as Uzbekistan. Other countries of interest for this study, such as Ethiopia, are among the most distant countries from the rest of the world, ranking 96th globally and 98th in intra-regional trade. Mongolia, an East Asian country, is also poorly integrated with the rest of the world (87th at the global level and 111th

[15] For the identification of countries, code ISO 3166-1 alpha-3 is used to facilitate visualizations in figures and tables. For a full list of country names and their corresponding ISO alpha-3 codes, see https://wits.worldbank.org/WITS/wits/WITSHELP/Content/Codes/Country_Codes.htm

in the extra-regional ranking). Finally, Lao People's Democratic Republic, which is located in East Asia, is close to the world average (65th in the global ranking) and is characterized by being more intra- regionally than extra-regionally integrated.

Figure 2. Intra- and extra-regional proximity ranking by economy, 2015



Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Dimension of the areas represents the value of total exports in 2015. The squares highlight the four targeted countries: Ethiopia (ETH), Lao People's Democratic Republic (LAO), Mongolia (MNG) and Uzbekistan (UZB). Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), and South East Asia (SEA). See table A1 in Appendix A.

Table 3 completes the evaluation of the landlocked countries in the sample. Of the 114 economies analysed, the 19 landlocked countries are distributed in 9 of the 13 regions. Not surprisingly, landlocked countries located in Europe (none of which is a commodity-dependent LLDC) are the ones with the lowest trade costs. The top four of them in Europe are members of the European Union (Austria, Czechia, Hungary and Slovakia) This indicates that trade policy and integration with large markets reduce trade costs linked to geography. However, trade costs are still at least 15 per cent higher than in the European region as a whole. Mixed in this first grouping are Paraguay and Kazakhstan, which are characterized by some advances in trade openness and market access during the period. Lao People's Democratic Republic has higher trade costs than its region (South East Asia), but is in a process of convergence with the regional level. Between 1995 and 2015, Lao People's Democratic

Republic was one of the landlocked countries that showed the greatest reduction in trade costs (-22 per cent). At the bottom of the table are African countries with trade costs that are almost three times higher than those of the European countries. Burundi, at the bottom of the list, even registered a high increase in its trade costs during the period

Table 3. Tariff and non-tariff equivalent trade cost for landlocked countries, 1995 and 2015
(per cent)

Country	1995			2015			Variation		
	Tariff	Non_T	Total	Tariff	Non_T	Total	Tariff	Non_T	Total
Austria	13.3	242.8	298.4	9.2	229.3	265.9	-31.2	-5.6	-10.9
Czechia	14.4	249.3	310.4	9.1	232.6	269.4	-36.5	-6.7	-13.2
Hungary	22.3	245.6	340.2	9.1	236.3	273.3	-59.4	-3.8	-19.7
Slovakia	12.1	261.3	314.6	8.5	246.1	281.8	-29.8	-5.8	-10.4
Paraguay	14.7	268.8	334.6	12.5	267.4	323.2	-14.7	-0.5	-3.4
Belarus	20.6	354.7	469.4	12.3	272.1	327.4	-40.6	-23.3	-30.2
Kazakhstan	20.0	402.7	525.7	13.0	269.5	328.0	-34.9	-33.1	-37.6
Switzerland	38.7	187.7	325.9	25.5	236.4	341.7	-34.1	25.9	4.8
Lao People's Democratic Republic	30.5	293.3	441.2	12.1	286.3	343.3	-60.2	-2.4	-22.2
Malawi	28.1	215.0	324.0	17.3	319.4	408.1	-38.3	48.5	26.0
Mongolia	24.3	297.6	416.3	12.0	348.2	413.5	-50.7	17.0	-0.7
Bolivia (Plurinational State of)	14.5	305.3	376.7	14.0	344.5	420.4	-2.9	12.8	11.6
Uzbekistan	24.5	243.6	346.7	20.8	326.7	435.5	-14.9	34.2	25.6
Nepal	9.3	479.6	544.7	13.8	363.2	441.1	48.9	-24.3	-19.0
Ethiopia	38.6	241.4	405.2	24.5	319.9	446.3	-36.5	32.5	10.1
Turkmenistan	12.4	358.8	427.9	22.1	334.5	452.0	78.0	-6.8	5.6
Kyrgyzstan	11.1	417.0	486.5	12.5	394.4	469.7	13.0	-5.4	-3.5
Uganda	29.5	293.1	435.9	19.8	368.9	482.7	-32.7	25.9	10.7
Burundi	38.8	196.2	338.9	15.7	483.4	595.0	-59.5	146.4	75.6

AFR CAS EAS ERS EUR SAM SAS SEA

Source: Prepared by the author using the database developed by Moncarz et al. (2021).
Note: Regions: Africa (AFR), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), South America (SAM), South Asia (SAS), and South East Asia (SEA). See table A1 in Appendix A.

Mongolia benefits economically from bordering China, its main trading partner, as the latter experienced a well-known trade boom during the period. During this period, Mongolia slightly improved its total proximity, particularly as a result of better intra-regional proximity, reducing its trade costs by approximately 10 per cent from 1995 to 2015.

Even though Mongolia has a vast territory, barely 1 per cent of it is suitable for cultivation due to its extreme continental climate and topography (World Bank, 2003). Agricultural production is devoted essentially to livestock farming and exports mainly of wool, including cashmere. Consequently, Mongolia is one of the least-integrated countries in the world (87th globally and

111th in the extra-regional rankings), and its closest proximity is to countries in its region, East Asia (see table B2 in Appendix B).

Unlike Mongolia, which is located in a neighbourhood of countries that saw a dynamic evolution of trade over 1995–2015, Ethiopia is in a region that trades relatively little intra-regionally (Table 1). It is one of the most populous countries in the world, with 100 million inhabitants and a high population growth rate.[16] Agriculture is the cornerstone of the economy. Exports are almost entirely comprised of agricultural commodities such as coffee, seeds, pulses and livestock products.[17] Although it is one of the most distant countries in the global proximity ranking (96th out of 114), its extra-regional integration ranking (77th) is better than its intra-regional one (98th), as its main trading partners are from outside its continent (Saudi Arabia, China and India). During the study period, Ethiopia's proximity ranking worsened, particularly its extra-regional proximity: in 1995 it ranked 80th in global proximity and 59th in extra-regional proximity.

Uzbekistan, like other Central Asian countries, has close ties to the Russian Federation, including trade and economic ties. While Uzbekistan's economy has a strong state presence, many reforms carried out after independence have had positive results in terms of trade growth (OECD, 2017). Uzbekistan ranked 93rd in global proximity in 2015 compared to 60th in 1995.

Uzbekistan's main trading partners are from outside the Central Asia region, namely the Russian Federation, China and European countries. The main agricultural export is cotton, which was once Uzbekistan's main source of income but has lost importance since independence, when wheat began to gain prominence. Uzbekistan is the largest producer of jute in Western Asia and also produces significant quantities of silk, fruit and vegetables. In particular, the fruit sector, including dried fruit, constitutes an important part of the agricultural sector in terms not only of current production and exports, but especially in terms of growth potential (Cárcamo-Díaz et al. 2021).

Finally, Lao People's Democratic Republic was able to implement some economic reforms that contributed to great progress in its trade integration during the period of analysis. Currently, the country occupies average positions in global proximity (65th), while at the beginning of the period it was at the bottom of the list (100th). This is mainly due to greater intra-regional proximity (52nd) than extra-regional (78th) proximity, although in both directions

[16] https://www.worldbank.org/en/country/ethiopia

[17] Mitiku Tebeka (2021) points out that the coffee industry is essential for the Ethiopian economy, bringing in nearly US$715 million of export revenues in 2016 (41.5 per cent of total Ethiopian exports) and playing a vital role as a source of income for about one-fourth of the country's population.

Lao People's Democratic Republic showed significant progress over time, as in 1995 it ranked 59th and 100th, respectively (figure 2).

Viet Nam and Thailand are Lao People's Democratic Republic's main trade partners within South East Asia. Though the country's main exports are minerals, agriculture is also an important economic activity, especially in terms of employment and as a source of income in rural areas. The agriculture sector accounts for 10 per cent of the country's GDP. The main food crop is rice, which is also imported to cover domestic demand. Cárcamo-Díaz (2020) points out that after rice, maize is the second largest crop by planted area in Lao People's Democratic Republic. Additionally, one of the county's main agricultural exports is bananas. Finally, livestock is also important. Lao People's Democratic Republic mainly exports livestock products to China, a bordering country and main trading partner.

4 Landlocked countries and target products

4.1 Maize export performance in Lao People's Democratic Republic

Over 2000–2016, more than 125 countries reported maize production.[18] World production of maize is basically geared toward domestic market demand, while there are small numbers of large exporters that supply most imports. However, during 2000–2016 there was an increase in exports (openness of production) from 11 to 16 per cent. In 2016, 10 producers accounted for more than three-quarters of world production (77.9 per cent), although their share of consumption was somewhat smaller (68 per cent).

The four countries with the highest export specialization are the United States, Brazil, Argentina and Ukraine. Two other countries of note in the maize trade are Mexico, which has as an importer specialization and France, which registers the two specializations together as exporter and importer country. The rest of the countries with importance in global production (China, Indonesia, India and the Philippines) do not have trade specialization: that is, their own production satisfies mainly their domestic demand. Except for the United States, openness for the export-specialized countries increased during the period. Lao People's Democratic Republic appears to be an export country, with a share of export orientation a bit greater than the world average in 2016. In 2017, maize was the second largest crop by planted area in Lao People's Democratic Republic, and the agriculture sector accounted for 10 per cent of the country's GDP (Cárcamo-Díaz 2020).

The structure of international trade is analysed with an origin-destination matrix grouped by region, selecting flows representing more than 1 per cent of world trade. Exports are concentrated in Europe, North America, South America and Eurasia. Import specialization is much more diversified in 9 of the 13 regions. The cases of Europe and North America are highlighted where export and import trade flows can be verified simultaneously. In addition, both regions record the world's largest intraregional maize flows.

In 2016, exports from South East Asia to East Asia coincided with the flow from Lao People's Democratic Republic to China. Another highlight is that the East Asian region ranks first in terms of net imports (US$6.4 billion in 2016) due to the rapid increase in the consumption of animal feed in the region in parallel with the increase in animal protein consumption.

[18] See Appendix A for the data characteristics of the sector and the set of Harmonized System (HS) codes included in it. In section 3, the data set for the whole agriculture sector employs a sample of 114 countries. Starting in section 4, as specified in Appendix A, the data set is expanded to include almost all countries in the world (see https://www.usitc.gov/data/gravity/itpde.htm)

In 2000, 28 landlocked countries were maize producers, and this number increased to 29 by 2016. Table 4 presents data on the largest maize producers within the group of 16 landlocked countries. Lao People's Democratic Republic is one of five countries with export specialization alongside Hungary, Serbia, Paraguay and Zambia (highlighted in yellow in table 4). The countries specializing in imports are Malawi and Zimbabwe (green). The rest are non-specialized countries characterized by consuming their own production without generating relevant excess demand or supply.

Table 4. Main landlocked maize producers, 2000 and 2016
(millions of United States dollars and per cent)

Country	2000			2016			2000		2016	
	Internal Trade	Production (P)	Consumption (C)	Internal Trade	Production (P)	Consumption (C)	Export /P	Import /C	Export /P	Import /C
Ethiopia	320	320	320	1,460	1,460	1,467	0.0	0.1	0.0	0.5
Hungary	264	448	275	508	1,097	602	41.0	4.0	53.7	15.6
Serbia	0	0	0	712	1,004	731	0.0	0.0	29.0	2.6
Malawi	278	280	280	717	721	856	0.7	0.8	0.6	16.3
Paraguay	66	89	76	240	626	288	26.1	13.2	61.7	16.9
Nepal	181	181	181	599	599	706	0.0	0.0	0.0	15.2
Burkina Faso	37	39	37	494	495	494	3.7	0.3	0.1	0.0
Mali	23	23	23	493	493	493	2.0	0.0	0.0	0.0
Switzerland	44	60	55	17	441	67	26.4	19.0	96.1	74.1
Belarus	4	4	19	414	414	461	0.0	77.9	0.0	10.1
Zimbabwe	327	332	329	332	333	634	1.2	0.5	0.3	47.7
Zambia	311	315	313	114	322	116	1.3	0.6	64.6	2.0
Austria	161	188	194	103	304	311	14.1	16.9	66.1	66.9
Bolivia (Plurinational State of)	112	115	114	275	286	294	2.3	1.3	4.0	6.5
Lao People's Democratic Republic	8	8	8	230	285	231	0.5	0.9	19.3	0.4
Slovakia	21	37	25	164	243	210	44.1	17.1	32.6	22.0
Subtotal	2,157	2,438	2,248	6,871	9,122	7,963	11.5	4.0	24.7	13.7
Share (per cent)	91.4	92.0	89.5	89.4	90.7	88.1				
Landlocked	2,360	2,649	2,513	7,686	10,055	9,038	10.9	6.1	23.6	15.0

Source: Prepared by the author using data from the International Trade and Production Database.

This section now turns to analysing the asymmetric index from the exporter point of view, which involves the trade intensity and expenditure dependence indicators (*TI* and *ED*, see

equations 4 and 6 in Section 2).[19] In this case it is not necessary to rely on a country having balanced trade, as in the case of Novy's index. Both the *TI* and *ED* indicators were calculated for major trade flows in 2016.[20] The Novy trade cost index could only be computed for two bilateral relationships, which indicates the relevance of using different measurements of trade costs. Table 5 shows these indicators for landlocked exporting countries. Novy's index is not defined (due to lack of bilateral maize trade flows), or shows very low values, which accounts for the asymmetry in the maize trade relationship.

Exports from Lao People's Democratic Republic to China appear in table 5 for 2016, reflecting the increase in maize production and regional exports between 2000 and 2016. In this case, both the trade intensity and dependence expenditure ratio are low. Take into account that we are considering a trade flow from a new exporter (Lao People's Democratic Republic) to the largest maize consumption market in the world (China), which is characterized by a trade pattern of non-specialization (with a high level of self-supply).

Table 5. Landlocked maize exporting countries' main bilateral trade in 2016: Trade intensity and expenditure dependence
(millions of United States dollars and ratios)

Exporter-Importer	2000			2016				
	Bilateral trade	Trade intensity	Expenditure dependence ratio	Bilateral trade	Trade intensity	Expenditure dependence ratio	Novy	Equivalent tariff Novy
Switzerland-Iran (Islamic Republic of)	0	n.a.	n.a.	297	74.1	0.638	n.a.	n.a.
Paraguay-Brazil	23	6.3	0.007	228	8.8	0.033	0.005	192.8
Hungary-Italy	10	1.4	0.007	161	13.1	0.086	0.001	290.3
Switzerland-Israel	15	190.7	0.157	125	161.3	1.388	n.a.	n.a.
Zambia-Malawi	0	0.1	0.001	97	69.4	0.115	n.a.	n.a.
Zambia-Zimbabwe	1	0.5	0.002	92	89.2	0.148	0.001	298.9
Austria-Italy	6	2.0	0.005	86	25.3	0.117	0.004	203.1
Hungary-Austria	7	7.5	0.039	81	47.1	0.309	0.012	140.7
Hungary-Germany	11	4.9	0.025	68	10.8	0.071	0.000	408.5
Hungary-Romania	3	0.7	0.004	61	8.4	0.055	0.003	220.9
Serbia-Bosnia and Herzegovina	0	n.a.	n.a.	52	44.9	0.233	0.000	399.5
Serbia-Iran (Islamic Republic of)	0	n.a.	n.a.	45	4.9	0.026	n.a.	n.a.
Hungary-Russian Federation	13	10.4	0.054	45	6.6	0.043	0.000	965.5
Lao People's Democratic Republic-China	0	0.0	0.000	41	0.5	0.001	n.a.	n.a.

[19] It is not feasible, as in the case of Novy's index, to make a transformation to express this index in equivalent tariffs terms.
[20] Major trade flows were more than US$300 million in 2016.

Exporter-Importer	2000			2016				
	Bilateral trade	Trade intensity	Expenditure dependence ratio	Bilateral trade	Trade intensity	Expenditure dependence ratio	Novy	Equivalent tariff Novy
Austria-Germany	5	5.3	0.013	38	21.7	0.100	0.014	133.2
Serbia-Spain	0	n.a.	n.a.	36	3.7	0.019	0.000	1,089.6
Paraguay-Republic of Korea	0	n.a.	n.a.	33	5.3	0.020	n.a.	n.a.
Hungary-Slovakia	3	22.1	0.114	30	25.8	0.169	0.001	272.3
Serbia-Slovenia	0	0.0	0.000	30	77.8	0.405	0.000	500.7
Hungary-Ukraine	12	8.6	0.044	29	4.7	0.031	0.000	549.2
Slovakia -Austria	0	2.6	0.001	26	67.1	0.105	0.007	173.0
Serbia-Republic of Korea	0	n.a.	n.a.	20	2.1	0.011	n.a.	n.a.

Source: Prepared by the author using data from the International Trade and Production Database.

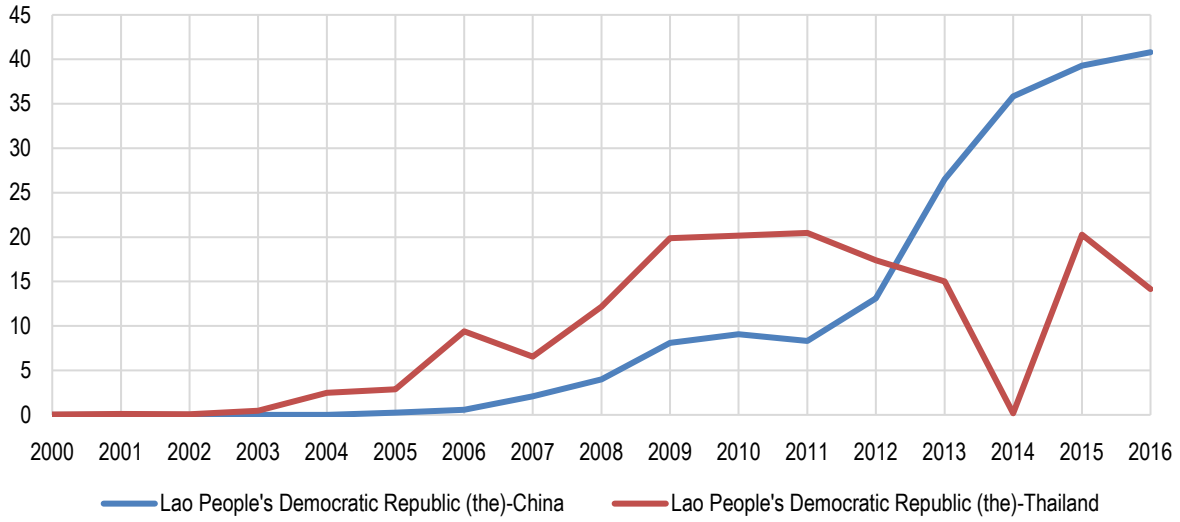
Note: ISO3 per exporter and importer are used to identify bilateral relationships. For a full list of country names and their corresponding ISO3 codes, see: https://wits.worldbank.org/WITS/wits/WITSHELP/Content/Codes/Country_Codes.htm

According to available disaggregated international trade data, Lao People's Democratic Republic has only two markets relevant to its maize exports,[21] Thailand and China, with the importance of the latter increasing after 2011 (figure 3).

Maize is one of the most important export products of the Lao People's Democratic Republic agriculture and forestry sector. The central feature of Lao People's Democratic Republic's international insertion into maize exports is its orientation towards the regional market, especially China. Late in the first decade of the 2000s, China began to import maize, but in small proportions. In 2016, only 1 per cent of total Chinese consumption was imported. A major supplier was the United States, which was then replaced by Ukraine (figure 3).

[21] Using information from a national survey, Cárcamo-Díaz (2020) points out that key export destination markets include China, Thailand and Viet Nam, all countries where maize produced in the country is used as an input for the growing animal feed sectors. As indicated in that study, there are data issues that affect the adequate measurement of maize trade flows in Lao People's Democratic Republic.

Figure 3. Markets for Lao People's Democratic Republic exports, 2000–2016
(millions of United States dollars)

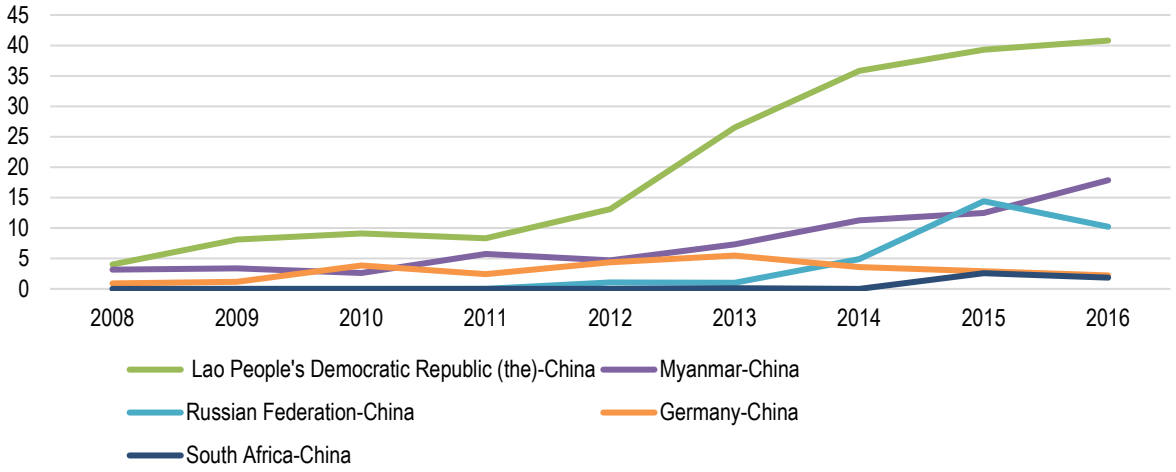


Source: Prepared by the author using data from the International Trade and Production Database.

In Lao People's Democratic Republic, maize production increased six times over between 1998 and 2018, from 0.11 to 0.77 million tons (Cárcamo-Díaz 2021). A similar growth pattern happened in the neighbouring countries: China's production increased 93.4 per cent, Thailand's production increased 8.4 per cent and Viet Nam's production increased twofold. By comparison, maize production in Lao People's Democratic Republic is much smaller than that of its neighbour trading partners.[22]

[22] Cárcamo-Díaz (2020) shows that in 2018, Lao maize production was 15.3 per cent of Thailand's production of 5 million tons, 15.8 per cent of Viet Nam's production of 4.87 million tons, and only 0.3 per cent of China's production of 257.17 million tons.

Figure 4. Origin of China's imports, 2000–2016
(millions of United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.

The value of the trade intensity indicator of maize trade between Lao People's Democratic Republic and China is extremely low as a result of the large dimensions of the Chinese maize market. The value of the trade intensity indicator between Lao People's Democratic Republic and Thailand is larger because, although Thailand specializes in maize exports, it periodically imports maize from Lao People's Democratic Republic. As expected, Lao People's Democratic Republic's largest trade intensity value is registered vis-à-vis its own market. About 80 per cent of consumption is supplied with domestic production (x_{llt}/x_{lt}), while its share of global supply is marginal (y_{lt}/y_w). Figure 5 presents the evolution of the trade intensity index for Lao People's Democratic Republic's own market, China and Thailand.

Export dependence is simply the ratio of trade intensity to this index in the domestic market, which is high for Lao People's Democratic Republic. Export trade costs relative to domestic ones are high. Recent performance indicates that the trend is towards reducing trade costs. However, this occurs at an extraordinarily high level of equivalent tariffs. High trade costs translate into low export prices for Lao producers.

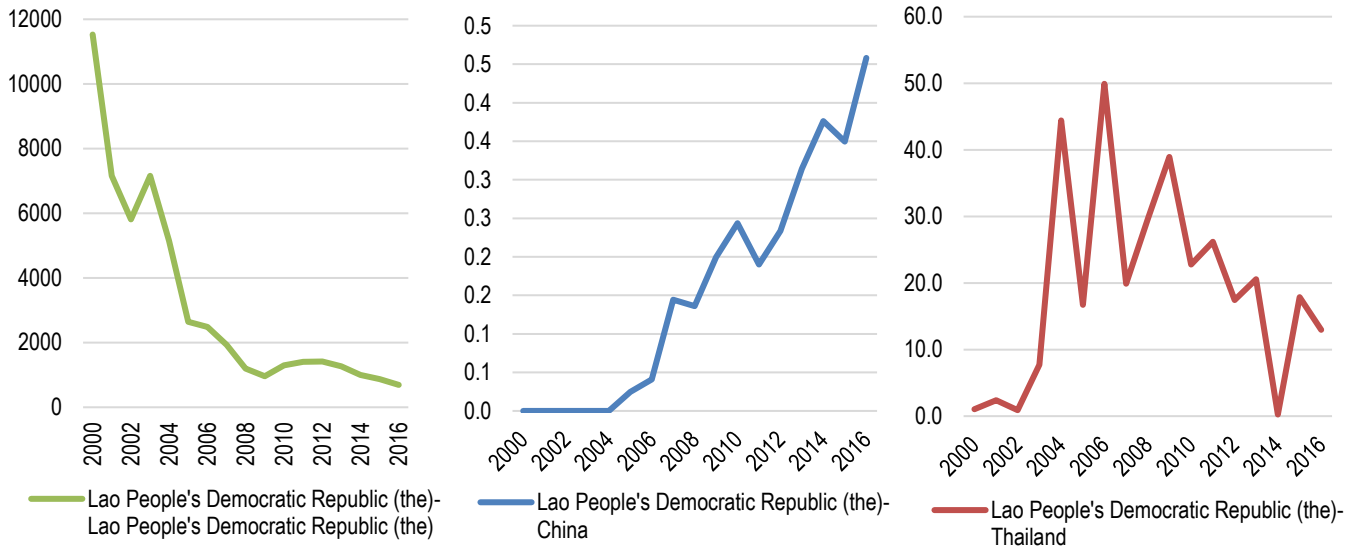
In addition to geographic proximity and the existence of maize demand in the border areas of neighboring countries that drive maize exports, Lao People's Democratic Republic has had a free trade agreement (FTA) with China since 2005. However, until the end of 2016, access was made by paying the Most Favoured Nation (MFN) tariff on the main export product (100590 of the HS), as trade liberalization started later for this product.[23] Lao People's Democratic Republic entered the Chinese market under enhanced protection because its production is always smaller than Chinese imports, so market conditions (domestic prices) do

[23] More recent tariff data is available on the ASEAN website at http://tariff-finder.asean.org/index.php?page=search2.

not change. Further liberalization will only result in increases in export prices without changing the conditions of protection in the Chinese market. Any reduction in tariff payment becomes an export price increase. The situation is different with Thailand, regarding which Lao production is higher than its imports.

China's applied tariff to maize from Lao People's Democratic Republic was reduced to 50 per cent, which means a tariff preference of 15 per cent over all other exporters without an agreement. This preference is shared with Thailand, which also participates in the same FTA. It should be noted that only members of the Association of Southeast Asian Nations (ASEAN) exporting maize to China have this preferential access. Deepening this preference on the Chinese market would be advantageous to maize exporters from Lao People's Democratic Republic to further improve access conditions and better integrate the sector into a regional value chain. The main destination of maize production is to be used as an input in the animal feed industry (especially for pigs and poultry).

Figure 5. Trade intensity for Lao exports of maize, 2000–2016 (index)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: See Index definition in equation (4).

4.2 Coffee and Ethiopia's export performance

Over 2000–2016, more than 120 countries recorded some level of coffee and tea production.[24] Production on the coffee and tea world market is open to international trade, although over

[24] See Appendix A for the data characteristics of the sector and the set of HS codes included in it that justifies why the two products (coffee and tea) are considered together.

2000–2016 there was a reduction in trade openness of production (exports/production) from 74 to 63 per cent.

Data obtained from the International Trade and Production Database (ITPD, Appendix A) have some missing elements that warrant discussion. Some countries have all the information required to calculate intra-national trade, production and consumption. From the set of countries for which intra-national trade data were available, there were 10 big producers in the world in 2016. [25] The countries with export specialization were Brazil, Kenya, Honduras, Ethiopia and Nicaragua. As one of the four landlocked developing countries of special interest for this study, Ethiopia is among the countries highlighted in the subsample of main producers in this market. Japan stands out as an important importer, while India and Indonesia register the import and export specializations combined. The rest of the countries are without trade specialization: their own production satisfies mainly their own domestic demand (China and Thailand).[26]

However, there is a set of important participants in the international coffee market for which only international trade information available. Fourteen countries account for more than 90 per cent of the aggregated trade of this sample. Most of them (Viet Nam, Colombia, Sri Lanka, Peru, Guatemala, Uganda, Costa Rica, Mexico and the United Republic of Tanzania) have an export specialization orientation, according to the available information. Two countries have an import specialization pattern: Germany and the United Kingdom. The other three countries in the sample (Belgium, Poland and Armenia) have a two-sided trade specialization pattern.[27] Ethiopia stands out as one of the largest producers in the world. During the period under study, export orientation increased significantly.

The structure of international trade of coffee and tea shows that the biggest inter-regional flow of trade in this sector is between South America and Europe, followed by the flow between South America and North America. These flows are largely dominated by coffee exports from large producers and exporters like Brazil and Colombia to importing countries in Europe, the United States and Canada. Exporting regions are Southeast Asia, South Asia, Africa, Central America and South America. Regions with that specialize in imports are a bit more diversified, including 7 of the 13 world regions. Europe, North America and East Asia account for more

[25] Production in the coffee and tea market is split among different suppliers. Ten big producers account for 62.9 per cent of world production, but their share of consumption is much smaller (38.6 per cent). Consumption, on the other hand, is more diversified, as 90 per cent of world consumption is split among 40 countries.

[26] This is especially the case for China, which drinks much more tea, to a large degree produced domestically, than coffee, which is imported.

[27] Many European countries such as Switzerland and the Netherlands export roasted or soluble coffee.

than three-quarters of world imports. The main markets for African exports are Europe, South Asia and intra-regional trade with neighbouring countries on the continent.

In 2000, there were 35 landlocked countries that were coffee and tea producers, and this number increased to 37 in 2016. Table 6 presents data for the 10 largest coffee and tea producers within the landlocked countries group. Ethiopia has the largest production within this group, and has an export specialization pattern similar to Lao People's Democratic Republic, Burundi and Nepal. Uganda, Rwanda, Malawi and Zimbabwe are also major exporters, but there is no information of intra-national trade, so for those countries it is not possible to calculate trade specialization ratios.

Table 6. Trade specialization by main landlocked coffee and tea producers, 2000 and 2016
(millions of United States dollars and per cent)

Country	2000			2016			2000		2016	
	Internal Trade (IT)	Production (P)	Consumption (C)	Internal Trade (IT)	Production (P)	Consumption (C)	Export /P	Import /C	Export /P	Import /C
Ethiopia	110	375	112	66	865	66	70.7	1.7	92.4	0.3
Uganda	0	237	1	0	498	2				
Rwanda	0	42	0	0	102	0				
Lao People's Democratic Republic	39	58	39	39	95	40	32.7	0.0	58.7	0.9
Malawi	0	83	0	0	83	0				
Burundi	43	98	44	1	78	1	55.5	0.1	99.2	2.6
Paraguay	22	24	23	27	30	30	4.7	2.2	11.1	11.3
Bolivia (Plurinational State of)	12	26	13	19	29	21	53.6	7.7	33.7	10.5
Zimbabwe	0	35	0	0	27	3				
Nepal	1	1	1	1	14	2	47.3	51.3	95.0	61.9
Sample top 10	228	978	233	152	1821	166				
Landlocked with IT	228	611	732	153	1224	1341	62.7	68.9	87.5	88.6
Share (per cent)	100	60	100	100	63	100				
Landlocked	228	1016	733	153	1934	1347	77.6	68.9	92.1	88.7

Source: Prepared by the author using data from the International Trade and Production Database.

Table 7 presents both the trade intensity and expenditure dependence indicators for those landlocked countries with important bilateral exports of coffee and tea. Novy´s index is not defined in almost all cases due to the asymmetry in trade of this sector. Among the 19 selected bilateral trade flows of landlocked countries presented in table 7, nine are exports with an Ethiopian origin (red) and the rest are from other landlocked African countries (Uganda, Malawi and Rwanda). Both the trade intensity and expenditure dependence ratio indicators could be calculated for Ethiopia. The data show that the three main importers of Ethiopian coffee and tea exports are Germany, Saudi Arabia and the United States, with trade intensity

and expenditure dependence indicators being largest for exports to Saudi Arabia. This indicates that trade costs are the lowest for this bilateral trade flow.

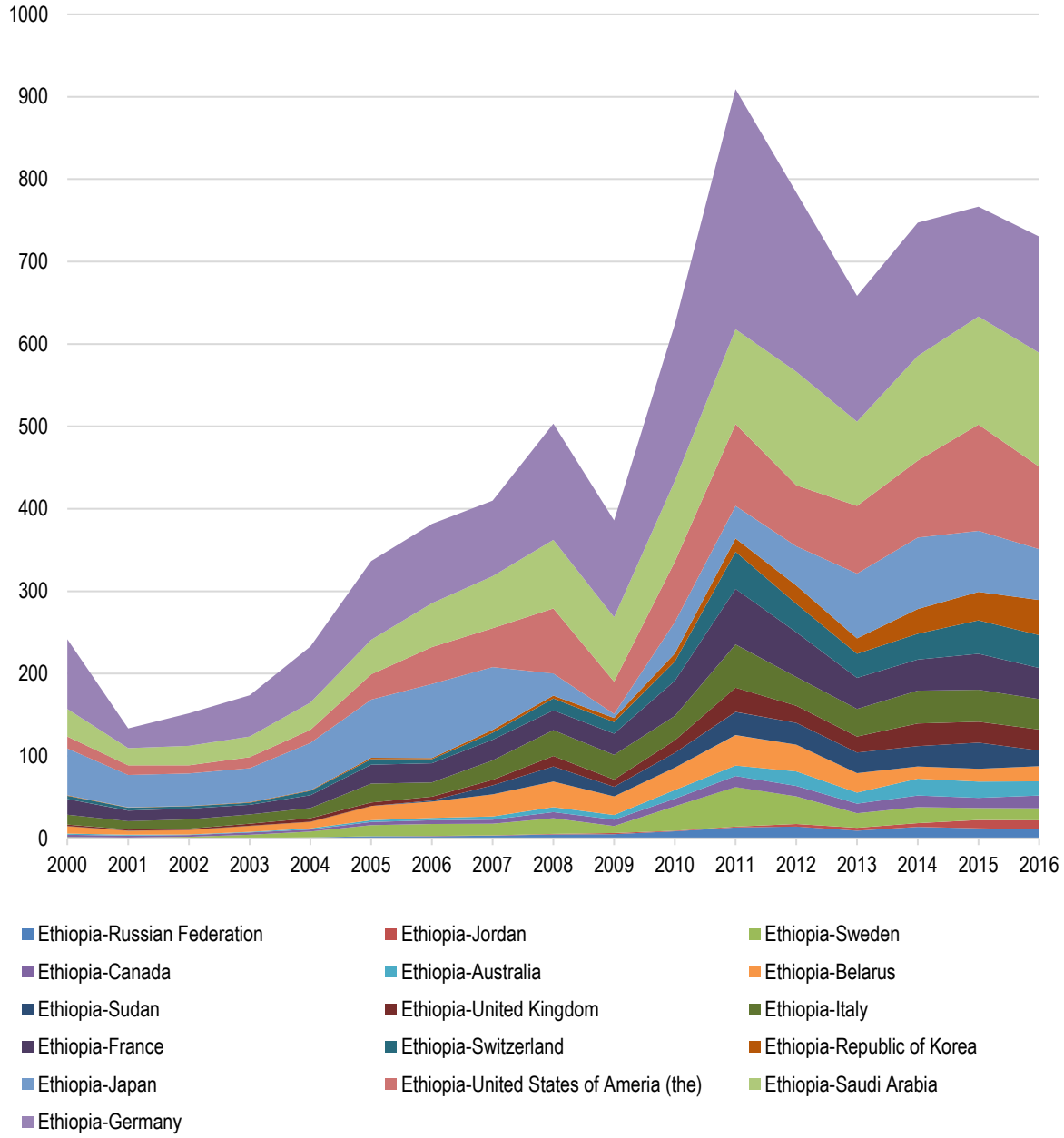
Table 7. Landlocked coffee exporting countries' main bilateral trade in 2016: Trade intensity and expenditure dependence
(millions of United States dollars and index)

Exporter-Importer	2000			2016		
	Bilateral trade	Trade intensity	Expenditure dependence ratio	Bilateral Trade	Trade intensity	Expenditure dependence ratio
Ethiopia-Germany	85	2.4	0.055	141	2.1	0.04
Ethiopia-Saudi Arabia	34	8.3	0.191	138	26.8	0.56
Ethiopia-United States of America (the)	15	0.2	0.006	100	0.9	0.02
Uganda-Italy	22	2.4	0.000	83	4.6	n.a.
Uganda-Kenya	37	20.3	0.000	78	16.8	n.a.
Uganda-Germany	31	1.4	0.000	72	1.9	n.a.
Ethiopia-Japan	57	0.8	0.019	62	1.2	0.02
Uganda-Sudan	8	12.0	0.000	55	61.7	n.a.
Ethiopia-Republic of Korea	1	0.2	0.005	43	4.7	0.10
Ethiopia-Switzerland	4	1.0	0.024	40	3.0	0.06
Ethiopia-France	19	1.5	0.035	38	2.6	0.05
Ethiopia-Italy	12	0.8	0.019	37	1.2	0.02
Rwanda-Pakistan	8	13.9	0.000	32	26.9	n.a.
Uganda-Belgium	10	2.4	0.000	31	3.1	n.a.
Malawi-South Africa	6	17.2	0.000	28	130.4	n.a.
Ethiopia-United Kingdom	2	0.2	0.004	25	1.3	0.03
Switzerland-Israel	3	140.9	0.000	25	309.7	n.a.
Uganda-United States of America (the)	14	0.4	0.000	24	0.4	n.a.
Malawi-United States of America (the)	12	0.9	0.000	23	2.1	n.a.

Source: Prepared by the author using data from the International Trade and Production Database.

Ethiopia's coffee and tea exports reach more than 50 countries, but 16 of those countries accounted for 90 per cent of exports in 2016. Figure 6 presents the evolution of these export flows between 1995 and 2016 for this set of 16 countries. Note that the countries' increase in coffee and tea export can be associated with an increase in the diversification of destinations: while in 2000 the first four markets (Germany, Japan, Saudi Arabia and France) had an aggregate share of less than three-quarters of exports, by 2016 the first four markets (Germany, Saudi Arabia, United States and Japan) accounted for slightly over half of exports. This occurred despite the fact that the value of exports increased more than threefold during the period.

Figure 6. Markets for Ethiopian exports, 2000–2016
(millions United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.

Figure 7 shows how Ethiopian coffee and tea exports rank in its two main destination markets (Germany and Saudi Arabia).[28] Germany has a very diversified import origin pattern for coffee and tea. In 2016, the first six origins accounted for a bit less than three-quarters of total imports

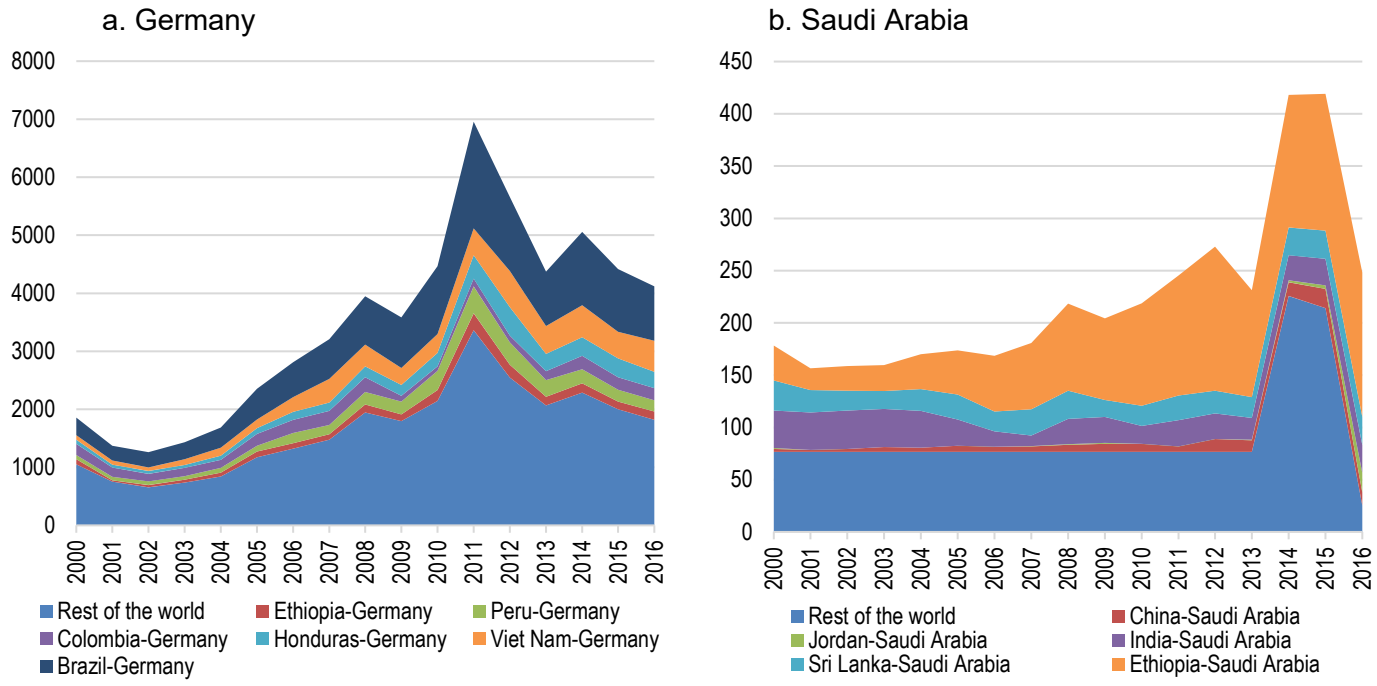
[28] Ferro (2021) selected Saudi Arabia for further analysis due to its market scale and close commercial ties with Ethiopia concerning the coffee sector.

of the sector, with Ethiopia coming in the sixth place. Importantly, most of the coffee imports are green coffee that is roasted locally.

The case of Germany contrasts with that of Saudi Arabia, a country that has a much more concentrated import pattern. In the latter, five export origins account for more than 90 per cent of imports, with Ethiopia having the largest coffee and tea exports to Saudi Arabia.

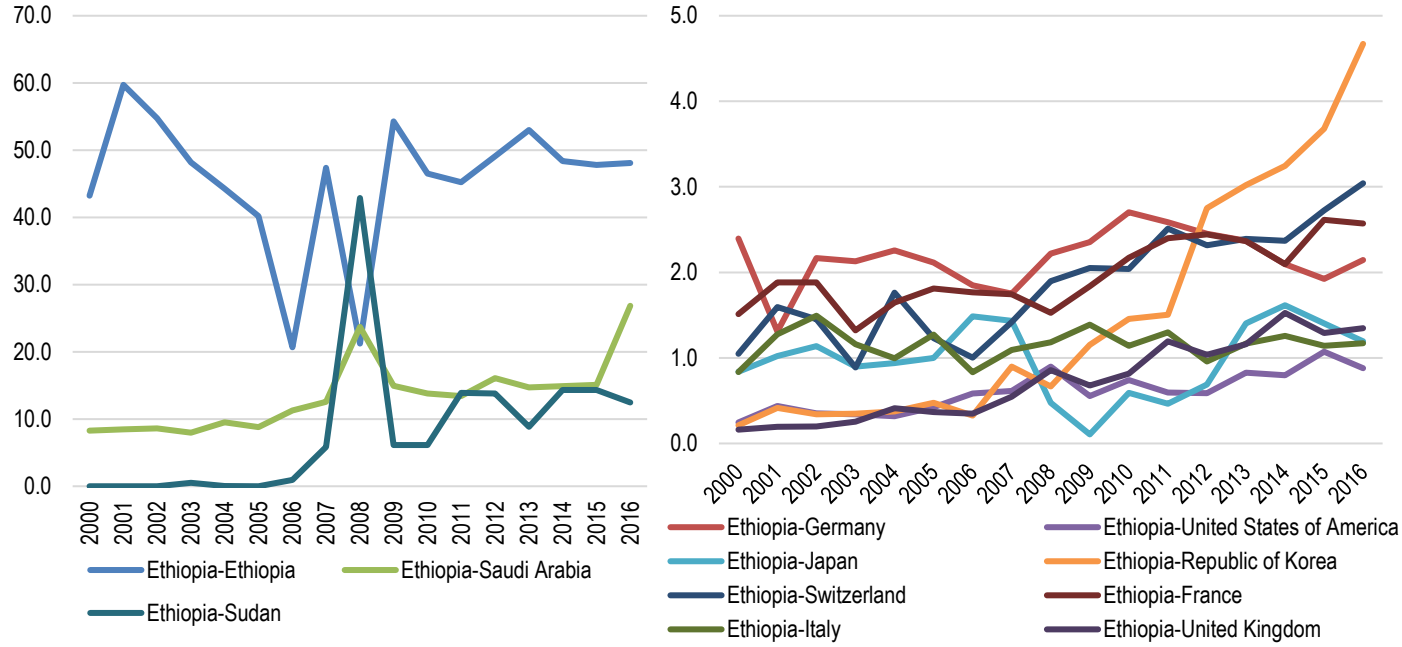
Ethiopia's trade intensity is high with Saudi Arabia and Sudan (see the left panel of figure 8). As expected, Ethiopia's greatest trade intensity is with its own market (figure 8). Almost all domestic consumption is supplied with domestic production, while its share of global supply is around 2 per cent. The evolution of the trade intensity indicator between Ethiopia and other important markets such as the Republic of Korea, Switzerland, France and Germany is presented in the right-hand side panel of figure 8.

Figure 7. Main origins of German and Saudi Arabian coffee and tea imports, 2000–2016
(millions of United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.

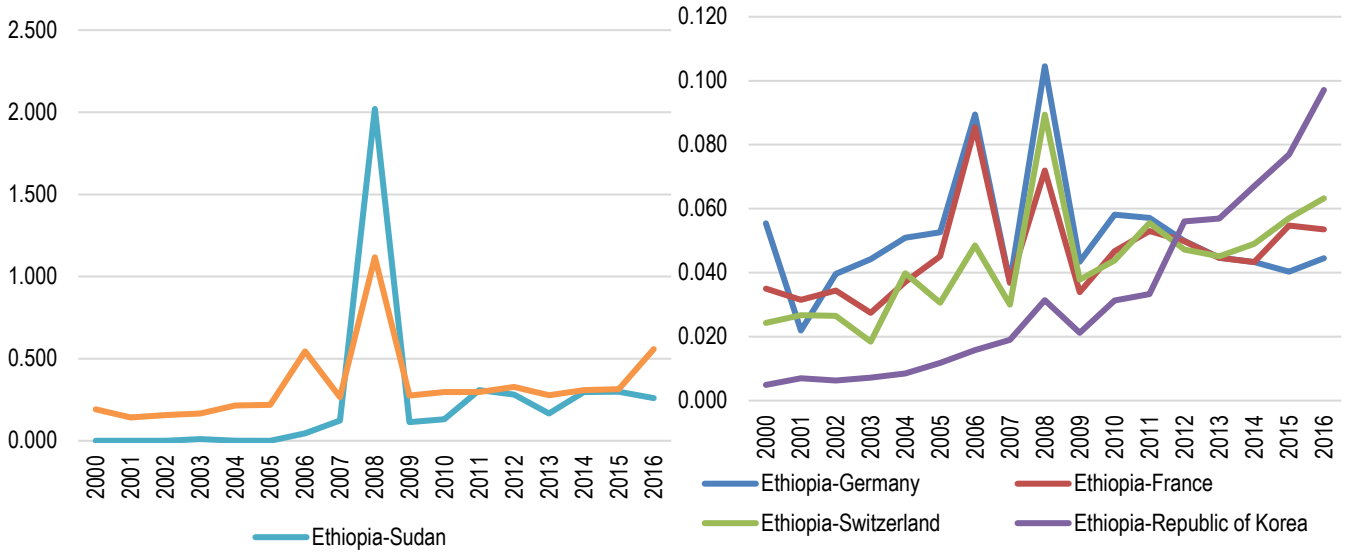
Figure 8. Trade intensity for Ethiopia's main production destinations, 2000–2016
(ratios)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: See Index definition in equation (4).

As in the case of the trade intensity, the greater values of the expenditure dependence index are for Saudi Arabia and Sudan, with high values as well for the Republic of Korea (figure 9).

Figure 9. Expenditure dependence for Ethiopia's main export destinations, 2000–2016
(ratios)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: See Index definition in equation (6).

It is interesting to look at Ethiopia's market access in its main markets and in relation to its main competitors (table 8). Saudi Arabia has zero MFN tariffs on all coffee products. According to Ferro (2021), Ethiopian exports of coffee are concentrated in green coffee, and exports of roasted coffee are marginal. Ferro (2021) highlights that the downstream segment of the coffee value chain and opportunities to transform green coffee in Ethiopia remain largely unexplored. This is a typical characteristic in the market for roasted coffee, as producing countries account for around 1.5 per cent of this trade in roasted coffee (Ferro 2021), and coffee roasted at origin represents a small proportion of total coffee consumed.

Important destination markets for coffee such as the European Union apply a tariff escalation scheme according to processing level. In the European Union and Korean markets, Ethiopia has preferential access because it corresponds to the least-developed countries group, which benefits from zero tariffs on all coffee products. Consequently, it is possible for Ethiopia to access these markets with a greater preference in those products with the greatest degree of industrial processing. In relation to its main export rivals in coffee, Ethiopia has preference in the European Union in terms of access only with respect to Brazil, while in the Republic of Korea it also has access with tariff preferences over Colombia and Honduras.

However, non-reciprocal preferences do not consolidate market access, particularly when the objective is to increase industrial transformation over the value chain. Market access needs to be reciprocal in order to foster investment decisions, which in turn are fundamental to expand production and trade.

Table 8. Trade policy for Ethiopian exports, 2020
(per cent)

Name	HS	MFN			Applied tariff							
					Ethiopia		Brazil		Colombia		Honduras	
		Saudi Arabia	European Union	Republic of Korea	European Union	Republic of Korea	European Union	Republic of Korea	European Union	Republic of Korea	European Union	Republic of Korea
Coffee	0901	0.0	6.1	5.1	0.0	0.0	6.1	5.1	0.0	5.1	0.0	5.1
Not roasted and decaffeinated	090111	0.0	0.0	2.0	0.0	0.0	0.0	2.0	0.0	2.0	0.0	2.0
Decaffeinated	090112	0.0	8.3	2.0	0.0	0.0	8.3	2.0	0.0	2.0	0.0	2.0
Roasted	090121	0.0	7.5	8.0	0.0	0.0	7.5	8.0	0.0	8.0	0.0	8.0
Roasted and decaffeinated	090122	0.0	9.0	8.0	0.0	0.0	9.0	8.0	0.0	8.0	0.0	8.0
Others	090190	0.0	5.8	5.5	0.0	0.0	5.8	5.5	0.0	5.5	0.0	5.5

Source: Prepared by the author using World Trade Organization (WTO) data; see http://tariffdata.wto.org/default.aspx (accessed 17 December 2021).

Note: There is no information on Sudan's trade policy in either the WTO or World Integrated Trade Solution databases. HS: Harmonized System; MFN: Most Favored Nation.

4.3 Meat and Mongolia's export performance

Over 2000–2016, there were more than 140 countries that recorded meat production.[29] Production on the world meat market is basically geared towards meeting domestic market demand. During 2000–2016, there was an increase in the trade openness of production (exports/production) from 11.2 to 16.8 per cent.

In 2016, 10 producing countries accounted for more than two-thirds of both meat production and consumption worldwide (65 per cent and 64 per cent, respectively). The two countries with export specialization are Brazil and Spain. Italy and the United Kingdom stand out as importers, while Germany has the two specializations together. The rest of the countries do not have trade specialization: their own production satisfies mainly their own domestic demand. This is the case, for example, of the United States, China, France, the Russian Federation and Viet Nam.

The main meat exporters of the world are the United States, Brazil, Germany and Australia. While Australia does not appear among the top 10 countries in production, it is the fourth largest exporter in the world, with exports accounting about half of production in 2016. The other three largest exporters mentioned increased their export orientation between 2000 and 2016. The United States is the largest exporter, but has a low level of export orientation (exports over production). A corollary of this is that domestic conditions in the United States meat market influence international meat markets. The others important player is Brazil, which significantly increased its exports during the period and in 2016 was the second largest world exporter of meat. Mongolia has no trade specialization in meat, as its production satisfies its own consumption.

The structure of international trade is studied with an origin-destination matrix for large regions, selecting those flows representing more than 1 per cent of world trade. Exports are concentrated in Europe, North America, and South America. The export-specialized regions are South America, the Pacific and South Asia. Europe and North America have strong intra-regional trade and also import from outside their region. For these reasons, both regions have a two-sided trade specialization pattern. Five regions that specialize in imports are East Asia, Middle East, South East Asia, Africa and Eurasia. All other regions are non-specialized.

Table 9 reports the largest meat producers within the landlocked country group, showing data for 14 countries. Mongolia ranks 10th among them. Among the countries, there is only one export-specialized country, Ethiopia (highlighted in yellow), but even that country records very small exports of meat. Three countries have both export and import specialization: Austria, Hungary and Slovakia. Czechia and Luxembourg have an import specialization pattern. The

[29] See Appendix A for data on the sector and the set of HS codes included in it.

rest of the landlocked countries in table 9 are non-specialized countries, which means that their production basically satisfies their own consumption.

Table 9. Trade specialization by main landlocked meat producers, 2000 and 2016
(millions of United States dollars and per cent)

Country	2000			2016			2000		2016	
	Internal trade (it)	Production (P)	Consumption (C)	Internal trade (it)	Production (P)	Consumption (C)	Export/P	Import/C	Export/P	Import/C
Switzerland	5,367	5430	5780	7,289	7,425	8,146	1.2	7.1	1.8	10.5
Kazakhstan	38	71	55	6,312	6,333	6,536	46.9	32.3	0.3	3.4
Serbia				6,023	6,141	6,155			1.9	2.1
Austria	1,717	2167	2186	3,287	4,896	4,706	20.8	21.5	32.9	30.2
Hungary	927	1523	987	1,523	2,892	2,168	39.2	6.1	47.3	29.7
Czechia	1,254	1320	1351	2,159	2,539	3,424	5.0	7.2	14.9	36.9
Paraguay	0	83	3	0	1,174	12	100.0	100.0	100.0	100.0
Belarus	0	55	57	0	750	104	100.0	100.0	100.0	100.0
Slovakia	220	237	291	472	694	1,097	6.9	24.4	32.0	57.0
Mongolia	212	244	214	343	375	365	13.2	0.7	8.3	6.0
Botswana	14	71	18	173	269	192	80.6	24.9	35.8	10.2
Ethiopia	16	45	17	73	175	76	63.2	1.3	58.1	3.4
Bolivia (Plurinational State of)	163	165	168	151	168	168	0.9	2.7	10.0	9.7
Luxembourg	51	79	158	120	145	333	35.3	67.7	17.4	64.1
Subtotal	9,978	11,489	11,284	2,7926	33,975	33,482	13.1	11.6	17.8	16.6
Share (per cent)	98.5	97.9	97.0	99.4	99.3	98.0				
Landlocked	10,125	11,739	11,634	28,084	34,217	34,150	13.7	13.0	17.9	17.8

Source: Prepared by the author using data from the International Trade and Production Database.

Table 10 examines landlocked meat-exporting countries. It shows that Novy's index is not defined or acquires very low values in almost all cases due to the asymmetry in the trade relationship. Only two cases record tariffs equivalent to less than 200 per cent (highlighted in brown), corresponding to landlocked countries that are European Union members. Mongolia does not appear in the table.

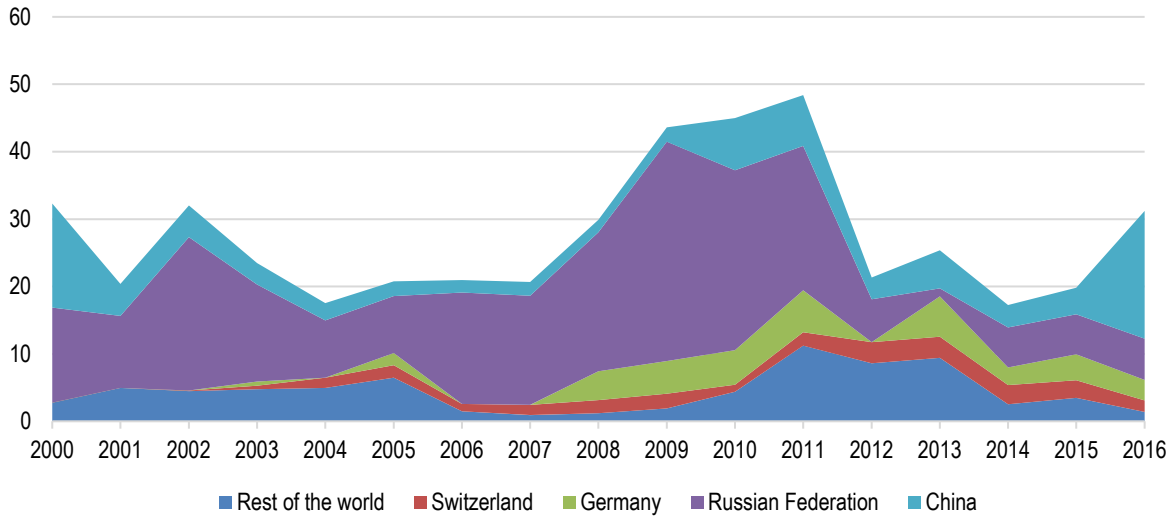
Table 10. Landlocked export countries main bilateral trade in 2016: Trade intensity and expenditure dependence
(millions of United States dollars, and ratios)

Exporter/Importer	2000			2016				
	Bilateral trade	Trade intensity	Expenditure dependence ratio	Bilateral trade	Trade intensity	Expenditure dependence ratio	Novy	Equivalent tariff (Novy)
Belarus-Russian Federation	50	25.8	n.a.	728	19.2	n.a.	n.a.	n.a.
Austria-Germany	83	0.7	0.004	637	2.1	0.018	0.003	218.0
Paraguay-Chile	47	1,385.8	n.a.	367	198.9	n.a.	n.a.	n.a.
Paraguay-Russian Federation	0	0.1	n.a.	263	4.4	n.a.	n.a.	n.a.
Austria-Italy	200	2.5	0.015	249	1.3	0.011	0.001	345.2
Czechia-Slovakia	19	23.0	0.070	180	53.0	0.260	0.011	144.9
Hungary-Germany	173	2.1	0.007	172	0.9	0.005	0.000	396.3
Hungary-Romania	21	2.5	0.009	155	10.9	0.055	0.000	377.6
Paraguay-Brazil	29	5.2	n.a.	154	2.4	n.a.	n.a.	n.a.
Hungary-Austria	25	3.5	0.012	135	8.1	0.041	0.002	232.1
Hungary-Japan	36	0.4	0.001	131	1.1	0.006	0.000	1,873.8
Paraguay-Viet Nam	0	0.0	n.a.	101	2.5	n.a.	n.a.	n.a.
Paraguay-Israel	0	0.0	n.a.	99	22.2	n.a.	n.a.	n.a.
Austria-Netherlands (the)	14	0.7	0.004	95	2.3	0.020	0.002	232.0
Slovakia -Hungary	0	0.9	0.001	92	50.2	0.099	0.007	171.5
Austria-Hungary	8	1.7	0.010	92	7.1	0.061	0.002	232.1
Hungary-Italy	70	1.3	0.004	74	0.6	0.003	0.000	602.4
Hungary-China	3	0.0	0.000	71	0.2	0.001	0.000	8,923.0
Austria-Czechia	7	1.1	0.007	71	3.5	0.030	0.000	432.7
Hungary-France	52	0.6	0.002	65	0.4	0.002	0.000	752.4
Slovakia -Czechia	7	10.8	0.007	64	22.2	0.044	0.011	144.9
Ethiopia-United Arab Emirates (the)	1	54.4	n.a.	60	157.9	0.035	n.a.	n.a.

Source: Prepared by the author using data from the International Trade and Production Database.

According to the latest available data, Mongolia has only four relevant markets for its meat exports. As shown by figure 10, its two largest markets are China and the Russian Federation. In a second order of importance, and significantly below the previous two destinations, are Germany and Switzerland. The central feature of Mongolia‘s meat sector is that it has some domestic production; however, its export orientation is marginal (US$30 million of total meat exports in 2016).

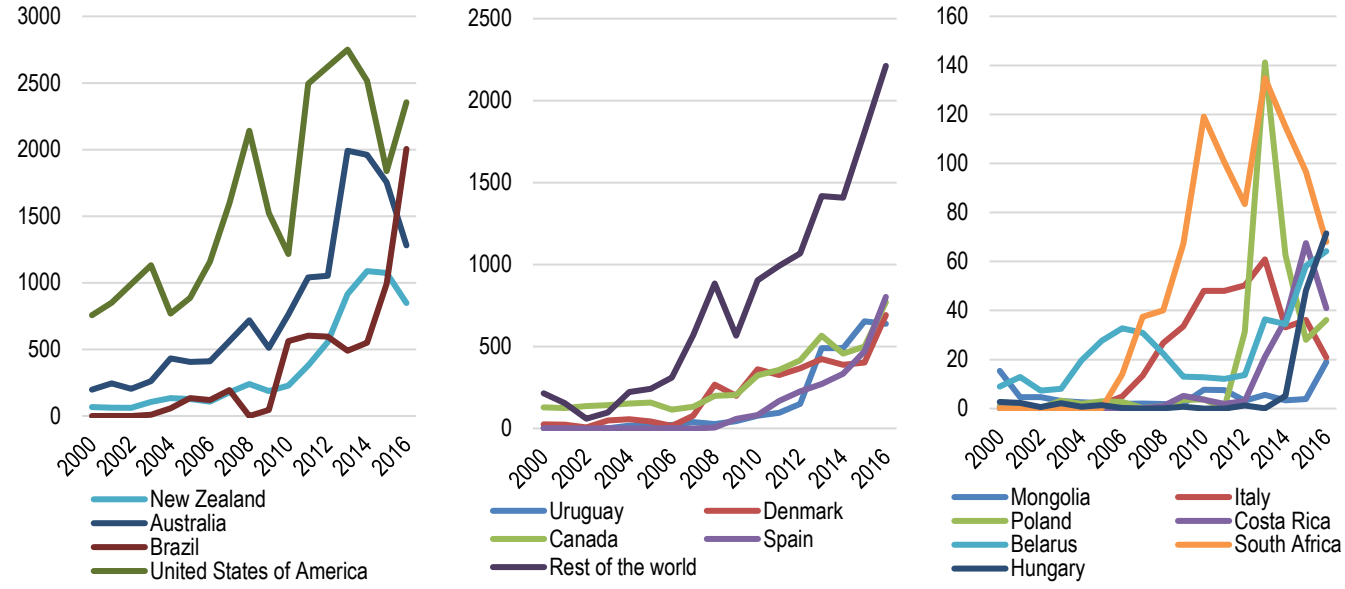
Figure 10. Markets for Mongolian exports, 2000–2016
(millions of United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: ROW: rest of the world.

China, which has a very diversified origin of its imports, is Mongolia's main market for meat. In terms of suppliers of meat to China, there is a large exporter group consisting of the United States, Brazil, Australia and New Zealand (around US$1 billion dollars or more of meat exports each), followed by a second tier of exporters supplying around US$500 million of meat annually that includes Spain, Denmark and Uruguay (figure 11). Mongolia exports US$18 million of meat to China.

Figure 11. Origin of Chinese meat imports by size, 2000–2016
(millions of United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.

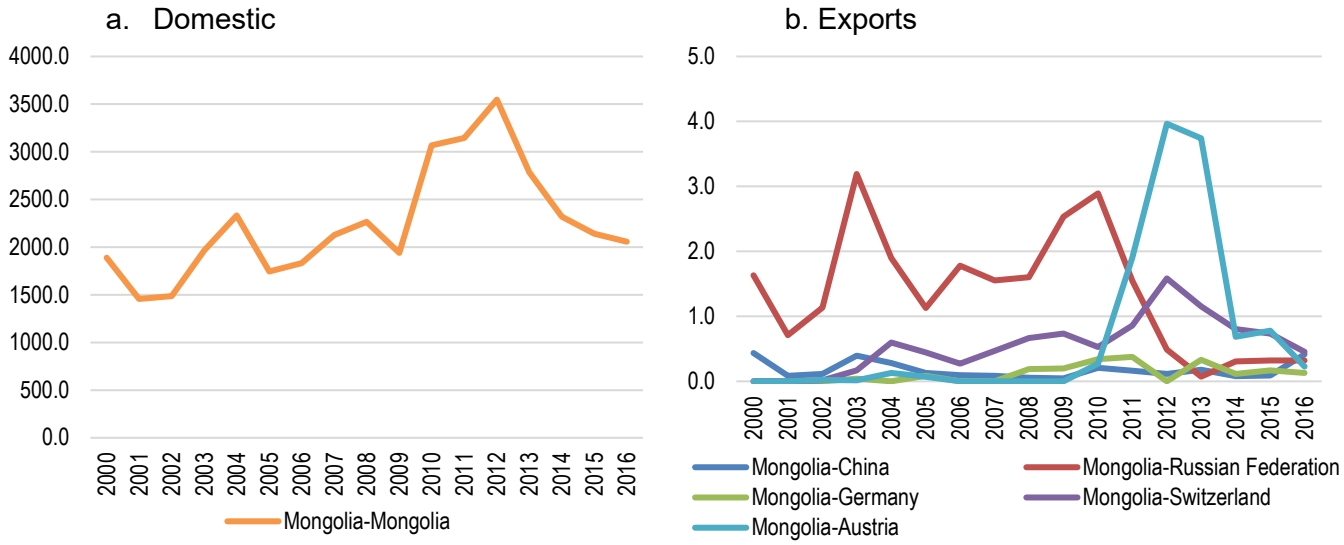
Note: ROW: rest of world.

The values of Mongolia's trade intensity indicator for meat exports with its main export markets are less than one, and with respect to its own market are extremely high (figure 12.) Naturally this is the result of the importance of the Mongolia's domestic market for Mongolian meat producers. More than 90 per cent of consumption is supplied with domestic production. Mongolia's share of the global supply of meat is marginal.

The expenditure dependence indicator is high for Mongolia, indicating that international trade costs relative to domestic ones are high. It is worth noting that the evolution of this indicator in the recent past suggests that the trend is not towards reducing trade costs. Given that high trade costs are absorbed by exporters, these high trade costs translate into low export prices for Mongolia's exporters.

Globally, the meat market is characterized by a high level of protection, including those countries that are currently importing meat from Mongolia. Market access in China takes place under MFN ad valorem tariffs. Export rivals in this market have the same trade policy conditions, according to the tariff database of the WTO and the Inter-American Development Bank (IDB) (see table B7 in Appendix B). Only for horse meat in Switzerland do Mongolia's meat exports have some preferences under the Generalized System of Preferences. Mongolia only has one FTA, with Japan, in place since 2016.[30]

Figure 12. Trade intensity for Mongolia's meat production to main destination countries, 2000–2016
(index)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: See Index definition in equation (4).

[30] See the WTO's Regional Trade Agreements database at https://rtais.wto.org/UI/PublicSearchByCrResult.aspx.

Under the current conditions of high protection for meat exports, preferential openness has great value. A landlocked country with capacity and a comparative advantage for meat production should strive to secure favourable conditions of access to large and nearby markets. This requires a strong improvement in tariff preferences under preferential trade agreements (PTAs), as well as taking advantage of the non-reciprocal preferences granted by developed countries under the Generalized System of Preferences. However, in Mongolia, an important condition for taking advantage of such preferences is to continue to deepen ongoing work in improving sanitary standards along the meat value chain. This is particularly important in order to access high-price markets that in parallel have high standards of food safety and quality for meat.

4.4 Processed fruit and Uzbekistan's export performance

In the processed fruit sector, the ITPD does not have information about intra-national trade. For this reason, it is not possible to compute the same set of tables and figures as in the three previous sectors. Over 2000–2016, more than 140 countries recorded processed fruit exports (dried fruits are part of the processed fruit sector).[31] Trade in the processed fruit sector is characterized as a small market at the global level in comparison with the other three markets just analysed. However, it has been growing fast in the last few years.

The export side of international trade in processed fruit is relatively concentrated, while on the import side it is more diversified. In 2016, the 10 main exporters accounted for more than three-quarters of global exports but only one-third of imports. Using the coverage ratio (exports over imports), it is possible to identify five countries with an export specialization pattern: Turkey, Thailand, Chile, China and Argentina. France and Italy stand out as importers, while Germany, the United States and the Netherlands have both specializations.

The structure of international trade is analysed with an origin-destination matrix by world region selecting flows representing more than 1 per cent of world trade. Specialized export regions are Central Asia, Middle East, Eurasia, Africa and South America. Southeast Asia and East Asia have a two-sided trade specialization pattern. Six regions specialize in imports: Europe, Pacific, North America, East Asia, Eurasia and Europe. These regions also have high levels of intra-regional trade in processed fruit.

Thirteen landlocked countries have some role as exporters of processed fruits, as shown in table 11. However, a coverage ratio greater than 1 indicates that only five of them have trade specialization as exporters (i.e. Afghanistan, Uzbekistan, Serbia, Tajikistan, Kyrgyzstan). Over

[31] See table A2 in Appendix A for data on the fruit sector and the set of HS codes included in it.

2000–2016, the group of landlocked countries as a whole increased its participation in international trade of processed fruits.

Table 11. Landlocked countries in the processed fruit sector, 2000 and 2016
(United States dollars, and ratio)

Country	Exports		Imports		Coverage ratio	
	2000	2016	2000	2016	2000	2016
Afghanistan	5	69	0	3	50.3	21.0
Austria	1	35	9	49	0.2	0.7
Uzbekistan	12	28	0	0	3,114.2	860.1
Serbia	0	22	0	4	nd	5.8
Tajikistan	0	12	0	0	nd	2,361.4
Slovakia	1	10	3	20	0.2	0.5
Czechia	1	6	5	28	0.2	0.2
Hungary	1	6	2	9	0.8	0.7
Kyrgyzstan	1	5	0	1	220.8	3.8
Belarus	0	2	0	18	0.0	0.1
Switzerland	1	2	16	42	0.0	0.0
Luxembourg	0	1	1	3	0.0	0.2
North Macedonia	0	1	0	2	2.8	0.3
Subtotal	24	198	35	179	0.7	1.1
Share (per cent)	91.8	99.5	89.1	82.9	1.0	1.2
Landlocked	26	199	39	216	0.7	0.9

Source: Prepared by the author using data from the International Trade and Production Database.

Table 12 shows the trade intensity index for those landlocked countries that are relevant in this sector. Note that the third-highest ranking is for exports from Uzbekistan to Kazakhstan. Almost all bilateral trade in this group has a value greater than 1 on the trade intensity index.

Cárcamo-Díaz et al. (2021) point out that the edible fruit sector overall is the sixth largest sector in Uzbekistan's export profile.[32] At the beginning of the 2000–2016 period, the Russian Federation was the only market for Uzbekistan's exports, as shown in figure 13. By 2016, Uzbek exports by geographic destiny were more diversified. In 2016, the largest import market was Kazakhstan followed by Germany and Belarus. According to Cárcamo-Díaz et al. (2021), between 2016 and 2019 the main destination markets changed drastically, with Kyrgyzstan and China in the top positions (US$34 million and US$28 million in 2019, respectively).

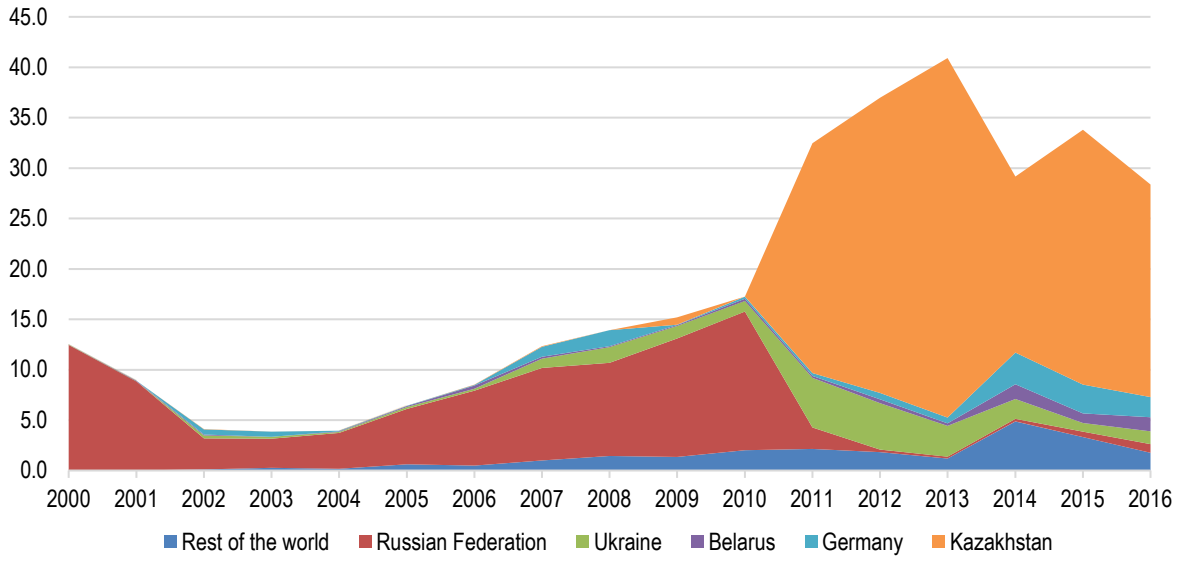
[32] In 2019, exports from the sector reached US$644 million, and accounted for the 4.5 per cent of Uzbekistan's total exports (US$14.3 billion). Cárcamo-Díaz et al. (2021) highlight that within edible fruit exports, dried grapes accounted for US$105 million, or 16.3 per cent, and other dried fruits, notably including prunes, dried apricots and dried apples, accounted for US$40 million, or 6.2 per cent. Together, therefore, in 2019 dried fruit accounted for 1 per cent of the entire export value of Uzbekistan.

Table 12. Landlocked bilateral flows and trade intensity, 2000 and 2016
(millions of United States dollars, and ratio)

Exporter/Importer	Bilateral trade		Trade intensity	
	2000	2016	2000	2016
Afghanistan-India	4.59	66.7	94.6	37.6
Austria-Germany	0.61	23.3	4.3	7.5
Uzbekistan-Kazakhstan	0.00	21.1	2.5	64.3
Tajikistan-Kazakhstan	0.01	8.9	3.4	65.5
Serbia-United States of America (the)	0.00	7.7	n.a.	3.9
Slovakia -Czechia	0.05	3.9	15.7	36.5
Slovakia -Germany	0.40	2.8	6.7	3.0
Kyrgyzstan-Germany	0.00	2.2	n.a.	5.5
Hungary-Austria	0.44	2.1	29.8	19.8
Uzbekistan-Germany	0.00	2.0	n.a.	0.8
Austria-Italy	0.08	2.0	1.3	1.6
Czechia-Slovakia	0.25	1.9	102.0	41.4
Austria-Switzerland	0.15	1.8	5.6	3.3
Belarus-Russian Federation	0.00	1.7	n.a.	56.3
Czechia-Poland	0.01	1.6	2.2	12.1
Austria-France	0.01	1.5	n.a.	0.8
Top 16 landlocked	6.62	151.32		
Share (per cent)	15.03	75.62		
Landlocked	44.0	200.1		

Source: Prepared by the author using data from the International Trade and Production Database.

Figure 13. Markets for Uzbek exports of processed fruits, 2000–2016
(millions United States dollars)

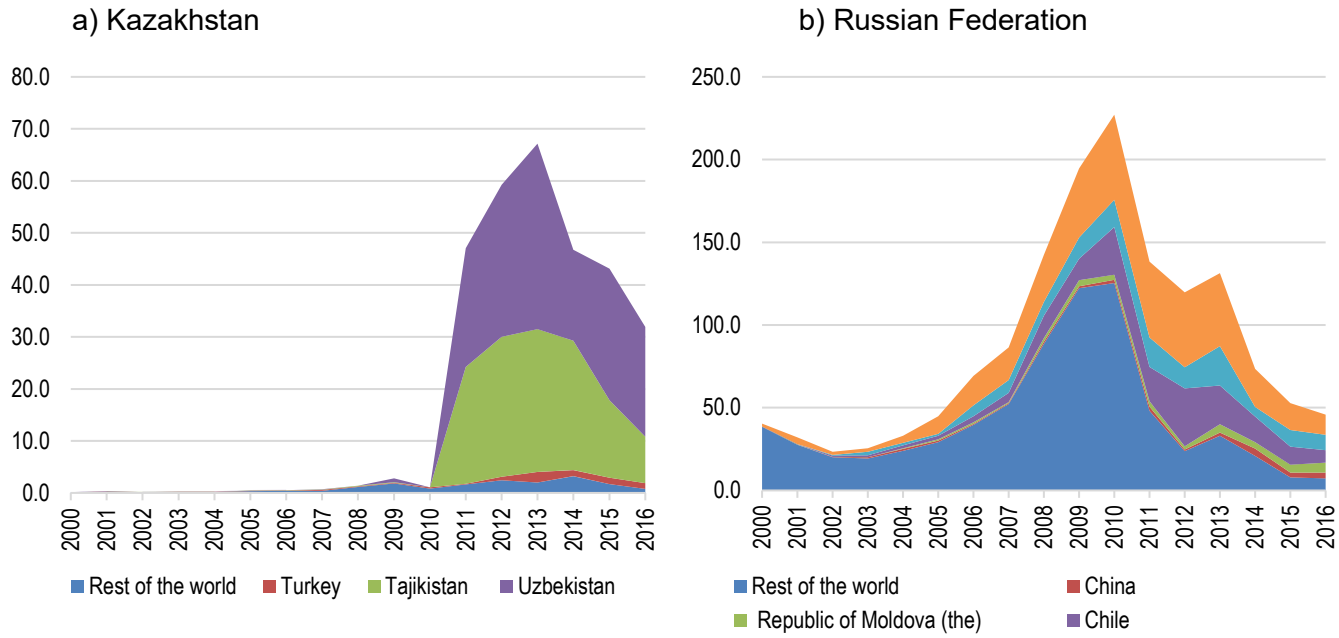


Source: Prepared by the author using data from the International Trade and Production Database.
Note: ROW: rest of the World.

One possible explanation for the significant changes in the roles of Kazakhstan and Kyrgyzstan is that both countries are important transit countries for Uzbekistan's exports. Hence, it is possible that exports registered as going to these countries are in fact going through these transit countries to other markets like the Russian Federation, China and other markets.

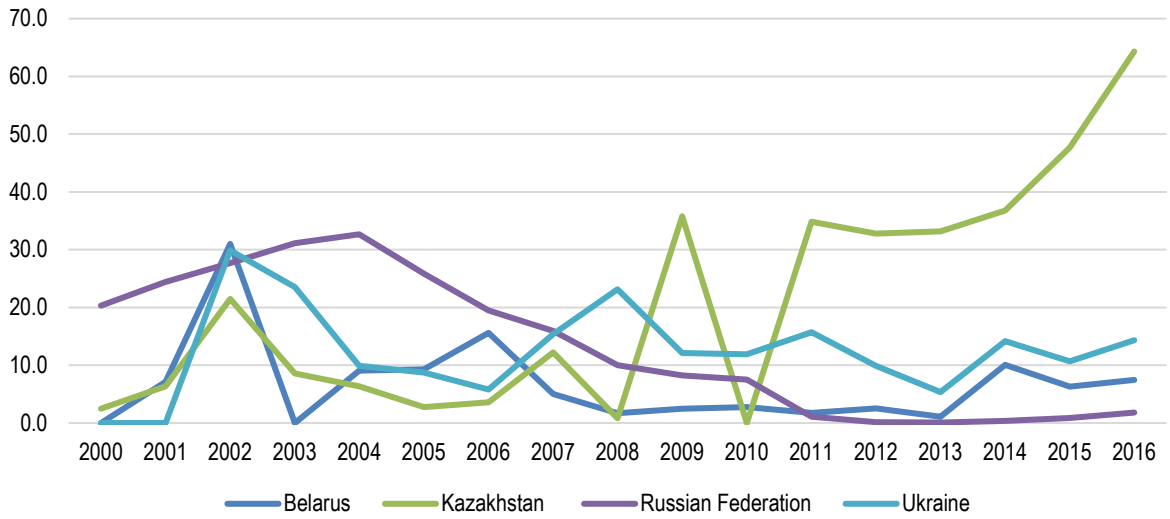
To complete the characterization of international insertion, it is important to know the export rivals of Uzbekistan in the two neighbouring countries: Kazakhstan and the Russia Federation (figure 14). Tajikistan is the rival of Kazakhstan and Turkey in the Russia Federation. Kazakhstan and Tajikistan are neighbors of Uzbekistan. Both could be transit countries. Trade figures sometimes do not differentiate provenance and origins; data suggest that this is the case in this sector.

Figure 14. Main origins of exports to Kazakhstan and the Russian Federation, 2000–2016
(millions of United States dollars)



Source: Prepared by the author using data from the International Trade and Production Database.
Note: ROW: rest of world.

Figure 15. Trade intensity for main Uzbekistan export destinations, 2000–2016
(ratios)



Source: Prepared by the author using data from the International Trade and Production Database.

Table 13. Import tariff for Uzbekistan and its export rivals in main export destinations
(per cent)

HS	MFN			Uzbekistan			Turkey	Tajikistan
	Kazakhstan	Russian Federation	European Union	Kazakhstan	Russian Federation	European Union (GSP)	Russian Federation	Kazakhstan
080610	5.0	5.0	14.4	0.0	0.0	9.5	3.9	nd
080620	5.0	3.3	2.4	0.0	0.0	0.0	2.6	nd
081310	5.0	5.0	5.6	0.0	0.0	2.1	3.9	nd
081320	5.0	5.0	9.6	0.0	0.0	6.1	3.9	nd
081330	8.0	8.0	3.2	0.0	0.0	0.0	6.2	0.0
081340	5.0	5.0	3.3	0.0	0.0	1.0	3.9	0.0
081350	9.7	10.0	6.9	0.0	0.0	3.0	7.7	0.0

Source: Prepared by the author based on the World Trade Organization tariff database.
Note: GSP: Generalized System of Preferences; HS: Harmonized System; MFN: Most Favored Nation.

Finally, is important to analyse the status of trade policy for Uzbekistan's processed fruit exports and also for its export rivals, as indicated by table 13. For processed fruit, import tariffs are much lower than, for example, the meat market, which reveals less protectionist pressure in this more open market. Only in the European Union do fresh grapes have a tariff over 10

per cent.[33] For dried grapes, Uzbekistan has preferential access to three markets considered. Tariff preferences are low because MFN tariffs are also low (2.6 per cent). As table 13 clearly shows, only in the product mixtures of dried fruit (HS 081350) tariff preference is high for Uzbekistan (7.7 per cent) in the Russian Federation market in comparison with its main competitor, Turkey.

[33] The processed fruit sector does not include fresh grapes, which are included in table 12 only as a reference for comparisons with dried grapes.

5 Trade costs: Parametric analysis

The parametric section follows the same analytical procedure as the non-parametric sections. First the methodology is applied to the agriculture sector as a whole and then to the particular products under study.

5.1 Structural gravity trade model

This section identifies the mechanism through which trade policy instruments influence trade costs and, in particular, estimates the trade costs of landlocked countries via the structural gravity trade model (SGTM). Critical to the adequate estimation of a SGTM is the availability of intra-national trade information. Vaillant et al. (2020) show that the inclusion of internal transactions in an SGTM is important in order to have an unbiased estimate of trade costs. Unfortunately, the lack of comparable data between trade statistics (in gross production value) and domestic statistics (in added value) results in intra-national trade transactions generally being omitted in many empirical studies. Having such data is needed to transform domestic production in value added to gross production value and then obtain the difference in intra-national trade.

Additionally, employing the methodology used in Vaillant et al. (2020) allows for estimating bilateral proximities (ϕ_{ijt}) in each period without requiring that the symmetry assumption of trade (as required by Novy's indicator) be valid. The trade geography of countries is included in the model in the form of multilateral resistance as sellers (Ω_{it}) and buyers (Φ_{jt}).[34] Multilateral resistance refers to aggregations of proximities to all markets, weighted by the ability of each market to sell or buy. The supply capacity of an origin (S_{it}) is obtained by dividing its total supply ($Y_{it} = \sum_j x_{ijt}$) by its total proximity as seller to all markets. The demand capacity of a destination (M_{jt}) is obtained by dividing its total expenditure ($E_{jt} = \sum_i x_{ijt}$) by its total proximity as buyer from all markets. The SGTM is specified as a system of three equations for bilateral flows and a pair of multilateral resistances:

$$x_{ijt} = S_{it} M_{jt} \phi_{ijt} = \frac{Y_{it}}{\Omega_{it}} \frac{E_{jt}}{\Phi_{jt}} \phi_{ijt} \quad (7)$$

$$\Omega_{it} = \sum_l \frac{E_{lt}}{\Phi_{lt}} \phi_{ilt} \quad (8)$$

$$\Phi_{jt} = \sum_l \frac{Y_{lt}}{\Omega_{lt}} \phi_{ljt}. \quad (9)$$

[34] See Yotov et al. (2016) for a detailed description of the SGTM and the derivation of multilateral resistance.

In order to identify the variables that influence proximity (which, as mentioned, are the inverse of trade costs), a distinction is made between permanent effects (ϕ_{ij}) and those that change over time $(\tilde{\phi}_{ijt})$. The latter are mainly linked to countries' trade policy interventions. Typically, most empirical studies only consider an indicator variable that measures whether there are PTAs within the class of FTAs and customs unions.

To enrich the estimation of the effects of trade policy, the specification develops two innovations with respect to the conventional way of estimating the SGM. First, the trade policy effects are divided into three main components:

1) *Preferential FTAs.* This variable implies the existence of almost total trade liberalization over a reciprocal basis. It includes FTAs and customs unions $(\tilde{\phi}_{ijt}^{PTA})$.

2) *Other trade preference agreements* $(\tilde{\phi}_{ijt}^{OPRE})$. This accounts for preferences applied in a discriminatory manner by the importer, but which, unlike those associated with PTAs, are not applied on a reciprocal basis but, rather, unilaterally. Such is the case with the Generalized System of Preferences granted by developed countries to developing countries. It also includes partial reciprocal preferences between developing countries.

3) *Openness non-discriminatory measures* $(\tilde{\phi}_{ijt}^{OPE})$. These measures consider the effect of MFN import tariffs and trade facilitation instruments. They affect the rate of substitution between domestic and international trade. Therefore, they can only be captured using information that includes domestic transactions. These types of interventions reduce the effect of a country's border on trade and are analogous to a unilateral opening on an MFN basis. The correct specification of the facilitation variables then is that they take one value when buyer and seller are the same (i.e. domestic trade), and another when it comes to international trade.

It then holds that the decomposition of total proximity could be divided into permanent (ϕ_{ij}) and variable proximities $(\tilde{\phi}_{ijt})$. Then:

$$\phi_{ijt} = \phi_{ij}\tilde{\phi}_{ijt} = \phi_{ij}\tilde{\phi}_{ijt}^{PTA}\tilde{\phi}_{ijt}^{OPRE}\tilde{\phi}_{ijt}^{OPE}. \quad (10)$$

Among the trade costs that vary over time, the evolution of PTAs plays an important role. The most common approach in the literature is to assume that trade agreements are bilateral, and with a high coverage of goods and services. Also, the conventional assumption is that there is a homogenous effect among different FTAs in terms of reducing trade barriers (Yotov et al. 2016). In all these cases, the most common empirical strategy is the use of a dummy variable that takes the value one if two countries have an agreement, and zero if not. As a result, a measure of trade costs for pairs of countries that have a trade agreement is obtained in relation to pairs without such an agreement.

This paper also follows Vaillant et al. (2020) by considering a heterogeneous effect of PTAs on bilateral proximities. To this end, the PTA variable is interacted with both the number of bilateral liberalized relationships via PTAs maintained by the exporter and the importer. It is understood that the more agreements the exporter has, the greater the effect on the agreements it signs, given that it has a competitive export capacity that leads it to sign new agreements. On the other hand, the larger the number of trade agreements that an importer has, the lower the preference obtained by a new additional trade agreement.

The signing of a trade agreement changes the relative costs of trade with different origins (including the signer's own trade, i.e. domestic trade), resulting in substitution effects known as "trade diversion" and "trade creation." The latter type of substitution occurs between domestic production sold in the domestic market and imports from the country with which the agreement is signed, for which it is essential to estimate the model including data on domestic transactions.[35]

For a country where the export sector is important, there are political economy incentives to have a more open trade policy. This should be reflected in higher levels of openness. The signing of PTAs should also be reflected in other complementary trade policies (trade facilitation, special regimes, policies aimed at facilitating foreign direct investment, etc.), which would be aligned with the predominance of the export sector.

Table 14. Correlation between openness and number of preferential bilateral relationships, 1995 and 2013

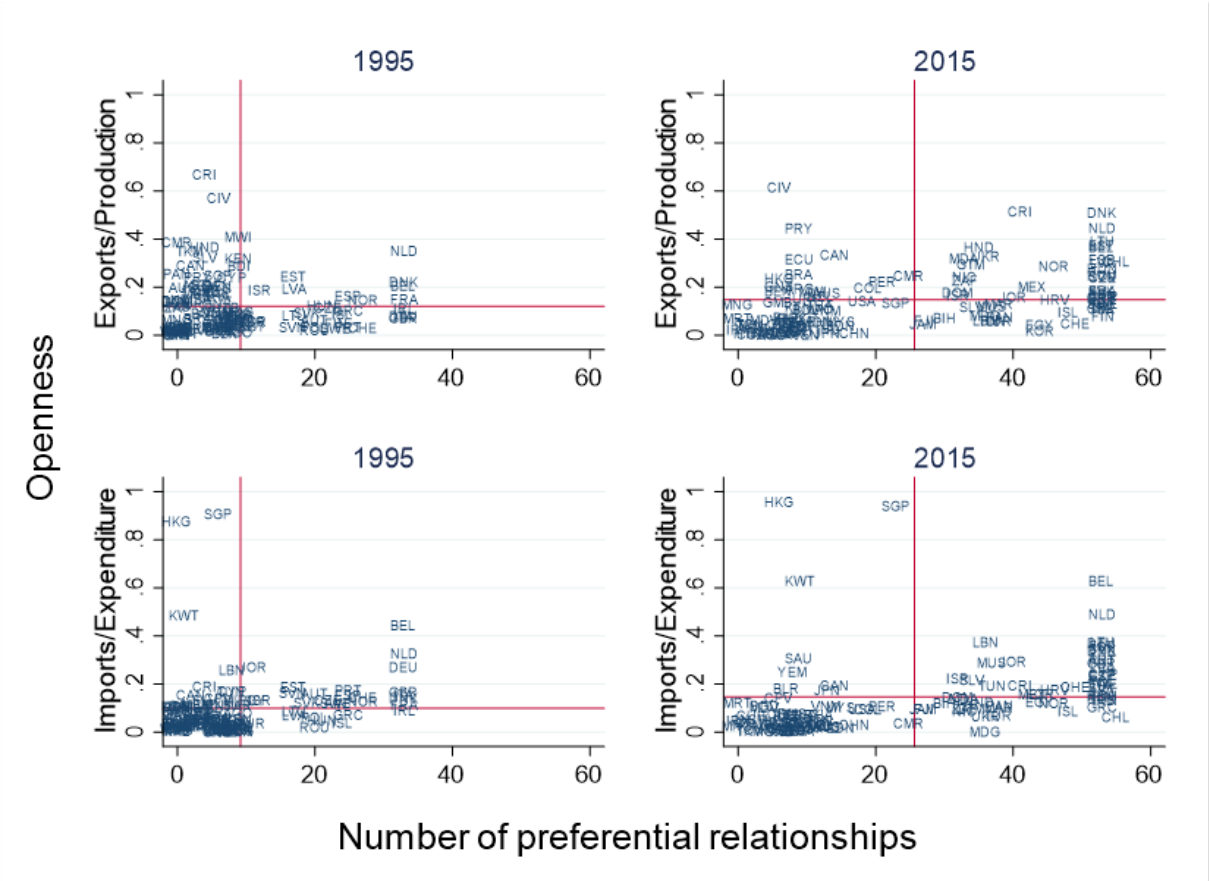
Openness	1995	2015
Exports / Production	0.02	0.42
Imports / Expenditure	0.20	0.38

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

This section proposes that one way to represent this preference for openness is to examine information on the accumulated amount of bilateral trade liberalized by a PTA, which should inform the level of trade openness granted to other countries, as well as the openness received from them. As shown in table 14 and figure 16, a stylized fact is that countries with a greater number of bilateral relations under PTAs, such as free trade areas or customs unions, exhibit higher levels of trade openness. This stylized fact has become more evident in recent years, as shown in table 14.

[35] In a model with monopolistic competition in which each variety is produced by a single company, neither diversion nor creation of trade can arise; instead we refer to "modification" of trade. On the one hand, instead of trade diversion, varieties imported from *z* are replaced by consumption of varieties imported from the new partner *i*. On the other hand, instead of trade creation, the consumption of domestic varieties is replaced by the consumption of varieties produced by country *i*.

Figure 16. Degree of openness and number of preferential relations, 1995 and 2015



Source: Prepared by the author using the database developed by Moncarz et al. (2021).

5.2. Estimates and empirical results for the agriculture sector

The empirical specification of the structural gravity model faces two main information challenges. First, there is a high proportion of trade flows in the dataset that equal zero, that is, censored observations in which there is no trade between two countries (or their value is so small that the agencies compiling the statistics approximate it to zero). Second, as mentioned above, information on domestic trade is often lacking, as sales of own production in the domestic market are excluded from most international trade databases. Since domestic trade is usually more important than any bilateral trade flow, this can be seen as a country-specific truncation in the right-hand tail of the distribution of traded values.

The problem of zero trade flow has been addressed in the literature by using two different possible solutions. Helpman et al. (2008) proposed a micro-founded model with heterogeneous firms (à la Melitz), developing a two-stage estimator where the first stage provides information on the extensive margin and this information is used in the second stage. In contrast, Santos et al. (2006) proposed using a pseudo-maximum likelihood Poisson estimator (PPML), which is consistent in the presence of heteroscedasticity and provides an

alternative to Helpman et al. (2008) to consider zero trade cases. Fally (2015) showed that the inclusion of exporter-time and importer-time fixed effects enables the PPML estimator to satisfy the general equilibrium conditions of the structural gravity model, as derived from the seminal paper by Anderson and van Wincoop (2003).

Larch et al. (2019) developed a procedure to deal with the computational constraints that may arise from the inclusion of bilateral fixed effects or origin-destination, especially when many countries are included in the sample. The method also allows trade restrictions to be divided into a permanent and a variable component. Based on the above discussion, the following functional form for the estimation of bilateral trade flows is used:

$$x_{ijt} = \exp\Big(\psi_{it} + n_{jt} + \mu_{ij} + \alpha_1 PTA_{ijt} + \alpha_2\big[PTA_{ijt} \times NPTA_{it}\big] + \alpha_3\big[PTA_{ijt} \times NPTA_{jt}\big] + \\ + \alpha_4\big[PTA_{ijt} \times ln\big(T_{ijt}\big)\big] + \beta\big[OP_{ijt} \times ln\big(T_{ijt}\big)\big] + \gamma_1\big[NoP_{ijt} \times ln\big(T_{ijt}\big)\big] + \gamma_2\big(NPTA_{it} \times \\ NPTA_{\mathrm{jt}}\big)\Big) + \varepsilon_{ijt}. \qquad (11)$$

The set of bilateral relations is divided into three mutually exclusive groups. PTA_{ijt} is a dichotomous variable equal to 1 if countries *i* and *j* have a deep PTA (of the FTA or customs union types) in year *t*; OP_{ijt} is a dichotomous variable equal to 1 if country *i* receives from country *j* a tariff preference outside a deep trade agreement, either on a bilateral or unilateral basis; and NoP_{ijt} is a dichotomous variable that assumes the value 1 if country *i* does not receive any preferential treatment from country *j*. $NPTA_{it}$ is the number of bilateral preferential relations that country *i* has in year *t* (excluding the one it may have with country j), T_{ijt} is (one plus) the tariff applied by country *j* on imports from country *i* at time *t* . ψ_{it}^{s}, n_{jt}^{s} and μ_{ij}^{s} are, respectively, origin-time, destination-time, and origin-destination fixed effects. It is assumed that the latter are asymmetric $\big(\mu_{ij} \neq \mu_{ji}\big)$.

The origin-destination fixed effect is controlled by the permanent proximities (ϕ_{ij}), while the variable proximities $\big(\tilde{\phi}_{ijt}\big)$ variable is broken down into three parts: one part related to the effect of *i* and *j* having a PTA: $\tilde{\phi}_{ijt}^{PTA} = \exp\big(\alpha_1 PTA_{ijt} + \alpha_2\big[PTA_{ijt} \times NPTA_{it}\big] + \alpha_3\big[PTA_{ijt} \times NPTA_{jt}\big] + +\alpha_4\big[PTA_{ijt} \times ln\big(T_{ijt}\big)\big]\big)$; another part related to non-PTA trade preferences $\tilde{\phi}_{ijt}^{OPRE} = \exp\big(\beta\big[OP_{ijt} \times ln\big(T_{ijt}\big)\big]\big)$; and a third part corresponding to the preference for openness as measured by the facilitation variables $\tilde{\phi}_{ijt}^{OPE} = \exp\Big(\gamma_1\big[NoP_{ijt} \times ln\big(T_{ijt}\big)\big] + \gamma_2\big(NPTA_{it} \times \mathrm{NPTA}_{\mathrm{jt}}\big)\Big)$.

Equation 11 is estimated using data for the entire agriculture sector (ISIC Rev. 3 sector A and B; see Appendix A) with a two-year interval from 1995 to 2015. Following this design, the

estimator proposed by Larch et al. (2019) is used. The results of the estimation of equation 11 are reported in table 15.[36]

Table 15. Estimation of structural gravity in agriculture

Variable	Coefficient
PTA_{ijt}	0.1569***
PTA_{ijt} x $NPTA_{it}$	0.0033**
PTA_{ijt} x $NPTA_{jt}$	-0.0054***
$NPTA_{it}$ x $NPTA_{jt}$	0.0003***
PTA_{ijt} x $ln(T_{jt})$	-2.4661***
OP_{ijt} x $ln(T_{jt})$	-1.7329***
NoP_{ijt} x $ln(T_{jt})$	-1.9693***
Observations	115676

Source: Prepared by the author using the database developed by Moncarz et al. (2021).
Note: *** p<0.01, ** p<0.05, * p<0.1.

Taking into account the form of the empirical specification, which seeks to allow for heterogeneity in terms of the number of foreign trade agreements already signed, the impact of an agreement depends on the values and signs of the estimated coefficients, as well as on the values assumed by the explanatory variables.

As shown in table 15, the effect of a trade agreement increases as the exporting country (*i*) has a greater number of preferential relations (the coefficient δ_2 is positive), while it decreases (the coefficient δ_3 is negative) with the number of preferential relations of the importing country (*j*). The first result could be rationalized according to the fact that the more open an economy, the better its productivity and therefore the greater the possibilities of taking advantage of the access provided by the signing of a new agreement. On the other hand, the more open the importing country, the less preference is given to new partners, and therefore the effect of signing a new agreement is less important. Furthermore, the effect of an agreement is greater the lower the applied tariff (the higher the margin of preference granted, the coefficient α_1 is negative).

[36] In addition, as a robustness exercise, an alternative version of equation 11 was estimated. Instead of using applied tariffs, the specification included data on MFN tariffs and two variables controlling for trade preferences granted within a preferential FTA (of the FTA/customs union type). The results of this alternative specification are qualitatively similar to those reported here. They are available from the authors. Standard errors are clustered at the exporter-importer-year level.

Table 16. Average marginal effect of a new preferential relationship, 1995–2015
(per cent of pre-agreement trade)

Year	Marginal effect (per cent)
1995	49.4
1997	46.2
1999	43.4
2001	43.2
2003	41.9
2005	38.5
2007	36.2
2009	35.5
2011	34.8
2013	33.8
2015	33.8

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

One way to look at the effect a new preferential relationship has on exports from *i* to *j* is through the marginal effect of a PTA, which can be calculated as the ratio between the post- and pre-agreement proximities. Table 16 reports the evolution of the average marginal effect for all pairs of countries that at a given moment do not have a PTA, assuming full liberalization. The average marginal effect is positive but decreasing over time. This pattern can be explained because due to the proliferation of PTAs in recent decades, the scope for an increase in trade as a result of a new trade agreement has fallen, as shown by table 16.

As was argued previously, the number of trade agreements captures the multilateral effect on an MFN basis of signing PTAs. These agreements, in addition to the preferences themselves, involve changes that mean the elimination of other trade policy instruments that hinder trade. Additionally, the number of agreements reveals a country's preference for trade openness, and how export interests overcome the interests of import-substituting sectors. In this sense, they capture the trade preference effect that globalization variables had already identified. The difference is that, instead of being captured as a general trend common across countries, they capture the heterogeneity with which the phenomenon manifests itself at the level of each individual country. This effect can only be captured using a sample with domestic trade, since the substitution shown is between international and domestic trade. Therefore, it shows how the degree of trade openness of each country evolves.

Let's now turn to the distinction between permanent (ϕ_{ij}) and variable $(\tilde{\phi}_{ijt})$ proximities, with the latter divided between those directly related to FTAs $(\tilde{\phi}_{ijt}^{PTA})$, partial and non-reciprocal preferences $(\tilde{\phi}_{ijt}^{OPRE})$, and greater openness preferences $(\tilde{\phi}_{ijt}^{OPE})$. Table 17 reports the average proximities arising from the estimates in table 15 for 1995 and 2015. The results show that the increase in the variable proximity is primarily due to factors that can be associated with a greater preference for openness, in particular those identified as a preference for

openness measured by the interaction between the number of preferential bilateral relationships of exporter and importer, rather than by preferential agreements per se. However, this result indicates that the average barriers to international trade in terms of intra-national trade are still quite high.[37]

Table 17. Weighted average proximities, 1995 and 2015

Year	PTA	OPRE	Openness MFN		Variable proximity	Constant proximity	Total proximity
			Unilateral	No. of PTAs			
1995	0.9766	0.8662	0.9101	1.0582	0.9624	0.0042	0.0046
2015	1.0307	0.8885	0.8565	1.3849	1.3525	0.0040	0.0064

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: The values correspond to the simple averages of the proximity of each country in its exporting role. MFN: Most Favoured Nation; OPRE: Other preferences; PTA: Preferential trade agreement.

One feature of the specification adopted here is that it does not allow for the inclusion of time-invariant variables that are specific to each country-pair *ij*, which is due to the presence of fixed origin-destination effects. Furthermore, the presence of these fixed effects means that the impact of trade agreements measured by the PTA dummy variable refers only to those agreements that have entered into force during the period of analysis, as it is not possible to separately identify the effects associated with agreements adopted before the start of the period and that have been in force throughout the entire period.

As mentioned above, the $e^{\widehat{\mu}_{ij}}$ component that emerges from the estimate of the structural model represents those elements that are considered idiosyncratic and specific to the pair of countries *ij*. Although we have called this component a "constant," it can be interpreted more loosely, with the understanding that it refers to structural factors valid in each country during the period of time under study, but which could experience changes in the long term (i.e. outside the sample). Under this last interpretation, it would be interesting to identify whether the component $e^{\widehat{\mu}_{ij}}$ shows some relationship with factors that, although not constant over time, can be characterized as structural in the sense that they exhibit little variability over time.

To capture the two effects mentioned above, a second stage is carried out to estimate, by means of a PPML estimator, the following equation:

$$e^{\widehat{\mu}_{ij}} = \exp\left(\vartheta_i + \psi_j + \gamma_1 landlocked_{ij} + \gamma_2 island_{ij} + \gamma_2 contiguity_{ij} + \gamma_3 common\_language_{ij} + \gamma_4 ln\left(distance_{ij}\right) + \delta\overline{PTA}_{ij}\right) + \varphi\overline{CT}_{ij} + \varepsilon_{ij}, \quad (12)$$

[37] Using a substitution elasticity of 6, a value close to that reported by Head and Mayer (2015) as the average of a set of structural model estimates, the equivalent ad valorem tariff in 2015 was 173 per cent, while in 1995 it was 193 per cent.

where $\hat{\mu}_{ij}$ are the fixed country-pair effects estimated in the first stage, ϑ_i is a fixed effect of origin (exporter), ψ_j is a fixed effect of destination (importer), $landlocked_{ij}$ is a dummy variable equal to 1 if one or both of the countries of the bilateral relationship *ij* are landlocked, $island_{ij}$ is a dummy variable equal to 1 if one or both of the countries of the bilateral relationship *ij* are an island, $contiguity_{ij}$ is a dummy variable equal to 1 if countries *i* and *j* share a common border, $common\_language_{ij}$ is a dummy variable equal to 1 if countries *i* and *j* share a common language, $distance_{ij}$ is a variable that measures the distance between countries *i* and *j*, and $\overline{PTA}_{ij}$ is a dummy variable equal to 1 if for the entire period under study countries *i* and *j* have been members of a PTA in the form of a free trade area and/or a customs union. Finally, a measure of the export/import costs of the *ij* pair $(\overline{CT}_{ij})$ is incorporated. In particular, the average over 2009–2015 of the Global Alliance for Trade Facilitation Index is used. That index measures the costs for the exporter/importer to comply with the requirements for foreign trade. More specifically, the value of these indices, which are defined at the country level (in their role as exporter or importer), is bilateralized à la Novy using the geometric average.

Table 18. Decomposition of the constant component of proximity

Variable	Coefficient	Coefficient
Landlocked	-0.697***	-0.691***
Island	0.118	0.120
Contiguity	0.226**	0.226**
Common language	0.606***	0.604***
Distance	-0.957***	-0.950***
Permanent preferential trade agreement	0.176*	0.175*
Cost to export/import: Border compliance (geometric average)	-0.0592**	
Cost to export/import: Documentary compliance (geometric average)		-0.0532
Number of observations	10,920	10,920

Source: Prepared by the author using the database developed by Moncarz et al. (2021).
Note: Bootstrapped standard errors. *** p<0.01, ** p<0.05, * p<0.1.

The results reported in table 18 are in line with a priori expectations. Trade is lower when involving landlocked countries, while it increases between neighbouring countries as well as when countries share a common language. As expected, distance is negatively related with bilateral trade. Importantly, country-pairs that have continuously maintained a preferential trade relationship during the period studied here show higher levels of proximity. Lower levels of administrative trade costs also are related to a greater proximity, but we obtain a significant coefficient when they are measured in terms of border compliance (first column of table 18) as opposed to documentary compliance (second column of table 18).

5.3 Product-level estimates

This section estimates the structural gravity model for the case of three products (*p*) in the agricultural sector: coffee, maize and meat. While following the general estimation framework for the agricultural sector as a whole used in Section 5.2, the specifications adopted in this section are those that provide significant coefficients with the expected signs for each product. In particular, for coffee and meat the following specification is adopted:

$$x_{ijt}^{p} = \exp\left(\psi_{it}^{p} + n_{jt}^{p} + \mu_{ij}^{p} + +\alpha_1^p\left[PTA_{ijt} \times ln\left(T_{ijt}^{p}\right)\right] + \alpha_2^p\left[OP_{ijt} \times ln\left(T_{ijt}^{p}\right)\right] + \gamma_1^p\left[NoP_{ijt} \times ln\left(T_{ijt}^{p}\right)\right] + \gamma_2^p\left(NPTA_{it} \times NPTA_{jt}\right) + \delta CC_{ijt}\right) + \varepsilon_{ijt}, \quad (13)$$

where $p = coffee\ and\ meat$.

For empirical reasons the maize the specification is different:

$$x_{ijt}^{p} = \exp\left(\psi_{it}^{p} + n_{jt}^{p} + \mu_{ij}^{p} + +\alpha_1^p\left[PTA_{ijt} \times ln\left(T_{ijt}^{p}\right)\right] + \gamma_1^p\left[NoPTA_{ijt} \times ln\left(T_{ijt}^{p}\right)\right] + \gamma_2^p\left(NPTA_{it} \times NPTA_{jt}\right) + \delta CC_{ijt}^{p}\right) + \varepsilon_{ijt,} \quad (14)$$

where $p = maize$.

As can be seen, for coffee and meat the effect of applied tariffs is divided into three types of country-pairs: those in which the pair *ij* has a total trade liberalization agreement (FTA or customs union); those in which *j* offers a preference to *i*'s exports but under different frameworks than those of an FTA or customs union; and those in which *i*'s exports do not receive any preferential treatment from *j*.

In contrast, for maize the distinction is between country-pairs that have a deep trade agreement and those that do not. In both specifications, CC_{ijt}^{p} is a dummy variable that takes the value 1 if country *i* exports product *p* with revealed comparative advantage and country *j* imports product *p* with revealed comparative disadvantage. This variable intends to capture the existence of trade complementarity between the two countries of a country-pair.

Before presenting the results from the estimations, it is important to explain the methodology that was adopted to impute missing domestic trade values for countries for which such information was not available in the data.

From the structural gravity equation, intra-national trade $\left(x_{iit}^{p}\right)$ can be obtained as follows:

$$x_{iit}^{p} = x_{imt}^{p}\left(\frac{E_{it}^{p}}{E_{mt}^{p}}\frac{\phi_{iit}^{p}}{\phi_{imt}^{p}}\frac{\Phi_{it}^{p}}{\Phi_{mt}^{p}}\right). \quad (15)$$

In the above equation, the expression in parentheses can be understood as a factor for the expansion of trade between *i* and *j* that allows for obtaining the intra-national trade of *i*. To obtain this factor the process is carried out as follows:

1) For each product *p* the structural gravity equation is estimated with the available information, which in several cases lack data on intra-national trade for some countries.

2) The values of the total proximities are then calculated, and the country *m* that is the closest partner to each country *i*. is identified. Even when the values of the proximities may be biased, it is possible to expect the ranking for each country *i* to be less affected. Once the closest partner for each country *i* is identified, the correction factor is obtained using the results from the gravity model for the agriculture sector as a whole $\left(\frac{E_{it}^{p}}{E_{jt}^{p}}\frac{\phi_{iit}^{p}}{\phi_{imt}^{p}}\frac{\Phi_{it}^{p}}{\Phi_{mt}^{p}}\right) \cong \left(\frac{E_{it}}{E_{jt}}\frac{\phi_{iit}}{\phi_{imt}}\frac{\Phi_{it}}{\Phi_{mt}}\right)$.

3) Finally, using the values of x_{ijt}^{p}, the values for the x_{iit}^{p} when these were not originally available can be imputed.[38]

As reported in table 19, the results for the three products are in line with the arguments made previously for the model for the entire agricultural sector estimated in Section 5.2. For all three products, the preference for openness as measured by the interaction between the number of FTAs/customs unions of exporters and importers is positively related to the level of exports from country *i* to country *j*. A similar result emerges for the variable that accounts for the existence of trade complementarity, with larger trade flows for pairs where country *i* exports the product with comparative advantage and country *j* imports it with comparative disadvantage. Finally, the level of tariff that country *j* applies to imports from country *i* exhibits the expected negative sign in most cases. It is also possible to identify some differences in the magnitude of the impact in terms of the preferential relationship between the two countries.

Table 19. Estimation of structural gravity for three selected products

Effects/Products	Maize	Coffee	Meat
$NPTA_{it}$ x $NPTA_{jt}$	0.0009***	0.0007***	0.0008***
PTA_{ijt} x $ln(T_{jt})$	-1.8725*	0.0982	-1.0556***
$NoPTA_{ijt}$ x $ln(T_{jt})$	-1.4037		
OP_{ijt} x $ln(T_{jt})$		-2.4602**	-1.6741**
NoP_{ijt} x $ln(T_{jt})$		-0.1992	-0.6983*
CC_{ijt}	0.5296***	0.3066***	0.2756***
Observations	14.646	31.156	37.103

Source: Prepared by the author using the database developed by Moncarz et al. (2021).
Note: The sample includes the years 2001, 2003, 2005, 2007, 2009 and 2011. *** p<0.01, ** p<0.05, * p<0.1.

[38] The different specifications were also estimated without imputing domestic trade data. Qualitatively the results are almost identical. They are reported in Appendix B.

As in the case of the agriculture sector as a whole, once the gravity equation for each product is estimated, the permanent components (μ_{ij}^{p}) of the bilateral proximities are recovered and then regressed as a function of some explanatory variables. The results for permanent trade proximity, reported in table 20, are basically as expected. From among the traditional gravity variables, the two that have similar results across different products are common language and distance, showing the expected positive and negative signs, respectively. The fact that two countries had a deep permanent preferential relationship appears to have positive consequences for the trade of coffee, and to a less extent for that of meat. In addition, the level of trade proximity between any two countries is negatively related with the time required for border compliance; this result is statistically significant only for coffee and maize.

Table 20. Constant component of proximity for three selected products

Effects/Products	Without Trade Facilitation Effects			With Trade Facilitation Effects		
	Coffee (1)	Maize (2)	Meat (3)	Coffee (4)	Maize (5)	Meat (6)
Landlocked	0.14	-1.111	-0.35	0.269	-1.098*	-0.5
Island	-1.503***	-1.370**	0.378	-1.469***	-1.201	0.334
Contiguity	0.435	0.621**	0.303*	0.477	0.699**	0.431**
Common language	0.428***	0.0594	0.820***	0.323**	0.000315	0.846***
Distance	-0.710***	-1.349***	-1.061***	-0.833***	-1.473***	-0.965***
Permanent preferential trade agreement	0.684**	-0.149	0.24	0.638**	-0.164	0.313*
Cost to export/import: Border compliance (geometric average)				-0.484***	-0.270**	0.00598
Observations	5,103	2,356	6,172	4,681	2,185	5,583
R-squared	0.469	0.586	0.665	0.501	0.573	0.523

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: PTA: preferential trade agreement. *** p<0.01, ** p<0.05, * p<0.1. The first three columns are without the inclusion of the cost to export/import variable and the last three with the effect.

6 Conclusions and policy recommendations

This study has analysed the costs of international trade with a focus on agricultural products and landlocked countries. Data on bilateral trade for 114 individual economies during the 1995–2016 period was used to indirectly infer the level of trade barriers affecting the countries and products under study. Using both non-parametric and parametric methodologies, the intra- and extra-regional trade costs in agriculture and their compared evolution during the period were analysed first, followed by an analysis of the four selected products in the four landlocked countries of interest: coffee in Ethiopia, processed fruit in Uzbekistan,[39] maize in Lao People's Democratic Republic, and meat in Mongolia.

Information on total trade costs was combined with information on applied tariffs to calculate a measure of non-tariff trade costs. The results indicate that during the period analysed, there was tariff trade liberalization in agriculture, as indicated by a decrease in trade costs that can be attributed to tariffs that was partially offset by the growth of other trade costs. Therefore, the net reduction in total trade costs observed was small.

During the period under analysis, the study shows that there was a slight increase in trade openness, as shown by indicators calculated for the agriculture sector of the sample countries. The trade costs compared between regions of the world were found to be heterogeneous. Regions that include the landlocked countries of interest (South East Asia for Lao People's Democratic Republic, East Asia for Mongolia, Central Asia for Uzbekistan, and Africa for Ethiopia) have different levels of global trade costs, and are ranked from the fourth to the last position among the 13 regions of the world. Two regions of interest (South East Asia, East Asia) are in the top half of the ranking, and are thus more globally integrated into the world economy, while the other two regions of interest (Africa, Central Asia) are at the bottom of the ranking.

The study also confirmed that total intra-regional trade costs are lower than extra-regional cost for all regions, as geographic proximity is often reinforced by greater economic integration through lower tariffs on intraregional trade.

The four product markets of interest are different in terms of size and trade openness. Meat and maize are the largest in terms of the size of trade, and both are more open than the agriculture sector as a whole (17 and 16 per cent of exports as a share of production, respectively). Coffee is an open market (63 per cent), and its relevance in international trade is similar to that of maize. International trade in the processed fruit sector in terms of size is still small, but it grew rapidly during the period analysed. The study examines the degree of

[39] Processed fruit is sector 14 of the ITPD and includes dried fruits (see Appendix A).

trade openness in each product market and shows that market access is a relevant issue to be considered. Therefore, efforts to improve such access must be a priority for the national authorities of the LLDCs under study.

The four product markets are heterogeneous in terms of production and trade. In the maize market, production is highly concentrated, while meat production is more diversified, but exports are more concentrated. Coffee production and exports are diversified, while processed fruit exports are concentrated in a few countries.

When analysed at the regional level, the main international export flows are also heterogeneous. Meat and maize are produced by a few regions to satisfy their own demand (North America, Europe), but also to export (East Asia and Africa). Coffee and processed fruits are typically a South-North trade. It is interesting to note that the South America region is an important export source of the four individual products analysed. This study shows that only a small proportion of global production of these products is produced by landlocked countries, which on average have a high level of trade openness. Ethiopia and Uzbekistan are the main landlocked producers in coffee and processed fruits respectively. However, Lao People's Democratic Republic and Mongolia have a more marginal position in maize and meat exports respectively.

Those differences among countries and products result in the need to tailor export growth strategies at the national level to the specific characteristics of each product and country. This is something that other studies implemented within the framework of this project also clearly show, as in the cases of maize in Lao People's Democratic Republic (Cárcamo-Díaz, 2020), roasted coffee in Ethiopia (Ferro 2021) and dried fruit in Uzbekistan (Cárcamo-Díaz et al. 2021).[40] However, there are some common features across the LLDCs analysed that are interesting to highlight – particularly the importance of regional integration both via trade agreements such as the ASEAN+China agreement for Lao People's Democratic Republic and via infrastructure that improves international connectivity, especially for landlocked developing countries in general.[41]

In general, the handicap of being landlocked can be offset by trade policies that establish good trade facilitation practices, as well as logistics efforts in terms of land connectivity. Importantly, however, investment in connectivity infrastructure must be aligned with trade policy initiatives in order to succeed in reducing trade costs in the middle and long terms.

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[40] This refers to the UNCTAD project "Integrating Landlocked Commodity Dependent Developing Countries into Regional and Global Value Chains."

[41] For example, Grigoriou (2007) argues that three factors really matter to reduce trade costs in Central Asian landlocked developing countries: overland transportation costs, bargaining power with transit countries, and the infrastructure of those transit countries.

A corollary of this is that landlocked countries would benefit from focusing on addressing the different dimensions of trade cost reduction from a holistic perspective – for example, by improving intra-governmental coordination among those authorities focused on logistics and infrastructure, and those focused on access and tariff reduction. This complements the findings of other studies under this UNCTAD project about the importance of looking at the international competitiveness of a product based on an analysis of the entire value chain.

A comparison of experiences shows that landlocked countries that are deeply integrated into larger globally integrated markets tend to converge to the trade cost level in the region into which they are integrated. This is clearly the case of landlocked (developed) European countries, which have the lowest trade costs within the group of landlocked countries. But it is also observed in the case of Lao People's Democratic Republic and its progressive convergence in agricultural trade costs with the countries of East Asia and Southeast Asia.

The dynamics of variable trade costs are explained in this study by non-discriminatory trade policy (MFN tariffs, preference for openness, and trade facilitation factors) and by the effects of PTAs. Specifically, the degree of preference for trade openness between bilateral trade partners is measured through the interaction of the accumulated number of bilateral liberalized relationships. The political economy effects are expressed in more and better trade facilitation measures, among other factors.

PTAs influence trade directly. If a country has a PTA in place and the number of bilateral relationships liberalized of the exporting country is large, the impact on bilateral trade is usually positive. This occurs, among other reasons, due to the "learning" effect induced by trade, which results in increased "capacities" at the national level (see Hidalgo et al., 2011). Also, an effect of preference dilution takes place, indicating that the greater the number of PTAs that an importer has, the smaller is the effect of a PTA in increasing trade.

This suggests that landlocked developing countries need to pursue an active role in PTA negotiations, in particular with more integrated neighbours within their region that are important trade actors. The set of four landlocked countries studied have this opportunity because they have regional neighbours that meet this condition. A good example is Lao People's Democratic Republic, where convergence with the agricultural trade costs of South East Asian countries in the region was favoured by this dynamic activism in signing PTAs, notably including the ASEAN+China PTA. Finally, it is important for landlocked countries to take an active role in multilateral trade negotiations at the WTO aimed at fostering access by landlocked and least-developed countries, which can complement the above-mentioned role of regional trade partners and lead to further diversification of trade links and integration into global value chains in agriculture.

Appendix A. Database construction

Aggregated database for trade in agricultural products

The analysis in Sections 3 and 4 used data from a recent project implemented by the Latin American Development Bank . This project combined data from different sources with the aim of obtaining the necessary information for the analysis in this study, which notably includes data on intra-national trade to be able to calculate the Novy (2013) index. Data for 114 individual economies during the period 1995–2016 were used. For information and processing details on the dataset used here, see the Data Appendix in Moncarz et al. (2021).

Importantly, the dataset used included intra-economy trade flows. While some other databases include domestic commerce, their level of geographic coverage is limited, which means that no information is available for several developing countries. In addition, several other datasets used in the literature have problems in relation to the degree of sectoral coverage.[42]

This study uses the International Uniform Industrial Classification (ISIC, revision 3) for the definition of agriculture, livestock, hunting and forestry and fisheries (referred to as the AB Sector). As for geographical coverage, the study includes those countries for which the information could be obtained at the desired level, or, alternatively that could be reconstructed through the procedures explained below. The countries included in the database account for more than 90 per cent of global trade in the AB sector. The full list of countries is shown in table A1.

In addition to the above-mentioned trade data, other data sources used include the UNSTATS National Accounts - Analysis of Main Aggregates database for production and value-added data for the AB sector; [43] the World Bank's World Development Indicators database for value-added data;44 the OECD's Input-Output Tables database for production, value-added, and gross and net exports;45 and the CEPII BACI database for six-digit bilateral trade data of

[42] Databases reporting agricultural totals from more disaggregated data do not specify whether these totals arise from considering all subsectors or only those for which information could be obtained. In other cases, since there are no data for some subsectors, the total sector is not reported.

[43] The database is available at https://unstats.un.org/unsd/snaama/Index (accessed 17 December 2021).

[44] See World Bank, "Data bank," https://databank.worldbank.org/source/world-development-indicators (accessed 17 December 2021).

[45] The database is available at http://www.oecd.org/sti/ind/input-outputtables.htm (accessed 17 December 2021).

the 1992 version of the Harmonized System (HS-1992).[46] One advantage of the BACI database is that it reports statistics in which a harmonization process has been carried out between what has been declared by the importing country and what has been declared by the exporting country. The data are expressed in free on board values, and the original information source is COMTRADE.

To assemble the bilateral transaction database, it was necessary to develop four databases that were then combined: current dollar production; total exports in current dollars; domestic transactions in current dollars; and bilateral flows of trade in current dollars. The last step is to join the bilateral trading flow database (after making the timely corrections mentioned) with the domestic transaction database. This results in a database covering the period 1995–2016 for a total of 114 economies, for the AB sector.

In addition to data on bilateral trade flows and domestic transactions, information was also collected on the most common variables of the gravity trade model. The two main sources are the Gravity Database developed by CEPII, and the Dynamic Gravity Dataset developed by the United States International Trade Commission (USITC).[47] Moncarz et al. (2021) provide greater detail on the assumptions and all the transformations performed.

[46] See CEPII at http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37 (accessed 17 December 2021).

[47] See the USITC "Gravity portal" at https://www.usitc.gov/data/gravity/dgd.htm (accessed 17 December 2021).

Table A1. Economies included in the bilateral trade data with intra-national trade

Africa (23)	Central America and Caribbean (10)	Europe (34)	Pacific (5)
Angola	**Central America**	Germany	Australia
Benin	Costa Rica	Austria	Fiji
Burundi	El Salvador	Azerbaijan	New Zealand
Cabo Verde	Guatemala	Belarus	Samoa
Cameroon	Honduras	Belgium-Luxembourg	Tonga
Côte d'Ivoire	Nicaragua	Bosnia and Herzegovina	**Eurasia, Central and South Asia (10)**
Egypt	Panama	Cyprus	**Central Asia**
Ethiopia	**The Caribbean**	Croatia	Kyrgyzstan
Gambia	Cuba	Denmark	Turkmenistan
Guinea	Haiti	Slovakia	Uzbekistan
Guinea-Bissau	Jamaica	Slovenia	**Eurasia**
Kenya	Dominican Republic (the)	Spain	Russian Federation
Madagascar		Estonia	Kazakhstan
Malawi	**North America (3)**	Finland	Turkey
Morocco	Canada	France	**South Asia**
Mauritius	United States of America (the)	Greece	Bangladesh
Mauritania	Mexico	Hungary	India
Nigeria		Ireland	Maldives
South Africa	**South America (10)**	Iceland	Nepal
Sudan	Argentina	Italy	Pakistan
United Republic of Tanzania (the)	Bolivia (Plurinational State of)	Latvia	**East and South East Asia (11)**
Tunisia	Brazil	Lithuania	**East Asia**
Uganda	Chile	Republic of Moldova	China
	Colombia	Norway	Hong Kong (China)
Middle East (7)	Ecuador	Norway	Japan
Saudi Arabia	Paraguay	Poland	Republic of Korea
Iran (Islamic Republic of)	Peru	Portugal	**South East Asia**
Israel	Uruguay	United Kingdom	Philippines (the)
Jordan	Venezuela (Bolivarian Republic of)	Czechia	Indonesia
Kuwait		Romania	Lao People's Democratic Republic
Lebanon		Sweden	Malaysia
Yemen		Switzerland	Singapore
		Ukraine	Thailand
			Viet Nam

Source: Prepared by the author.

Database at the product level (HS6)

For the product analysis carried out in this study, the six-digit set of products of the harmonized system (HS6) that fall within each of the selected commodities was established. The database was constructed using COMTRADE data for the period 1995–2018. The structure of fields is the following: product code (HS); year (*y*); importer (*imp*); exporter (*exp*); description of the product (*name*); and bilateral trade (*xij*). Table A2 reports results for the sample of products for each of the selected countries.

The trade database does not include information about total product supply in each country. For that purpose, Borchert et al. (2020) developed a new International Trade and Production Database for Estimation (ITPD-E) at a sector level.[48] The information on total supply requires having information on the intra-national trade transactions carried out, that is, own production, which is absorbed in the country's own market. Intra-national trade (*xii*) plus export (*ei*) is equal to total supply (*yi*) (*yi*=*xii*+*ei*). The ITPD-E sectoral coverage follows the ISIC rev. 4 classification system. The agricultural products are classified according to the FAOSTAT Commodity List of the Food and Agriculture Organization (FAO).[49] The matching between sectors in the ITPD-E database and the commodities studied in this paper is very strong for three of the four cases: maize (sector 3); processing/preserving of meat (sector 34); and beverage, nec (sector 22, which includes coffee). For processed fruits (sector 14, which includes dry fruits) data coverage is not as strong, and there is also no information about intra-national trade.

Table A2. Trade data for four commodities in four landlocked countries, 2018
(millions of United States dollars and per cent)

Name	HS	Exports		Share (per cent)	
		World	Laos PDR	World	Laos PDR
Cereals	10	207,921	121	100	100
Corn	1005	64,633	49	31	41
Maize (corn) seed	100510	5,874	50	3	42
Maize except seed corn	100590	58,700	1	28	1
			Ethiopia		Ethiopia
Coffee, tea, mate and spices	9	91,209	868	100	100
Coffee, coffee husks and skins and coffee substitutes	901	58,311	846	63.9	97.5

[48] As explained in Borchert et al. (2020), the ITPD-E contains consistent data on international and domestic trade for 243 countries, 170 industries, and 17 years. The data are constructed at the industry level covering agriculture, mining, energy, manufacturing and services. The ITPD-E thus almost completely describes the traded sectors of each economy. The time period covered begins in 2000 and extends to 2016.

[49] Available at http://www.fao.org/economic/ess/ess-standards/commodity/item-hs/en/ (accessed 17 December 2021).

Name	HS	Exports		Share (per cent)	
		World	Laos PDR	World	Laos PDR
Coffee, not roasted, not decaffeinated	90111	34,469	820	37.8	94.5
Coffee, not roasted, decaffeinated	90112	1,469	18	1.6	2.0
Coffee, roasted, not decaffeinated	90121	20,756	6	22.8	0.7
Coffee, roasted, decaffeinated	90122	1,272	0	1.4	0.0
Coffee husks and skins	90130	189	1	0.2	0.1
Coffee substitutes containing coffee	90140	28	1	0.0	0.1
			Mongolia		Mongolia
Meat and edible meat offal	2	242,896	100	100	100
Meat	201-206	92,252	75	38	75
Meat of bovine animals, fresh or chilled	201	47,350	0	19	0
Meat of bovine animals, frozen	202	4,517	3	2	3
Meat of swine, fresh, chilled or frozen	203	56,124	8	23	8
Meat of sheep or goats, fresh, chilled or frozen	204	15,057	0	6	0
Horse, ass, mule, hinny meat, fresh, chilled or froze	205	968	64	0	64
Edible offal of domestic animals	206	15,586	0	6	0
			Uzbekistan		Uzbekistan
Edible fruit, nuts, peel of citrus fruit, melons	8	250,188	556.7	100	100
Coconuts, Brazil nuts and cashew nuts, fresh or dried	801	19,138	0.7	8	0
Nuts except coconut, Brazil & cashew, fresh or dried	802	34,370	24.7	14	4
Bananas, including plantains, fresh or dried	803	27,134	3.4	11	1
Dates, figs, pineapple, avocado, guava, fresh or dried	804	26,480	1.4	11	0
Citrus fruit, fresh or dried	805	30,450	7.3	12	1
Grapes, fresh or dried	806	21,192	185.9	8	33
Fruit, dried, nes, dried fruit and nut mixtures	813	4,721	37.1	2	7
Coconuts, fresh or dried	80110	2,617	0.2	1	0
Brazil nuts, fresh or dried	80120	881		0	0
Cashew nuts, fresh or dried	80130	15,556	0.4	6	0
Almonds in shell fresh or dried	80211	2,665	0.6	1	0
Almonds, fresh or dried, shelled	80212	10,194	3.0	4	1
Hazelnuts and filberts in shell fresh or dried	80221	180	0.4	0	0
Hazelnuts and filberts, fresh or dried, shelled	80222	3,247		1	0
Walnuts in shell, fresh or dried	80231	2,106	6.2	1	1
Walnuts, fresh or dried, shelled	80232	4,148	14.2	2	3
Chestnuts, fresh or dried	80240	724		0	0
Pistachios, fresh or dried	80250	5,480	0.3	2	0
Nuts edible, fresh or dried, nes	80290	5,576	0.0	2	0

Source: Prepared by the author based on the COMTRADE database.

Note: HS: Harmonized System.

Table A3. Matching between the FAOSTAT Commodity List, Harmonized System and International Trade and Production Database classification

FCL	Description	HS07	ITPD-E id
56	Maize	1005.1	3
56	Maize	1005.9	3
656	Coffee green	901.11	22
657	Coffee, Roasted	901.12	22
657	Coffee, Roasted	901.21	22
657	Coffee, Roasted	901.22	22
658	Coffee Substitutes	901.9	22
604	Fruit, tropical (Dried) nes	803	14
604	Fruit, tropical (Dried) nes	804.3	14
604	Fruit, tropical (Dried) nes	804.4	14
604	Fruit, tropical (Dried) nes	804.5	14
604	Fruit, tropical (Dried) nes	813.4	14
604	Fruit, tropical (Dried) nes	813.5	14
620	Fruit, dried nes	813.3	14
620	Fruit, dried nes	813.4	14
620	Fruit, dried nes	813.5	14
867	Meat of cattle	202.1	34
867	Meat of cattle	202.2	34
867	Meat of cattle	201.1	34
867	Meat of cattle	201.2	34
868	Offals of cattle, edible	206.1	34
868	Offals of cattle, edible	206.21	34
868	Offals of cattle, edible	206.22	34
868	Offals of cattle, edible	206.29	34
870	Meat of cattle, boneless	201.3	34
870	Meat of cattle, boneless	202.3	34
872	Beef and Veal, Dried, Salted, Smoked	210.2	34
1097	Horse meat	205	34
1098	Offals of horses	206.8	34
1098	Offals of horses	206.9	34
977	Meat of sheep	204.1	34
977	Meat of sheep	204.21	34
977	Meat of sheep	204.22	34
977	Meat of sheep	204.23	34

FCL	Description	HS07	ITPD-E id
977	Meat of sheep	204.3	34
977	Meat of sheep	204.41	34
977	Meat of sheep	204.42	34
977	Meat of sheep	204.43	34
978	Offals of sheep, edible	206.8	34
978	Offals of sheep, edible	206.9	34

Source: Prepared by the author using the FAOSTAT Commodity List – Harmonized System (FCL-HS) and the International Trade and Production Database for Estimation.

Table A3 presents the matching of the HS codes studied with each of the four ITPD-E sectors. Unfortunately, a large amount of data are missing from the intra-national trade data. Where partial information was available, we used interpolation techniques to complete the database. This could be done for three of the four sectors, but not for the dried fruit sector (id=14 in table A3 and A4), as there are no data on intra-national trade in that sector. Table A4 presents information for the four sectors from the ITPD-E for the last year available (2016).

Table A4. Total supply and trade, 2016
(millions of United States dollars and per cent)

Id	Industry	Supply	Trade	Openness (per cent)
22	Beverages, nec	41,745	26,526	63.5
3	Corn	198,076	32,004	16.2
14	Prepared fruits and fruit juices[a]	2,760	2,760	--
34	Processing/preserving of meat	819,951	137,687	16.8

Source: Prepared by the author using the International Trade and Production Database for Estimation.
Note: No available information for intra-national trade.

The coffee market is a market open to international trade. In the case of maize and processing/preserving meat, the main orientation of production is the domestic market. To complete the information for the parametric estimation, we need a set of variables traditionally used in the gravity model as explanatory variables for permanent and time-dependent trade costs. For that purpose, the most recent and complete database is the USITC's Gravity Modelling Environment Database (see costs) by Gurevich and Herman (2018).

Appendix B. Statistical Data

Figure B1. Intra- and extra-regional proximity, by economy and region, 2015
a. Entire sample

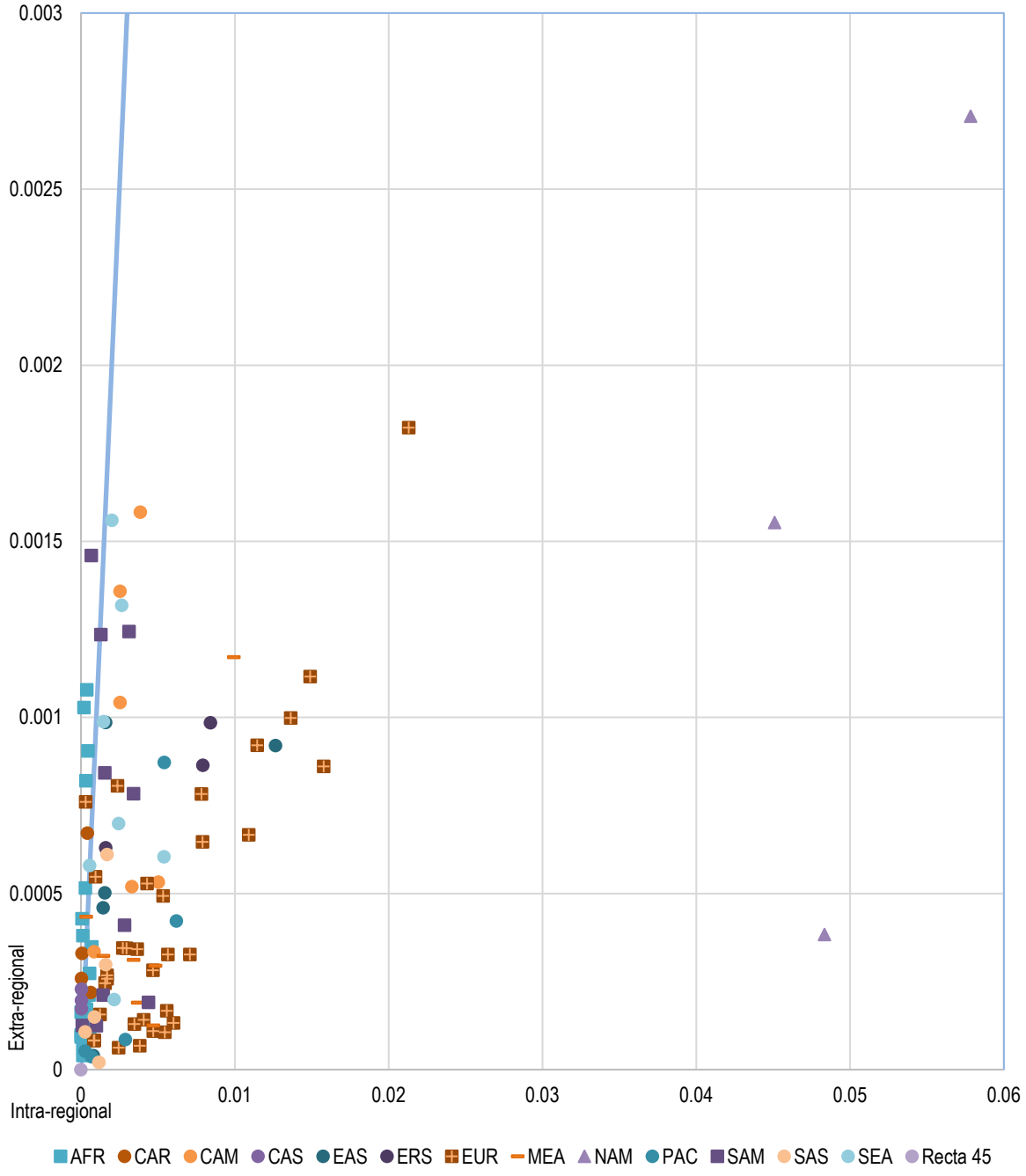
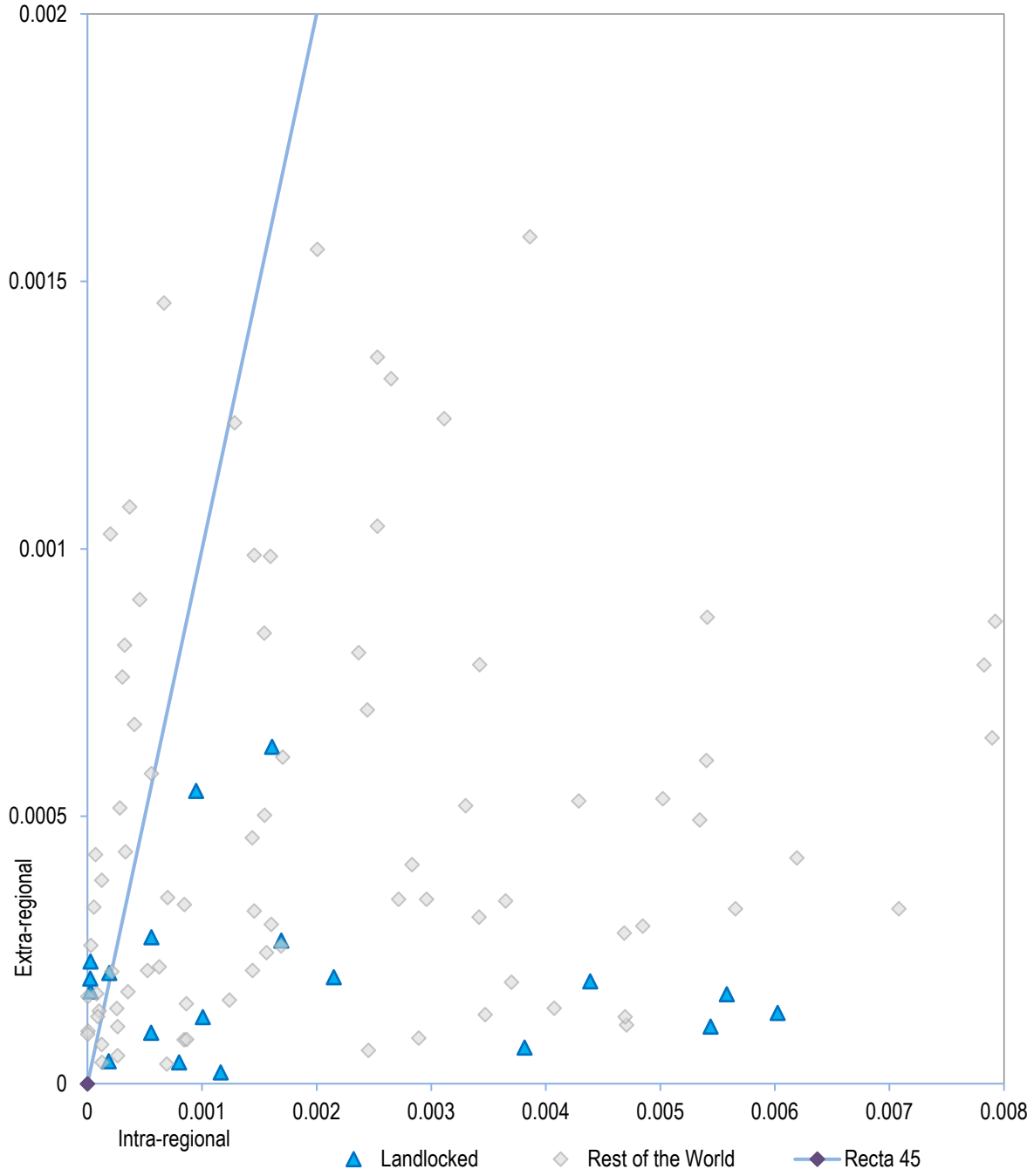


Figure B1. Intra- and extra-regional proximity, by economy and region, 2015
b. Highlighting landlocked countries (rescaled axis)



Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Figure B2. Intra- and extra-regional proximity by region, 1995 and 2015
(per cent)
a. Entire regions

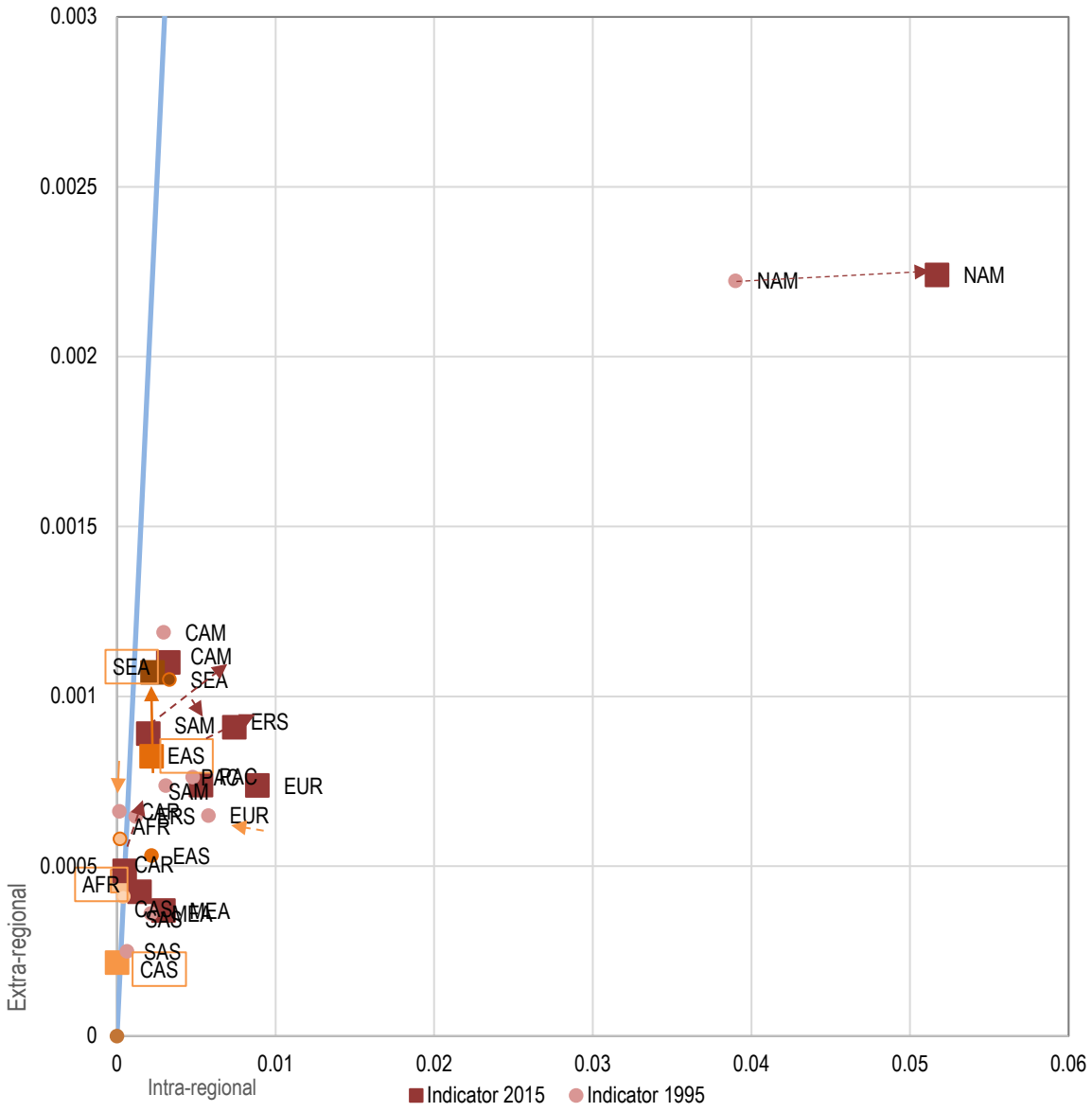
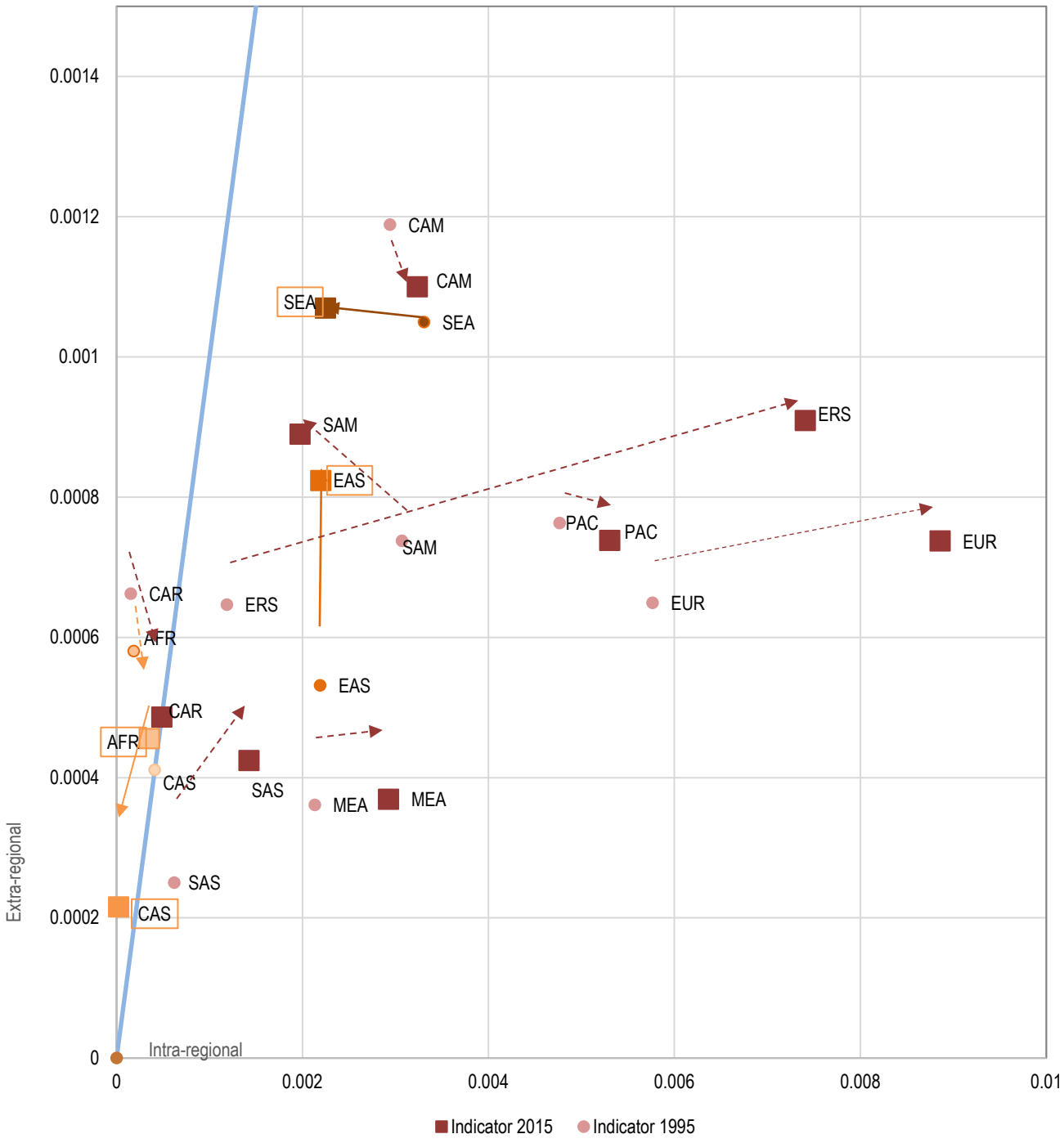


Figure B2. Intra- and extra-regional proximity by region, 1995 and 2015
(per cent)
b. Rescaled axis



Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), and South East Asia (SEA).

Table B1. Breakdown of total intra- and extra-regional variables, 1995–2015
(proximities and per cent)

a. Proximities

Region[a]	1995			2015			Variation (%)		
	Intra-regional	Extra-regional	Total	Intra-regional	Extra-regional	Total	Extra-regional	Extra-regional	Total
NAM	0.0390	0.0022	0.0037	0.0517	0.0022	0.0042	32.6	0.7	12.5
EUR	0.0058	0.0006	0.0023	0.0089	0.0007	0.0025	53.6	13.6	9.5
CAM	0.0029	0.0012	0.0012	0.0032	0.0011	0.0011	10.1	-7.5	-7.4
SEA	0.0033	0.0010	0.0012	0.0023	0.0011	0.0011	-32.0	1.9	-3.1
ERS	0.0012	0.0006	0.0007	0.0074	0.0009	0.0011	525.0	40.6	67.1
SAM	0.0031	0.0007	0.0010	0.0020	0.0009	0.0010	-35.7	20.6	4.8
EAS	0.0022	0.0005	0.0007	0.0022	0.0008	0.0009	0.3	54.9	38.4
PAC	0.0048	0.0008	0.0009	0.0053	0.0007	0.0008	11.3	-3.3	-3.5
SAS	0.0006	0.0003	0.0003	0.0014	0.0004	0.0005	130.3	69.6	81.8
MEA	0.0021	0.0004	0.0004	0.0029	0.0004	0.0005	37.2	2.2	17.2
CAR	0.0002	0.0007	0.0007	0.0005	0.0005	0.0005	219.4	-26.6	-27.3
AFR	0.0002	0.0006	0.0006	0.0004	0.0005	0.0004	89.4	-21.6	-21.1
CAS	0.0004	0.0004	0.0004	0.0000	0.0002	0.0002	-93.6	-47.7	-48.3
Total	**0.0014**	**0.0006**	**0.0008**	**0.0015**	**0.0007**	**0.0008**	**3.8**	**2.3**	**2.9**

b. Trade costs in tariff equivalent

Region [a]	1995			2015			Variation (%)		
	Intra-regional	Extra-regional	Total	Intra-regional	Extra-regional	Total	Extra-regional	Extra	Total
NAM	91.3	239.3	206.4	80.8	238.8	199.2	-11.5	-0.2	-3.4
EUR	180.4	334.1	237.5	157.4	323.1	231.4	-12.8	-3.3	-2.6
CAM	220.8	284.6	281.3	214.8	290.6	287.1	-2.8	2.1	2.1
SEA	213.4	294.3	285.1	238.5	292.8	287.5	11.8	-0.5	0.9
ERS	284.8	334.4	332.1	166.7	305.8	289.9	-41.5	-8.6	-12.7
SAM	218.1	323.1	299.9	247.4	307.5	296.2	13.4	-4.8	-1.2
EAS	240.3	351.8	330.2	240.1	313.9	303.1	-0.1	-10.8	-8.2
PAC	191.3	320.2	310.9	185.1	323.0	313.8	-3.2	0.9	0.9
SAS	338.1	425.3	416.2	270.8	372.6	358.1	-19.9	-12.4	-14.0
MEA	242.1	388.1	375.2	221.2	386.0	360.3	-8.7	-0.5	-4.0
CAR	479.2	332.3	332.3	359.2	359.9	360.7	-25.0	8.3	8.5
AFR	456.9	343.9	348.1	390.1	365.9	369.8	-14.6	6.4	6.2
CAS	375.8	375.6	375.4	724.4	441.3	442.4	92.8	17.5	17.9
Total	**271.7**	**334.4**	**317.7**	**269.0**	**332.4**	**315.4**	**-1.0**	**-0.6**	**-0.7**

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), and South East Asia (SEA).

Table B2. Breakdown of total intra- and extra-regional proximities, 1995–2015
(proximity index and percent)

Region	1995			2015			variation		
	Tariff	Non_T	Total	Tariff	Non_T	Total	Tariff	Non_T	Total
NAM	0.4075	0.0091	0.0037	0.5419	0.0077	0.0042	33.0	-15.4	12.5
EUR	0.4229	0.0054	0.0023	0.5552	0.0045	0.0025	31.3	-16.8	9.5
CAM	0.3513	0.0035	0.0012	0.5111	0.0023	0.0011	45.5	-36.3	-7.4
SEA	0.1928	0.0057	0.0012	0.4701	0.0024	0.0011	143.8	-58.0	-3.1
ERS	0.3629	0.0018	0.0007	0.3586	0.0030	0.0011	-1.2	65.3	67.1
SAM	0.3690	0.0026	0.0010	0.4729	0.0022	0.0010	28.2	-18.5	4.8
EAS	0.2086	0.0032	0.0007	0.3637	0.0025	0.0009	74.3	-19.4	38.4
PAC	0.4354	0.0020	0.0009	0.6078	0.0014	0.0008	39.6	-30.9	-3.5
SAS	0.0873	0.0029	0.0003	0.2312	0.0020	0.0005	164.8	-29.5	81.8
MEA	0.1448	0.0023	0.0004	0.3394	0.0014	0.0005	134.3	-42.2	17.2
CAR	0.3818	0.0017	0.0007	0.4397	0.0011	0.0005	15.1	-36.8	-27.3
AFR	0.1518	0.0030	0.0006	0.3838	0.0011	0.0004	152.9	-61.2	-21.1
CAS	0.3224	0.0012	0.0004	0.3326	0.0006	0.0002	3.2	-48.0	-48.3
Total	**0.2606**	**0.0029**	**0.0008**	**0.4158**	**0.0019**	**0.0008**	**59.6**	**-32.2**	**2.9**

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Note: Regions: Africa (AFR), Caribbean (CAR), Central America (CAM), Central Asia (CAS), East Asia (EAS), Eurasia (ERS), Europe (EUR), Middle East (MEA), North America (NAM), Pacific (PAC), South America (SAM), South Asia (SAS), South East Asia (SEA).

Table B3. Total intra-regional and extra-regional proximity ranking by economy and by region, 2015

Region	Economy	Rank Total	Rank Intra	Rank Extra
Africa	**Morocco**	44	97	15
	Cote d'Ivoire	41	87	13
	Egypt	50	90	27
	South Africa	49	85	22
	Tunisia	71	92	44
	Cameroon	77	106	49
	Mauritania	80	101	53
	Kenya	76	77	54
	Mauritius	90	84	75
	Sudan	99	88	83
	Uganda	103	83	101
	Guinea	101	105	84
	Ethiopia	96	98	77
	Malawi	85	82	67
	Benin	95	96	76
	Cape Verde	110	112	100

Region	Economy	Rank Total	Rank Intra	Rank Extra
	Nigeria	106	103	91
	United Republic of Tanzania (the)	102	95	90
	Madagascar	112	102	106
	Gambia, The	104	113	86
	Angola	114	100	112
	Burundi	113	99	110
	Guinea-Bissau	111	114	102
Caribbean	Dominican Republic (the)	57	86	33
	Jamaica	83	107	59
	Haiti	92	80	73
	Cuba	89	108	69
Central America	Costa Rica	15	33	3
	Guatemala	22	48	7
	Honduras	37	47	14
	El Salvador	63	40	43
	Nicaragua	55	25	41
	Panama	79	74	58
Central Asia	Uzbekistan	93	109	72
	Kyrgyzstan	100	110	82
	Turkmenistan	98	111	79
East Asia	Hong Kong, China	10	8	21
	China	43	59	18
	Japan	60	61	45
	Republic of Korea	66	66	47
	Mongolia	87	76	111
Eurasia	Kazakhstan	54	57	36
	Turkey	38	13	24
	Russian Federation	32	12	19
Europe	Netherlands (the)	1	4	2
	Belgium	3	5	25
	Germany	5	6	12
	Ireland	39	32	89
	Portugal	17	19	60
	France	8	9	20
	Spain	6	7	16
	Denmark	9	10	34
	Slovakia	30	34	107
	Czechia	20	20	85
	Austria	19	18	92
	Slovenia	35	37	93

Region	Economy	Rank Total	Rank Intra	Rank Extra
	United Kingdom	11	15	30
	Latvia	28	36	57
	Lithuania	13	24	46
	Hungary	24	21	99
	Poland	14	16	61
	Italy	12	14	35
	Sweden	25	27	97
	Norway	27	29	66
	Estonia	33	42	56
	Croatia	52	49	108
	Azerbaijan	62	91	31
	Romania	18	31	42
	Belarus	53	71	40
	Republic of Moldova (the)	59	60	71
	Greece	47	45	55
	Cyprus	70	68	87
	Switzerland	64	55	68
	Ukraine	34	51	28
	Finland	56	56	70
	Bosnia and Herzegovina	84	75	105
	Iceland	82	72	104
Middle East	Jordan	69	26	65
	Israel	31	11	11
	Kuwait	75	35	81
	Saudi Arabia	74	39	63
	Iran (Islamic Republic of)	73	89	48
	Yemen	91	28	95
	Lebanon	78	64	62
North America	Mexico	7	2	52
	Canada	4	3	5
	United States of America (the)	2	1	1
Pacific	Australia	45	22	23
	Fiji	86	43	103
	New Zealand	68	17	50
	Samoa	107	78	113
	Tonga	105	94	109
South America	Colombia	23	79	6
	Peru	29	67	10
	Chile	40	38	29
	Brazil	26	41	9
	Ecuador	46	62	26
	Paraguay	51	30	80

Region	Economy	Rank Total	Rank Intra	Rank Extra
	Argentina	61	44	51
	Uruguay	81	65	74
	Bolivia (Plurinational State of)	88	70	96
	Venezuela (Bolivarian Republic of)	108	104	94
South Asia	**Nepal**	94	69	114
	India	58	54	37
	Bangladesh	72	58	64
	Pakistan	97	73	88
	Maldives	109	93	98
South East Asia	**Singapore**	36	23	38
	Thailand	21	46	8
	Viet Nam	16	53	4
	Malaysia	48	50	32
	Indonesia	42	63	17
	Lao People's Democratic Republic	65	52	78
	Philippines (the)	67	81	39

Source: Prepared by the author using the database developed by Moncarz et al. (2021).

Table B4. Main importers of maize, 2016
(millions of United States dollars and per cent)

Economy	Demand	Imports	Import openness (per cent)	Economy	Demand	Imports	Import openness (per cent)
Japan	3,067	3,067	100	France	771	283	36.6
Mexico	7,536	2,690	35.7	Israel	348	266	76.5
Republic of Korea	1,946	1,898	97.6	Indonesia	6,490	231	3.6
Egypt	3,564	1,544	43.3	Bangladesh	740	220	29.8
Iran (Islamic Republic of)	1,802	1,463	81.2	Dominican Republic (the)	235	219	93.2
Viet Nam	2,812	1,391	49.5	Guatemala	217	217	100
Spain	1,930	1,216	63	Austria	311	208	66.9
Italy	2,221	894	40.2	Philippines (the)	2,241	202	9
Netherlands (the)	878	878	100	Tunisia	199	199	100
Colombia	1,249	871	69.8	Cuba	190	190	100
Taiwan Province of China	787	787	100	Ireland	187	187	100
Algeria	770	769	99.9	Jordan	184	175	95.2
Malaysia	714	711	99.6	Costa Rica	167	162	97.2
Saudi Arabia	731	693	94.7	Romania	1,311	156	11.9
Germany	1,138	682	59.9	El Salvador	435	152	35
China	61,862	640	1	United Arab Emirates (the)	142	142	100
South Africa	2,002	630	31.5	Malawi	856	139	16.3
Peru	1,332	605	45.5	Russian Federation	1,229	138	11.3
United States of America (the)	40,597	559	1.4	Poland	517	133	25.8
Brazil	8,249	500	6.1	Turkey	1,332	133	10
Venezuela (Bolivarian Republic of)	2,237	464	20.7	Greece	565	124	21.9
Morocco	432	399	92.4	Yemen	177	121	68.2
Portugal	484	366	75.6	Honduras	306	121	39.4
United Kingdom	362	362	100	Libya	117	117	100
Belgium	340	339	99.8	Ukraine	1,100	116	10.5
Canada	1,766	307	17.4	Nepal	706	107	15.2
Zimbabwe	634	303	47.7	Lebanon	103	103	99.9
Chile	378	292	77.1	Panama	173	101	58
				World	**198.599**	**32.004**	**16.1**

Source: Prepared by the author using the International Trade and Production Database for Estimation.

Table B5. Main importers of coffee and tea, 2016
(millions of United States dollars and per cent)

Economy	Demand	Imports	Openness to imports (per cent)	Economy	Demand	Imports	Openness to imports (per cent)
United States of America (the)	5,483	5,390	98.3	Finland	247	247	100
Germany	3,180	3,180	100	Malaysia	262	242	92.4
Italy	1,529	1,529	100	China	10,613	227	2.1
Japan	2,490	1,491	59.9	Taiwan Province of China	165	165	100
Russian Federation	919	919	100	Syrian Arab Republic (the)	164	164	100
United Kingdom	907	907	100	Viet Nam	164	164	100
Belgium	832	832	100	United Arab Emirates (the)	157	157	100
Canada	774	774	100	Greece	154	154	100
France	706	706	100	India	231	150	65.2
Spain	702	702	100	Mexico	148	148	100
Switzerland	629	629	100	Turkey	253	146	57.6
Netherlands (the)	587	587	100	Portugal	142	142	100
Pakistan	490	490	100	Norway	142	142	100
Republic of Korea	443	438	98.9	Iraq	117	117	100
Sweden	387	387	100	Ukraine	115	115	100
Australia	375	375	100	Kenya	390	115	29.3
Poland	338	338	100	Kazakhstan	113	113	100
Algeria	337	337	100	Thailand	480	107	22.4
Morocco	281	281	100	Jordan	107	107	100
Iran (Islamic Republic of)	298	272	91.2	South Africa	107	105	98.4
Saudi Arabia	248	248	100	**World**	**41,745**	**26,526**	**63.5**

Source: Prepared by the author using the International Trade and Production Database for Estimation.

Table B6. Main importers of meat, 2016
(millions of United States dollars and per cent)

Economy	Demand	Imports	Openness to imports (per cent)	Economy	Demand	Imports	Openness to imports (per cent)
China	100,517	12,690	12.6	Austria	4,706	1,419	30.2
Japan	32,655	12,021	36.8	Chile	1,288	1,288	100
United States of America (the)	122,287	8,974	7.3	Taiwan Province of China	24,624	1,275	5.2
United Kingdom	32,287	8,502	26.3	Czechia	3,424	1,265	36.9
Germany	51,854	8,009	15.4	Greece	2,715	1,232	45.4
Hong Kong, China	7,665	6,582	85.9	Portugal	3,567	1,224	34.3
Italy	32,890	6,087	18.5	Philippines (the)	1,992	1,095	55
Netherlands	6,761	5,474	81	Ireland	3,201	1,068	33.4
France	45,050	5,402	12	Singapore	1,358	974	71.7
Republic of Korea	7,560	4,372	57.8	Malaysia	1,970	859	43.6
Mexico	8,599	4,305	50.1	Switzerland	8,146	856	10.5
Viet Nam	27,901	3,432	12.3	Romania	4,045	794	19.6
Canada	20,528	2,967	14.5	Indonesia	882	650	73.7
Russian Federation	41,393	2,497	6	Hungary	2,168	645	29.7
Belgium	5,736	2,308	40.2	Slovakia	1,097	625	57
Saudi Arabia	3,247	2,116	65.2	Israel	3,121	589	18.9
Spain	24,157	1,999	8.3	Australia	11,246	584	5.2
United Arab Emirates (the)	1,764	1,764	100	South Africa	583	583	100
Poland	14,071	1,676	11.9	Iraq	575	575	100
Denmark	3,575	1,520	42.5	Qatar	502	497	99
Sweden	6,383	1,446	22.7	Angola	450	450	100
Egypt	2,252	1,438	63.9	**World**	**819,951**	**137,687**	**16.8**

Source: Prepared by the author using the International Trade and Production Database for Estimation.

Table B7. Main importers of dried fruit, 2016
(millions of United States dollars and per cent)

Economy	Imports	Economy	Imports
United States of America (the)	252	Hong Kong, China	48
Germany	245	Russian Federation	46
United Kingdom	241	Switzerland	42
Viet Nam	228	Sweden	41
France	142	Brazil	38
Italy	96	Mexico	36
Netherlands	87	Kazakhstan	32
China	79	Czechia	28
Japan	74	Denmark	25
Canada	74	Finland	24
India	71	Malaysia	23
Belgium	60	United Arab Emirates (the)	23
Spain	60	Israel	20
Poland	57	Slovakia	20
Australia	52	Romania	20
Austria	49	**World**	**2,760**

Source: Prepared by the author using the International Trade and Production Database for Estimation.

Table B8. Trade policy for Mongolia's main export destinations, 2020

Name		MFN			GSP	
	HS	China	European Union	Switzerland	European Union	Switzerland
Bovine, fresh or chilled, carcasses or half-carcasses	020110	20	[12.8 % + 176.8 EUR/100 kg]	[758 Fr./ 100 kg] [758 Fr./ 100 kg]	Without preferences	Without preferences
Bovine, fresh or chilled, cuts with bone	020120	12	[12.8 % + 141.4 EUR/100 kg] [12.8 % + 265.2 EUR/100 kg] [12.8 % + 212.2 EUR/100 kg] [12.8 % + 176.8 EUR/100 kg]	[1368 Fr./ 100 kg] [1368 Fr./ 100 kg]	Without preferences	Without preferences
Bovine, fresh or chilled, boneless	020130	12	[12.8 % + 303.4 EUR/100 kg]	[2212 Fr./ 100 kg] [2212 Fr./ 100 kg]	Without preferences	Without preferences
Bovine frozen, carcasses or half-carcasses	020210	25	[12.8 % + 176.8 EUR/100 kg]	[758 Fr./ 100 kg] [758 Fr./ 100 kg]	Without preferences	Without preferences
Bovine frozen, cuts with bone	020220	12	[12.8 % + 141.4 EUR/100 kg] [12.8 % + 176.8 EUR/100 kg] [12.8 % + 265.3 EUR/100 kg] [12.8 % + 221.1 EUR/100 kg]	[1233 Fr./ 100 kg] [1233 Fr./ 100 kg]	Without preferences	Without preferences
Bovine frozen, boneless	020230	12	[12.8 % + 221.1 EUR/100 kg] [12.8 % + 221.1 EUR/100 kg] [12.8 % + 304.1 EUR/100 kg]	[2057 Fr./ 100 kg] [2057 Fr./ 100 kg]	Without preferences	Without preferences
Sheep Lamb carcasses and half fresh or chilled	020410	15	[12.8 % + 171.3 EUR/100 kg]	[838 Fr./ 100 kg]	Without preferences	Without preferences

Name		MFN			GSP	
	HS	China	European Union	Switzerland	European Union	Switzerland
Sheep carcasses and half fresh or chilled	020421	23	[12.8 % + 171.3 EUR/100 kg]	[845 Fr./ 100 kg]	Without preferences	Without preferences
Sheep cuts with bone	020422	15	[12.8 % + 222.7 EUR/100 kg] [12.8 % + 188.5 EUR/100 kg] [12.8 % + 222.7 EUR/100 kg] [12.8 % + 119.9 EUR/100 kg]	[753 Fr./ 100 kg]	Without preferences	Without preferences
Sheep boneless	020423	15	[12.8 % + 311.8 EUR/100 kg]	[760 Fr./ 100 kg]	Without preferences	Without preferences
Frozen lamb carcasses or half	020430	15	[12.8 % + 128.8 EUR/100 kg]	[749 Fr./ 100 kg]	Without preferences	Without preferences
Frozen sheep	020441	23	[12.8 % + 128.8 EUR/100 kg]	[858 Fr./ 100 kg]	Without preferences	Without preferences
Sheep, cut with bones frozen	020442	12	[12.8 % + 167.5 EUR/100 kg] [12.8 % + 167.5 EUR/100 kg] [12.8 % + 141.7 EUR/100 kg] [12.8 % + 90.2 EUR/100 kg]	[809 Fr./ 100 kg]	Without preferences	Without preferences
Sheep, boneless frozen	020443	15	[12.8 % + 234.5 EUR/100 kg] [12.8 % + 234.5 EUR/100 kg]	[760 Fr./ 100 kg]	Without preferences	Without preferences
Goats fresh, chilled or frozen	020450	20	[12.8 % + 234.5 EUR/100 kg] [12.8 % + 167.5 EUR/100 kg] [12.8 % + 141.7 EUR/100 kg] [12.8 % + 128.8 EUR/100 kg] [12.8 % + 167.5 EUR/100 kg] [12.8 % + 311.8 EUR/100 kg] [12.8 % + 222.7 EUR/100 kg] [12.8 % + 222.7 EUR/100 kg] [12.8 % + 90.2 EUR/100 kg] [12.8 % + 171.3 EUR/100 kg] [12.8 % + 119.9 EUR/100 kg] [12.8 % + 188.5 EUR/100 kg]	[700 Fr./ 100 kg]	Without preferences	Without preferences
Horses, fresh, chilled or frozen	020500	20	5.1	[1459 Fr./ 100 kg]	0	Without preferences

Source: Prepared by the author using the World Trade Organization/Inter-American Development Bank database.
Note: GSP: Generalized System of Preferences; HS: Harmonized System; MFN: Most Favoured Nation.

Table B9. Estimation of structural gravity

Effects/Products	Corn	Coffee	Meat
$NPTA_{it} \times NPTA_{jt}$	0.0008***	0.0005**	0.0007***
$PTA_{ijt} \times ln(T_{jt})$	-1.8865*	-0.042	-1.3653***
$NoPTA_{ijt} \times ln(T_{jt})$	-1.426		
$OP_{ijt} \times ln(T_{jt})$		-2.5781**	-1.4558*
$NoP_{ijt} \times ln(T_{jt})$		-0.571	-0.3632
CC_{ijt}	0.6454***	0.1413**	0.2865***
Observations	14’559	30’717	36’878

Source: Prepared by the author based on the database developed for this project.
Note: *** p<0.01, ** p<0.05, * p<0.1.

Table B10. Decomposition of the constant component of proximity

Effects/Products	Coffee	Corn	Meat	Coffee	Corn	Meat
Landlocked	-0.563**	-0.5580	0.3130	-0.616**	-0.8870	-0.0188
Island	-0.767***	-0.4810	-0.970**	-0.4780	-0.5880	-1.193**
Contiguity	0.780***	0.926***	0.3280	0.647***	0.976***	0.2910
Common language	0.432***	0.0349	0.421***	0.513***	0.0094	0.535***
Distance	-0.542***	-1.045***	-0.910***	-0.530***	-1.106***	-0.923***
Permanent preferential trade agreement	0.259**	0.2250	0.0414	0.387***	0.2230	0.1070
Cost to export/import: Border compliance (geometric average)				-0.107*	-0.1580	-0.0173
Observations	5,103	2,356	6,172	4,681	2,185	5,583
R-squared	0.271	0.611	0.417	0.264	0.600	0.438

Source: Prepared by the author based on the database developed for this project.
Not: *** p<0.01, ** p<0.05, * p<0.1.

Appendix C. Non-parametric method

Derivation of the non-parametric indicator of Novy (2013) uses the basic equation of the gravity trade model:

$$x_{ijt} = \frac{Y_{it}}{Y_{Wt}\Omega_{it}}\frac{E_{jt}}{\Phi_{jt}}\phi_{ijt}, \quad \text{(C1)}$$

where x_{ijt} is bilateral trade between exporter country *i* and importer country *j* in period *t*; Y_{it} is the supply in country *i;* E_{jt} is expenditure country *j* ; Ω_{it} is exporter multilateral resistance; Φ_{jt} is importer multilateral resistance; and ϕ_{ijt} is bilateral proximity between exporter country *i* and importer country *j.*

In the case of intra-national trade:

$$x_{iit} = \frac{Y_{it}}{Y_{Wt}\Omega_{it}}\frac{E_{it}}{\Phi_{it}}\phi_{iit} \quad \text{(C2)}$$

From equation (C2) the following expression for the product of multilateral resistance can be derived:

$$\Omega_{it}\Phi_{it} = \left(\frac{Y_{it}E_{it}}{Y_{Wt}x_{iit}}\right)\phi_{iit} \quad \text{(C3)}$$

The multiplication of bilateral trade in *ij* and *ji* allows for obtaining the following result:

$$x_{ijt}x_{jit} = \frac{Y_{it}}{Y_{Wt}\Omega_{it}}\frac{E_{jt}}{\Phi_{jt}}\phi_{ijt}\frac{Y_{jt}}{\Omega_{jt}}\frac{E_{it}}{\Phi_{it}}\phi_{jit} = \frac{Y_{it}}{Y_{Wt}\Omega_{it}}\frac{E_{it}}{\Phi_{it}}\frac{Y_{jt}}{\Omega_{jt}}\frac{E_{jt}}{\Phi_{jt}}\phi_{ijt}\phi_{jit} \quad \text{(C4)}$$

Replacing (C3) in (C4), one obtains the indicator that measures the symmetrical (ϕ^{S}_{ijt}) proximity between country *i* and country *j*:

$$x_{ijt}x_{jit} = x_{iit}x_{jjt}\frac{\phi_{ijt}\phi_{jit}}{\phi_{iit}\phi_{jjt}} \Leftrightarrow \left(\phi^{S}_{ijt}\right) = \left(\frac{\phi_{ijt}\phi_{jit}}{\phi_{iit}\phi_{jjt}}\right)^{1/2} = \left(\frac{x_{ijt}x_{jit}}{x_{iit}x_{jjt}}\right)^{1/2}. \quad \text{(C5)}$$

It is relevant to establish the relationship between proximities (ϕ_{ijt}) and trade costs (τ_{ijt}). Bilateral proximities are the following function of trade cost:

$$\phi_{ijt} = (1+\tau_{ijt})^{(1-\sigma)} = \left(1+\underline{\tau}_{ijt}\right)^{(1-\sigma)}\left(1+t_{ijt}\right)^{(-\sigma)} =. \quad \text{(C6)}^{50}$$

Trade costs have two components: the ad valorem tariff (t_{ijt}), and $\underline{\tau}_{ijt}$ other trade costs (icebergs).

[50] Yotov et al. (2016) derive why the exponent of the ad valorem tariff is different in relation with other iceberg trade costs.

Then, multilateral resistance for the exporter and the importer is:

$$\Omega_{it} = {\Pi_{it}}^{1-\sigma} = \sum_j \frac{E_{jt}}{Y_{Wt}} \frac{\phi_{ijt}}{\Phi_{jt}} = \sum_j \frac{E_{jt}}{Y_{Wt}} \frac{(1+t_{ij})^{-\sigma}\left((1+\underline{\tau}_{ijt})\right)^{1-\sigma}}{{P_{jt}}^{1-\sigma}}. \quad \text{(C7)}$$

$$\Phi_{jt} = {P_{jt}}^{1-\sigma} = \sum_i \frac{Y_{it}}{Y_{Wt}} \frac{\phi_{ijt}}{\Omega_{it}} = \sum_i \frac{Y_{it}}{Y_{Wt}} \frac{\left((1+t_{ij})(1+\underline{\tau}_{ijt})\right)^{1-\sigma}}{{\Pi_{it}}^{1-\sigma}}. \quad \text{(C8)}$$

The Novy index could be transformed as a symmetric tariff equivalent measure (τ_{ijt}^s), which consolidates all trade barriers in bilateral trade:

$$\phi_{ijt}^s = \left(\frac{\phi_{ijt}\phi_{jit}}{\phi_{iit}\phi_{jjt}}\right)^{1/2} = \left(\frac{(1+t_{ijt})^{(-\sigma)}(1+t_{ijt})^{(-\sigma)}(1+\underline{\tau}_{ijt})^{(1-\sigma)}(1+\underline{\tau}_{jit})^{(1-\sigma)}}{(1+\tau_{iit})^{(1-\sigma)}(1+\tau_{jjt})^{(1-\sigma)}}\right)^{1/2} = (1+\tau_{ijt}^s)^{(1-\sigma)}, \quad \text{(C9)}$$

where $t_{iit} = t_{jjt} = 0$.

The equivalent tariff is derived from the above equation, which requires a value for the elasticity of substitution that exists between products from different countries.

$$\tau_{ijt}^s = \left(\phi_{ijt}^s\right)^{\frac{1}{1-\sigma}} - 1 = \left(\frac{x_{ijt}x_{jit}}{x_{iit}x_{jjt}}\right)^{1/[2(1-\sigma)]} - 1. \quad \text{(C10)}$$

With this indicator it is possible to have a measure of the other trade costs (iceberg) discounting the effect of tariffs.

$$\left(1+\underline{\tau}_{ijt}^s\right) = \frac{(1+\tau_{ijt}^s)}{(1+t_{ij}^s)^{-\sigma/1-\sigma}}, \quad \text{(C11)}$$

where $\left(1+t_{ij}^s\right) = \left(\left(1+t_{ijt}\right)\left(1+t_{jit}\right)\right)^{\frac{1}{2}}$. See that $\left(1+\underline{\tau}_{ijt}^s\right) = \left(\frac{(1+\underline{\tau}_{ijt})(1+\underline{\tau}_{jit})}{(1+\tau_{iit})(1+\tau_{jjt})}\right)^{\frac{1}{2}}$.

With the information from equations C10 and C11, it is possible to characterize the bilateral trade cost (with a symmetric structure) and its decomposition between tariffs (t_{ij}^s) and other trade costs $(\underline{\tau}_{ijt}^s)$. However, it is relevant to have an aggregate measure of trade costs at the country level. For that, we use the Arvis et al. (2016) proposal, which uses the same methodology proposed by Anderson and Neary (2003). The objective is to find an average trade cost $(\overline{\tau}_{it}^s)$ across all partners that generates the same level of trade. We know that:

$$\sum_{j\neq i}\left(x_{ijt}x_{jit}\right)^{1/2} = \sum_{j\neq i}\left(1+\tau_{ijt}^s\right)^{1-\sigma}\left(x_{iit}x_{jjt}\right)^{1/2} = \sum_{j\neq i}\left(1+\overline{\tau}_{it}^s\right)^{1-\sigma}\left(x_{iit}x_{jjt}\right)^{1/2}. \quad \text{(C12)}$$

Then:

$$\overline{\tau}_{it}^s = \left(\frac{\sum_{j\neq i}\left(x_{ijt}x_{jit}\right)^{1/2}}{\sum_{j\neq i}\left(x_{iit}x_{jjt}\right)^{1/2}}\right)^{\frac{1}{1-\sigma}} - 1. \quad \text{(C13)}$$

To have the same decomposition between tariffs and other trade costs at the country level, we compute the average other trade costs for country *i* in the following way:

$$\underline{\tau}_{it}^{s} = \left(\frac{\sum_j (x_{ijt} x_{jit})^{1/2}}{\sum_j \left(1+t_{ijt}^{s}\right)^{-\sigma} (x_{iit} x_{jjt})^{1/2}} \right)^{\frac{1}{1-\sigma}} - 1. \quad \text{(C14)}$$

Then, average tariff trade costs are:

$$\bar{t}_{it} = \left(\frac{(1+\overline{\tau}_{it}^{s})}{(1+\underline{\tau}_{it}^{s})} \right)^{\frac{1-\sigma}{-\sigma}} - 1.$$

To obtain average total (ϕ_{it}^{s}), tariff (ϕ_{it}^{ts}) and other proximities ($\overline{\phi}_{it}^{s}$) by country *i*, we go from trade cost to proximity:

$$\phi_{it}^{s} = \phi_{it}^{ts} \overline{\phi}_{it}^{s} = \left(1+\overline{\tau}_{it}^{s}\right)^{(1-\sigma)} = \left(1+\bar{t}_{it}\right)^{(-\sigma)} \left(1+\underline{\tau}_{it}^{s}\right)^{(1-\sigma)}. \quad \text{(C15)}$$

Following the same logic, if we sum in equation C12 over a subset of markets we can obtain the average trade cost (proximities) at the regional level $\overline{\tau}_{iRt}^{s}$ (ϕ_{iRt}^{s}) and extra-regional level $\overline{\tau}_{iEt}^{s}$ (ϕ_{iEt}^{s}) . For the aggregation by region of the world we use weighted average by trade:

$$\phi_{RT}^{s} = \sum_{i \in R} \phi_{iT}^{s} \frac{x_{iT}+x_{Ti}}{x_{RT}+x_{TR}} \; ; \; \phi_{RR}^{s} = \sum_{i \in R} \phi_{iR}^{s} \frac{x_{iR}+x_{Ri}}{2x_{RR}} \; ; \; \phi_{RE}^{s} = \sum_{i \in R} \phi_{iE}^{s} \frac{x_{iE}+x_{Ei}}{x_{RE}+x_{ER}} \; . \quad \text{(C16)}$$

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