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The Impact of Services Trade Restrictiveness on Food Trade

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Abstract

This paper examines the effects of restrictions in logistics, transportation, distribution, finance and other business sectors on food trade. We use a gravity model with panel data from 2014 to 2018 across 36 OECD countries, OECD indices of individual country restrictions and regulatory differences by country pair to capture the level of restrictions in these sectors. The paper concludes that importing and exporting country restrictions in logistics, finance and other business sectors have significant negative effects on food exports between OECD countries. Restrictions in the distribution sector have significant positive effects on exports. The sectors most affected are food, live animals and perishable products (milk, eggs and meat). Regulatory disparity in the logistics sector is a barrier to trade, but disparity in the transport sector has positive and significant effects on food exports. This negative impact disappears when the exporting country is closed to service providers. The deregulation or harmonization of these measures would be highly beneficial to food trade.

Keywords: Food trade, Service sector, Restrictions in services, Gravity model

JEL: F13, F14, K23, Q17

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I. Introduction

Since the GATT agreements in 1948 (General Agreement on Tariffs and Trade), tariffs have decreased significantly in world trade. For decades, high tariffs were the main obstacle to trade. However, under many implemented trade agreements (multilateral, bilateral and regional), tariffs have fallen to low levels (the simple average world tariff rate declined from 10.13% in 2000 to less than 7% in 2015, see figure 1).[1] At the same time, we have observed a huge increase in Non-Tariff Barriers (NTBs), particularly production standards, which represent the main obstacle to global economic growth (Kee et al., 2009; IMF, 2017). Indeed, market access that depended on traditional trade policies (tariffs and quotas) is now subject to compliance with regulatory measures (UNCTAD, 2013).

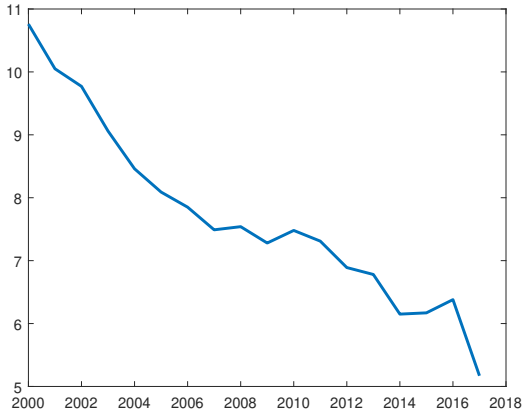

Figure 1: Tariff rate, applied, simple mean, all products (%)

Non-Tariff measures include a diverse array of measures from trade policy instruments (quotas, subsidies, export restrictions) to non-trade policy instruments, for example technical measures (SPS and TBT.)[2] These latter measures, considered as rules that establish production characteristics and procedures, aim at optimizing the reliability of products and ensuring food safety, animal and plant health, and environmental protection. Although they are important to address legitimate market failures, these measures have restrictive effects on international trade in food products (UNCTAD, 2013). These technical, health and quality regulations generate high compliance costs (product adaptation costs, costs related to equipment, technology and necessary skills). Therefore, the existence of fixed costs may influence the decision to export (WTO, 2005; Riker, 2015).

Services are also affected by national regulations and trade in services is more impacted by these restrictions than trade in goods (Kox and Nordås, 2007). For commodities, production and quality requirements only apply to goods. For services, they encompass the supplier, its foreign personnel and equipment. For some authors, the level or stringency of service restrictions is not an obstacle, but regulatory heterogeneity between countries appears to be restrictive (Kox and Nordås, 2007). However, it is not the level of regulation that discourages foreign suppliers, but rather the difference in regulations between origin and destination markets. Thus, additional compliance costs to establish a firm in a foreign country would be minimal if standards and qualifications were recognized in the home country. Service restrictions not only prevent foreign providers from accessing domestic service markets, but may also deter them from making new investments once they are established in the market; this is the so-called **regulation behind borders** (maintenance costs or operational restrictions.[3])

[1] Data provided by the World Bank through the World Integrated Trade Solution database.
[2] Sanitary and Phytosanitary Measures and Technical Barriers to Trade.
[3] Maintenance costs include costs related to the tax burden, the social security system, limiting the variety of

The food, manufacturing, and services sectors in OECD countries have registered significant export growth since 2015 (see figure 2) and the services sector is a key factor in the production and distribution of agricultural and manufactured goods. Table 2 describes the average intermediate consumption by industry for OECD countries in 2015. It shows that consumption by the food, beverages, and tobacco industry in services is larger than manufacturing and agriculture inputs excluding the service sector. Average consumption is around 37% for services, followed by 34% for industrial goods and 30% for agriculture, forestry and fishing goods. The food, beverages and tobacco sector has services as a significant input among industrial sub-sectors. As shown in table 3, in 2015, the food industry in OECD countries consumed more than half of all intermediate consumption in distribution services, 12% in transport and logistics, and nearly 20% in financial, insurance and other business sectors.

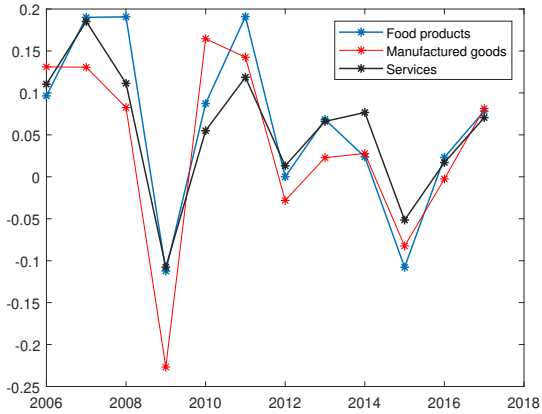

Figure 2: OECD countries' annual export growth from 2005 to 2017

The food sector requires a lot of transport and logistics services to carry out efficient and cost-effective import or export operations: the so-called "transit time". It provides vital distribution for production, as well as essential personal mobility, connecting companies to global markets. The quality of food products will depend on the mode and regulation of transport, as well as the efficiency of logistics, especially for perishable products. These sectors have a significant impact on the food supply chain. Maritime and road transport are the most important modes of transport for the food industry (see table 1).

Transport mode	**Tonne kilometers (tkm)**	**%**
Air	15.00 million tkm	0.16
Rail	930.00 million tkm	9.9
Road	2.91 billion tkm	30.97
Water	5.54 billion tkm	58.97

Source: Poore, J and Nemecek, T. (2018)

Table 1: Food miles by transport method in 2010

As the basic link between producer and consumer, the distribution sector is vital to the functioning of a market economy. Optimal regulation of this highly competitive sector has positive effects on consumer welfare through a wide choice of food products and associated services at attractive prices. Financial and insurance services facilitate transactions and provide access to financing for investments and for food export and import activities. These sectors address the risks of food trade activities. Indeed, food trade is risky, as importers may not pay after receiving the goods and exporters may not deliver if they pay in advance. To reduce the risks inherent to international trade, banks offer trade-specific finance products, the most common of which are letters of credit (LC) and documentary collections (Amiti and Weinstein, 2011;[4] Paravisini et al., 2014[5])

services, imposing fixed prices for certain services.

[4]They showed that, in Japan, firms linked to under-performing banks reduced their exports.

[5]They found that a reduction in credit supply to firms led to a decline in exports in Peru.

Using monthly US import data, Chor and Manova (2012) find that countries with higher interbank rates and stricter credit conditions exported less to the United States during the crisis. These effects were particularly pronounced in sectors that require significant external financing. Moreover, Bricongne et al (2010) find that French firms' exports in the sectors most dependent on external financing were more affected by the recent global crisis. The global financial crisis is an example of a strong impact of credit on trade (see figure 3).

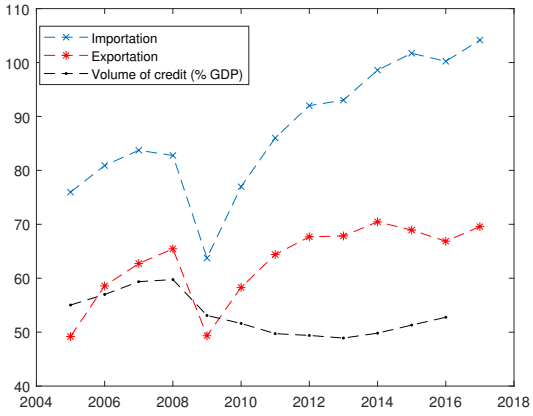

Figure 3: US import, export and credit volume from 2005 to 2017

Legal and accounting services are part of the institutional framework required to support a healthy market economy (OECD, 2008). Accounting has emerged as a standardized service. It enables the management of the food industry through tracking revenues and expenses, ensuring compliance with legislation and providing investors with information on the financial situation, which can be used to make business decisions. Restrictions in this sector lead to high transaction costs.

This paper examines the effects of service restrictions on food trade between OECD countries from 2014 to 2018 and discusses how to mitigate these restrictive impacts. Some studies have focused on the effects of the liberalization of services on economic growth (e.g. Francois and Schuknecht, 2000; Mattoo, Rathindran and Subramanian, 2001). Authors such as Doove et al. (2001) have examined the impacts of regulatory policies in services on the service sector performance (productivity, prices, and quality of services). Other authors have investigated the effects of services regulation on trade in services (Nordås and Rouzet 2016; Borchert, I et al., 2012; Van der Marel and Shepherd, 2013) and on the performance of manufacturing firms (Arnold et al., 2011; Duggan et al., 2013). Few studies have highlighted the effects of service restrictions on food trade.

Our study contributes to the literature on the impacts of non-tariff barriers on international trade in three ways.
First, we use a gravity model to assess the effects of service restrictions on food trade. The indices used are the Services Trade Restrictiveness Index (STRI) and the Regulatory Heterogeneity Index of the OECD. The first captures the level of restrictions in the 22 service sectors in 44 countries and the second reflects the disparity in regulatory policy in these sectors between country pairs, ranging from 0 (less restrictive) to 1 (closed to service providers). This index is more recent (from 2014 to 2019) and sector-specific than the World Bank's Services Trade Restrictions Database which includes 5 service sectors in 103 countries from 2014 to 2016.
The second contribution is the choice of our indices. As shown in table 3 and figure 4 show, we use restrictiveness indices in 4 service sectors (transport, logistics, distribution, finance and other business sectors) considered as crucial inputs in the food industry, and the restrictions are still significant.

The last contribution is the structure of our independent variable. We use pooled bilateral trade in food products between OECD countries. The food industry data are sectoral and group together all sub-sectors of the industry through the Standard International Trade Classification (SITC). This method provides a large enough sample, for which the assumption of homogeneous effects across products for restrictiveness index would not be too great (Niven, W et al., 2012).

Our paper suggests that importing and exporting restrictions in the logistics, financial and other business sectors have negative and significant effects on food exports between OECD countries. Moreover, restrictions on the distribution sector have positive and significant effects on exports. Restrictions in both importing and exporting countries are a barrier to trade in food products. The most strongly affected sectors are food, live animals and perishable products (milk, eggs and meat). Restrictions in logistics customs brokerage, cargo-handling, freight forwarding, banking, accounting, and road and sea transport, constitute an obstacle to trade in food products. Regulatory disparity in the logistics sector is an obstacle to trade but the disparity in the transport sector has positive and significant effects on food exports. However, the overall disparity in services has a significant negative impact on food trade. This impact disappears when the exporting country is closed to service providers.

The remainder of this paper is structured as follows. In the first part, we review the literature on the effects of these restrictive measures on trade flows. In the second part, we describe our econometric model with data, sources, types of regressions and methodology used. The last section presents our different results and the discussion.

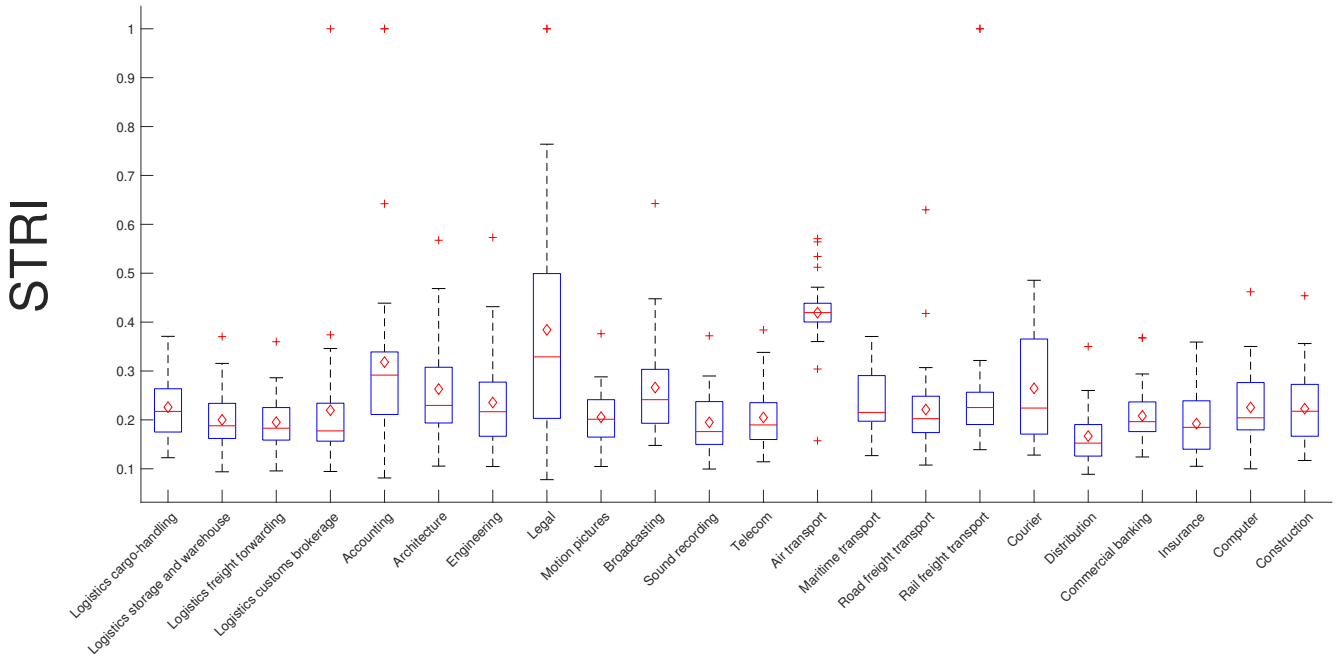

Figure 4: OECD countries' sectoral STRIs in 2017

Table 2: OECD Average Intermediate Consumption in Agriculture, Industry and Services in 2015 : Input-Output Table

Sectors in colum		*Agriculture sector*	*Manufacturing sector*								*Service sector*
Intermediate Products in row		**Agriculture, forestry fishing**	**Food products, beverages and tobacco**	**Mining**	**Textiles, wearing, apparel leather and related products products**	**Wood, Leather and Paper**	**Petroleum, Chemicals and Plastics**	**Metal**	**Electronics, Computers, Transport equipment and others**	**Construction**	**Services**
Agriculture, forestry and fishing	Consumption (millions US)	190957.9	649047	894.1	10249.7	51008.2	21060.7	1424.91	6297.4	8316.8	92203.4
	Ratio(%)	**23.6051**	**29.5546**	**0.2300**	**3.0020**	**6.8831**	**0.6651**	**0.0003**	**0.1024**	**0.2977**	**0.4483**
Manufacturing	Consumption (millions US)	325868.8	743497.2	273054.9	196298.8	433633.5	2107019.8	367813053.9	4254438.9	1791808.7	4179606.8
	Ratio(%)	**40.2820**	**33.8554**	**70.2463**	**57.4941**	**58.5150**	**66.5411**	**94.3329**	**69.2253**	**64.1558**	**20.3234**
Services	Consumption (millions US)	292140.1	803548.2	114761.5	134875.3	256420.9	1038412.1	22094825.91	1885048.2	992774.2	15601237.1
	Ratio(%)	**36.1127**	**36.5899**	**29.5236**	**39.5037**	**34.6017**	**32.7937**	**5.6666**	**30.6722**	**35.5463**	**75.8612**
Total (millions US)		808966.8	2196092.4	388710.5	341423.8	741062.6	3166492.6	389909304.7	6145784.5	2792899.7	19873047.3

Source: Data computed by the author using the OECD Input-Output Table in 2015, 2018 edition

Table 3: Average Intermediate Consumption of Food, Beverages and Tobacco in Service in 2015: Input-Output Table

Services	**Food, beverages and tobacco**	
Wholesale and retail trade repair of motor vehicles	Consumption (millions US)	467526.4
	Ratio(%)	**58.1827**
Transportation and storage	Consumption (millions US)	98997.2
	Ratio(%)	**12.3200**
Accomodation and food services	Consumption (millions US)	5404.3
	Ratio(%)	**0.6725**
Publishing, audiovisual and broadcasting activities	Consumption (millions US)	1036.6
	Ratio(%)	**1.2904**
Telecommunications	Consumption (millions US)	5138.9
	Ratio(%)	**0.6395**
IT and other information services	Consumption (millions US)	8281.3
	Ratio(%)	**1.0305**
Financial and insurance activities	Consumption (millions US)	34595.9
	Ratio(%)	**4.3053**
Real estate activities	Consumption (millions US)	13048.1
	Ratio(%)	**1.6238**
Other business sector services	Consumption (millions US)	122488.9
	Ratio(%)	**15.2435**
Public administration and defence compulsory social security	Consumption (millions US)	5801.9
	Ratio(%)	**0.7220**
Education	Consumption (millions US)	3828.5
	Ratio(%)	**0.4764**
Human health and social work	Consumption (millions US)	22472.5
	Ratio(%)	**2.7966**
Arts, entertainment, recreation and other service activities	Consumption (millions US)	5594,7
	Ratio(%)	**0.6962**
Private households with employed persons	Consumption (millions US)	0
	Ratio(%)	**0**
Total (million US)		2196092.4

Source :Data computed by the author using the OECD Input-Output Table, In 2015, 2018 edition

II. Literature review

Studies that examine the impact of restrictions in services on international trade use two main methods: analysis of bilateral trade and firm-level data. Indeed, the economic literature that investigates the impact of standards in services on international trade uses the OECD/World Bank Trade Restrictiveness Index. The first analysis focuses on the impacts of these indices on bilateral trade and the second on the performance of manufacturing firms through firm-level data.

i. Service Trade Restrictiveness Index (STRI) and Service Trade: Gravity Analysis

The existing literature on service restrictions and trade is exclusively empirical. To evaluate the effects of regulatory barriers in services on international trade as measured by the sectoral STRI index, we use a gravity model. Although specific to trade flows in goods and commodities, it has been applied by some authors to services and has been found to be adapted to trade in services (Head et al., 2009; Walsh, 2008). However, Kox and Nordås (2009) using a gravitational approach, it is possible to examine trade flows in transport and business services, and their interaction with an overall regulatory indicator. The analysis by Kox and Nordås (2007) considers financial services and other business services in their model.

Nordås and Rouzet (2016); Nordås (2016) apply the gravity model to analyze the impacts of the STRI index and the regulatory heterogeneity index on trade in services. Based on a gravity model with aggregate data and the PPML (Pseudo-Maximum Likelihood Estimator) as the estimation method, they find that the most restrictive countries in the service secto, import and export significantly fewer services. In addition, the negative impact of restrictions in services on exports is about twice as large as on imports. The most affected sectors are the banking, financial and transport sectors, considered as service providers. Examining the regulatory disparity between countries, they find that regulatory heterogeneity in services has negative impacts on cross-border trade in services. In this case, countries trade more with partners with similar regulations. A low heterogeneity index (harmonization or convergence of standards) is associated with a strong stimulation of trade in services. According to their study, if the STRIs of importer and exporter countries are low, harmonization stimulates trade in services, but if the STRIs are high, harmonization attempts to limit this trade.

Another approach that differs from the first is the analysis by Borchert, I et al., 2012. They use the restrictiveness index developed by the World Bank, rather than the OECD measure, to capture the impact of regulatory policies on trade in services[6]. Through the PPML estimate, they find that higher levels of STRI discourage investment. Van der Marel and Shepherd's (2013) analysis (very similar to the previous one) also finds a negative relationship between the World Bank's bilateral restrictiveness index and cross-border trade in transport and financial services. Riker, D (2015) highlights the impact of restrictions on foreign suppliers (import restrictiveness index) and cross-border trade in services. He also finds negative effects of the latter on cross-border trade in services. Further, his study simulates the effect that would be made on U.S. financial services exports if its trading partners eliminated restrictions on these

[6]Foreign investment inflows and access to financial services through the provision of bank lending.

imports from all countries. He notes that while China and India do not apply any barriers to market entry, the United States has recorded a significant rise in its financial services exports, both in dollars ($186.0 million and $42.2 million) and rate change (10.14% and 3.76%). On the other hand, in a country like Germany, US exports have increased slightly (7.7 million dollars or 0.23%). Indeed, according to Riker, in the financial services sector, Germany is a relatively large export market for the United States, after the United Kingdom, but the impact on trade is lower because the level of restrictiveness in this country is relatively low compared to countries like China or India.

Another analysis that differs from those mentioned above and that is included in our paper is that of Ariu et al., 2018. They explore the interaction between international goods trade and restrictions on services. They consider data from Belgian firms from 1995 to 2005, PMR index (Product Market Regulation) data and that on customs duties on goods and services. They come to the following conclusion: when import barriers for goods and commodities rise, firms import fewer services. Further, these authors use their results to quantify the impacts of lowering barriers to goods and services on trade between the US and the EU. They find that liberalization of the services sector has direct and significant effects on goods trade.

Our paper also contributes to the recent literature on firm-level trade in services (Crozet et al., 2016; Ariu, 2016). This literature describes the characteristics of firms exporting services and finds that very few firms are able to export services due to regulatory barriers in the market.

ii. Service Regulation and Manufacturing Firm Performance: Firm-Level Data

Several previous studies estimated the effects of services regulation on firm performance through firm-level data. The study of Arnold et al., 2011 highlights the link between services sector reforms and the productivity of manufacturing industries that depend on services inputs. Many aspects of services reform are considered, namely the presence of foreign suppliers, privatization and the level of competition. The results, based on firm-level data from the Czech Republic, show a positive relationship between services sector reforms and the performance of domestic firms in downstream manufacturing sectors. Reforms that allow foreign entry into service industries appear to be the key channel through which services liberalization contributes to improving the performance of manufacturing sector.

Duggan et al. (2013) investigate the extent to which policy restrictions on foreign direct investment in the Indonesian services sector affected the performance of manufacturers over the period 1997-2009. They use firm-level data on manufacturers' total factor productivity and the OECD index on regulatory restrictions on foreign direct investment, combined with data from Indonesia's input-output tables regarding the intensity with which manufacturing sectors use service inputs. Controlling for firm-level fixed effects and other relevant policy indicators, they find that policy relaxing FDI policies in the services sector is associated with improved manufacturing sector performance.

Bas (2014) analyzes the relationship between the reform of energy, telecommunications, and transport services in India in the mid-1990s and manufacturing firms' export performance. The empirical analysis relies on exogenous indicators of the regulation of Indian service sectors and detailed firm-level data for India in 1994-2004 period. It finds that reform of

the upstream services sector has increased the probability of exporting and the export sales share of downstream manufacturing industries. The results suggest that the effect of services liberalization on manufacturing firms' export performance is stronger for initially more productive firms. The analysis of Arnold et al. (2016) similar to the above looks at the link between reforms in services and the productivity of manufacturing firms in India. Using panel data on about 4,000 Indian firms for the period 1993-2005, they find that banking, telecommunications, insurance, and transportation reforms all had significant positive effects on the productivity of manufacturing firms. Services reforms benefited both foreign and domestic manufacturing firms, but the effects on foreign firms tended to be stronger.

This analysis shows that restrictions in services have a negative impact on trade flows. Measures in banking, transportation, and logistics have a significant impact on trade flows. The divergence of regulations between countries has a significant negative impact on trade. Our work is a extension of previous studies that have addressed the issue of standards in international trade.

III. Gravity Model of Bilateral Trade

To conduct an empirical analysis of the effects of restrictive measures on trade flows, we use the gravity model developed by Anderson (1979). It is based on the assumption that products are differentiated by the origin of country, i.e. by location (Armington's hypothesis), where consumers have defined preferences for these differentiated products. In this approach, each country can import a good from another country at any market price. In this case all goods are traded, all countries trade and on balance, national income is the sum of domestic and foreign demand for the single good produced. In the model, trade costs are considered as transport costs.
After Anderson's theoretical approach, authors drew upon trade theories to find a theoretical framework for the gravity equation. Bergstrand (1989) shows that a gravity equation is a direct implication of the trade model based on monopolistic competition by Krugman ,P (1980). Identical countries manage to exchange differentiated goods because consumers prefer variety. According to the concept of monopolistic competition, it is not the location of firms that determines differentiated goods trade but the preference of consumers for variety. Eaton and Kortum (2002) derive a gravitational equation from a Ricardian model, and Helpman et al. (2008); Chaney, T (2008) obtained it from a theoretical model of international trade by firm heterogeneity.
The general formulation of the gravity equation is as follows:

$$X_{ij}=GS_iM_j\Phi_{ij}$$

Where X_{ij} is the value of exports from country i to country j, M_j represents demand from the importing country (importing country's GDP), S_i is the value of the exporting country's GDP, G is a variable that does not depend on i or j and represents the level of global liberalization, Φ_{ij} represents the ease of access by exporter i to market j.

Anderson and Van Wincoop (2003) show that control over trade costs remains crucial in order to properly specify the gravity equation. However, trade costs are very important for the gravity equation. Two countries will trade less if they are separated by an ocean or by vast

stretches of deserts and mountains. Trade between two nations for this purpose is determined by relative trade costs, i.e. trade costs between the two nations (absolute costs) and trade costs between the country (importer, exporter) and the rest of the world, which will be called the MTR (Multilateral Trade-Resistance). However, multilateral resistance can be controlled through the time fixed effects of the importing and exporting countries (Anderson and Yotov, 2012) or by using a proxy.
To estimate this equation, we need to linearize it. Using the logarithm of each variable in the model, the equation becomes:

$$LnX_{ij} = a_0 + a_1 lnY_i + a_2 lnY_j + a_3 lnt_{ij} + a_4 ln\Pi_i + a_5 lnP_j + \epsilon_{ij} \quad (1)$$

Where a_0 is the constant, a_3= 1- σ, X_{ij} is the value of exports from country i to country j, Y_i and Y_j the GDP of exporting and importing countries, t_{ij} bilateral costs between our pairs of countries, Π_i terms measuring barriers to trade between each country and the rest of the world, P_j the price index of the importing country, ϵ_{ij} the error term. In practice, the gravity equation links the logarithm of monetary value of trade between two countries to the logarithm of their respective GDPs, a composite term reflecting barriers and trade incentives between these two countries, and terms measuring barriers to trade between these countries and the rest of the world.

IV. Individual STRIs and Food Exports : Augmented gravity models

Using the model of Anderson and Van Wincoop (2003); Anderson and Van Wincoop (2004), our baseline regression equation is the following:

$$X^k_{ij,t} = exp[\beta_0 + \beta_1 Z_{ij,t} + \beta_2 t_{ij} + \beta_3 STRI^s_{i,t} + \beta_4 STRI^s_{j,t} + \mu_{it} + \gamma_{jt} + \alpha_t + \alpha_s + \epsilon_{ijt}] \quad (2)$$

$X^k_{ij,t}$ denotes the nominal exports of food commodities in sector (k) from exporter (i) to importer (j) in year (t). We use nominal exports and not those deflated by U.S. aggregate price indices to avoid bias problems. Since there are global trends in inflation rates, the inclusion of this term probably creates biases via spurious correlations (Baldwin and Taglioni, 2006). $Z_{ij,t}$ is a time-variant vector of bilateral variables. We have a binary variable that equals 1 if i and j share the same regional trade agreement (RTA) and 0 otherwise, and average custom tariffs imposed by the importing country on the exporting country on food products in year t ($ln(1 + tariff_{ji,t})$. t_{ij} is the vector of the time-invariant bilateral control variables: bilateral distance (*Ln dist*), common language (*lang*), common border (*border*). [7] $STRI^s_{i,t}$ and $STRI^s_{j,t}$ are the STRI indices of respectively the exporter and the importer on a scale of 0 to 1, they represent our explanatory variables of interest and capture the level of restrictions in exporter and importer countries in the service sector *s* (logistics, transport, distibution, financial and other business sectors). The logistics sector includes cargo handling, storage and warehouse, freight forwarding, and customs brokerage logistics. The transport sector comprises air, maritime, road and rail freight transport. The financial and other business sector covers accounting, banking and insurance. The distribution sector covers general wholesale

[7] Dummy variables equal 1 if countries share a common border and common language and 0 otherwise.

and retail sales of consumer goods, and e-commerce. μ_{it} and γ_{jt} are other variables that vary respectively according to exporting and importing country in year, α_t is a year fixed effect (capturing the global macroeconomic cycle), α_s reflects the sector fixed effects and ϵ_{ijt} is an error term. β_3 and β_4 are our coefficients of interest and are negative according to the literature.

The inclusion of exporting and importing STRIs in the equation is relevant because restrictions in both countries have a significant impact on trade. Many restrictions in the exporting country's services have negative effects on production and trade through network services (transport, logistics, etc.). Once a food product arrives at the frontier of the importing country, logistics services are required, particularly storage, warehousing and customs services, as well as transport for the delivery of the product to distribution services. Moreover, the importing and exporting country's STRI have the same impact on trade, i.e. limiting imports of services. Considering the sectoral STRI of the two countries separately in equation (2) can be ambiguous and not easily interpreted. One country may be restrictive on one sector and the other on another sector or both countries may be restrictive in a service sector, which leads to a strong collinearity between our variables of interest. Also, we cannot include both individual STRIs and country time fixed effects because the latter absorbs the former and we cannot perceive the effects of the STRI. Indeed, the STRI varies by service sector, country and year, while the country fixed effects are sectoral and also capture the STRI. To address these issues, we construct an interaction term between the two STRIs.
Equation 2 becomes:

$$X_{ij,t}^{k} = exp[\beta_0 + \beta_1 Z_{ij,t} + \beta_2 t_{ij} + \beta_3 STRI_{ij,t}^{s} + \mu_{it,k} + \gamma_{jt,k} + \epsilon_{ijt}] \tag{3}$$

With $STRI_{ij,t}^{s} = STRI_{i,st}^{GDPserv_i/GDPserv_{(i+j)}} * STRI_{j,st}^{GDPserv_j/GDPserv_{(i+j)}}$. $GDPserv_i$ and $GDPserv_j$ are the value added of services as a % of GDP in exporting and importing countries. [8]
$\mu_{it,k}$ and $\gamma_{jt,k}$ are dummy variables representing the exporting and importing country's sector time fixed effects. The variable of interest $STRI_{ij,t}^{s}$ has negative effects on food exports, i.e. restrictions in services in both countries have limiting effects on trade.

V. Data Sources

As mentioned above, our paper attempts to analyze the effects of restrictive measures in services on food trade flows. We use panel data on trade in food products between 36 OECD countries (bilateral trade between countries) from 2014 to 2018.[9]

Our dependent variable is pooled bilateral food trade between OECD countries. We use information about bilateral food exports (annual frequency) from the United Nations Conference on Trade and Development database (UNCTADstat), which uses the Classification Standard International Trade (SITC Rev.4).[10] The food industry has four sub-sectors (SITC 0+1+22+4): food and live animals, beverages and tobacco, oil seeds and oleaginous fruits, animal and vegetable oils, fats and waxes. As independent variables, we have an index that captures the

[8] Our interaction term is adjusted for the value of services added to the GDP of the countries to reduce the significant correlation between our variables of interest.

[9] The data for 2014-2018 are based on the implementation and evolution of the STRI index.

[10] Data can be accessed at: https://unctadstat.unctad.org/wds/TableViewer/dimView.aspx

level of restrictions in these service sectors (STRI). The STRI Index provides a database of regulations affecting trade in 22 service sectors in 46 countries.[11] For each sector the database covers 5 policy areas: restrictions on the entry of foreigners, restrictions on the movement of persons, other discriminatory measures, barriers to competition and regulatory transparency. The qualitative information on these 5 areas has been converted into quantitative indices by sector ranging from 0 to 1 (where 0 corresponds to no restrictions and 1 to a sector completely closed to service providers) (Geloso Grosso et al., 2014). Data are available from the OECD STRI database.[12] The data on bilateral tariffs on food products are extracted from World Integrated Trade Solution Trade Stats (WITS) of the World Bank. Bilateral resistance variables such as the bilateral distance between the two capitals, common border, and language, are from the Centre d' Etudes Prospectives et d' Informations Internationales (CEPII), with binary variables that materialize regional trade agreements extracted from the WTO (Regional Trade Agreements Information System, RTA-IS).[13]

VI. Econometric Issues

Several questions related to the estimation of the standard gravity equation are considered in our study. Recently, researchers have identified eight problems inherent to gravitational models. The most important in this study are terms of multilateral trade resistance, gravity with disaggregated data, zero trade flows, heteroskedasticity of trade data, bilateral trade costs, adjustment to trade policy changes, and endogeneity of trade policy (Yotov et al., 2016; Piermartini and Yotov, 2016).
This section reviews the main problems and highlights relevant solutions that have been proposed in the literature to address these challenges.

i. Multilateral resistances and disaggregated trade data

Multilateral resistance terms (Π_i and P_j) are theoretical constructs and are not directly observable. A gravity estimation without proper control of its resistance terms leads to an omitted variable bias ("Gold Medal Mistake", Baldwin and Taglioni, 2006).

The first solution is provided by Anderson and van Wincoop (2003) who use custom nonlinear least squares iterative programming to account for multilateral resistances in a static framework. They first estimate trade cost parameters without controlling for multilateral resistances. Next, they use the estimated trade costs to construct a first set of multilateral resistances. Finally, they re-estimate the gravity model to obtain a new set of trade costs... until convergence is achieved.

The second solution is an approximation of multilateral resistance terms by remoteness indices constructed as a function of bilateral distance and gross domestic product (GDP) (Baier and Bergstrand, 2009). Head and Mayer (2014) criticize such reduced-form approaches as they bear little resemblance to the theoretical counterpart of the multilateral terms. For some

[11] 36 OECD countries plus Brazil, People's Republic of China, Colombia, Costa Rica, India, Indonesia, Malaysia, Russia, South Africa and Thailand

[12] https://stats.oecd.org/Index.aspx?DataSetCode=STRI.

[13] We use trade agreements on both goods and services, as we study the effects of restrictions in services on food products.

authors the multilateral resistance terms can be controlled using appropriate ratios based on the structural gravity equation (Head and Ries, 2001; Head et al., 2010 and Novy, 2013).

The recommended approach is that of Hummels (2001) and Feenstra (2016). They suggest the use of directional (exporter and importer) fixed effects in cross-sectional estimates. More recently, Olivero and Yotov (2012) demonstrated that multilateral resistance terms should be accounted for by export-time and import-time fixed effects in a dynamic gravity estimation framework with panel data.
In addition to accounting for unobservable multilateral resistance terms, the exporter and importer time fixed effects will also absorb the size variables (GDP, population, etc.) of the structural gravity model as well as all other observable and unobservable country-specific characteristics which vary across these dimensions, including various national policies, institutions, and exchange rates. Our independent variable is sectoral. Taking into account the terms of resistances must be sectoral in order to deal with the problems of gravity estimation with disaggregated data (Larch and Yotov, 2016; Yotov et al., 2016). Our exporter and importer time fixed effects become country time sector fixed effects.

ii. Zero trade flows and heteroskedasticity of trade data

The estimation of the gravity equation is conducted with an OLS estimator. However, the results of this estimator may constitute a bias in the presence of "Zero trade" in the presence of heteroskedasticity, and the OLS estimation may not be consistent. Indeed, this estimator, which does not include countries not trading with each other, compromises our results, because zero trade reveals crucial information (lack of information, high transport costs, landlocked countries), so omitting it can constitute a considerable bias in our study.[14] Problems with zeros become more pronounced when the trade data are disaggregated. This is the case in our paper.

Futhermore, the Tobit model proposed by Eaton and Tamura (1995) and Martin and Pham (2008) as an econometric solution to the presence of zero trade causes a disconnect between estimation and theory; Helpman et al. (2008) developed a two-stage estimation procedure that focuses both on the extensive estimation (export decision from i to j) and the intensive margins (export volume) of trade. While this approach offers a better understanding of the determinants of trade flows, it provides biased estimates in the presence of heteroskedasticity in the trade data (Silva and Tenreyro, 2013). To avoid biased estimation results, we use the Poisson estimator suggested by Silva and Tenreyro (2006).[15] The PPML is used in our case in order to deal with the constraints of zero trade between States, and also estimates the non-linear shape of the gravity model in the presence of heteroskedasticity. However, an important assumption of the PPML estimator is equidispersion, which means that the conditional variance of the dependent variable and its conditional mean are equal. PPML estimation can be assessed by solving the following condition:

$$\sum_{p}[X^{p} - exp(Z^{p}\beta)] = 0 \tag{4}$$

where p is the country pair, X^{p} is unilateral trade (i.e. exports or imports) between country

[14] Indeed, zero commerce is associated with high bilateral fixed costs of trade.
[15] Pseudo-Maximum Likelihood Estimator (PPML).

pairs in non-logarithmic levels and Z^p is the complete vector of the gravity equation as defined above.

iii. Bilateral trade costs and adjustment to trade policy changes

The standard gravity model requires the introduction of bilateral trade costs, $(1-\alpha)lnt_{ij;t}$. Moreover, these must be replaced by series of observable variables in the gravity estimation (bilateral distance, common border, common language, regional trade agreements, bilateral tariffs).

The implementation of trade policies does not have an instantaneous effect on trade. Indeed, the establishment of rules in a specific sector does not have an immediate effect; there is an adaptation period before a measure comes into force. Trefler (2004) criticizes trade estimates pooled over consecutive years. As Cheng and Wall (2005) point out, the estimation of fixed effects applied to pooled data over consecutive years is sometimes criticized on the grounds that dependent and independent variables cannot fully adjust in a single year's time.
In order to account for this issue, some authors have used panel data with intervals instead of data pooled over consecutive years: Trefler (2004) uses 3-year intervals, Anderson and Yotov (2016) use 4-year intervals, and Baier and Bergstrand (2007) use 5-year intervals. Through empirical studies, Olivero and Yotov (2012) show that gravity estimates obtained with 3-year and 5-year interval trade data are very similar, while estimates performed with panel pooled over consecutive years produce suspicious estimates of trade cost elasticity parameters. Our data are spread over 5 years and an estimate over 3-year and 5-year intervals is difficult to perform. In a robustness test, we will conduct estimates with two-year intervals.

iv. Endogeneity of trade policy

The gravity specification stipulates that trade policy variables (RTA, bilateral tariffs) and restrictiveness variables are endogenous. Indeed, a reverse causality exists between these variables and trade. All else being equal, a country is more likely to liberalize its trade with a country that shares the same trade agreement. Countries with significant trade flows have lower levels of restrictions, e.g. EU and EEA countries.

The estimation of the gravity model without taking into account the endogeneity of the RTA produces biased estimated coefficients. As a result, the RTA dummy variables are potentially correlated with the error term. The first authors to attempt to consider the endogeneity of trade policy variables in cross-sectional analysis used the instrumental variable approach (Trefler, 1993 and Lee and Swagel, 1997). However, Magee (2003) finds that the instrumental variable approach is not efficient in addressing the issue of endogeneity bias of the RTA due to its binary form. An alternative method to control for the potential endogeneity issue of RTA is to estimate the gravity model including country pair fixed effects in panel data, Baier and Bergstrand (2007). Indeed, these country pair fixed effects eliminate or account for, respectively, unobservable links between the endogenous trade policy covariate and the error term in the gravity regressions. Moreover, they will absorb all bilateral time-invariant covariates (e.g. bilateral distance, common language, common border, etc.), but will have the advantage of accounting for any unobservable time-invariant component of trade costs (Egger

and Nigai, 2015; Agnosteva et al., 2014) [16].

The downside of including country-pair fixed effects is that it is impossible to identify the effects of bilateral determinants of trade which do not vary over time because they are absorbed by the fixed effects. In our paper, restrictiveness indices vary by country, by year and by service sector, but do not change by food sector. An estimation using country pair fixed effects and restrictiveness indices leads to non-significant results. In this case, the restrictiveness indices are considered fixed according to the disaggregated food product data. One way to address this issue is to apply a two-step procedure, where the estimates of the pair fixed effects from the first-stage structural gravity equation are regressed on standard gravity variables in a second-stage estimation (Agnosteva et al., 2014; Anderson et al., 2015C). This two-step approach also enables us to recover estimates of the pair fixed effects that cannot be identified directly in the first stage, due to missing or zero trade flows, allowing us to construct the full matrix of bilateral trade costs and to perform counterfactual experiments (Anderson and Yotov, 2016).

The two-step procedure stipulates that the RTA between countries i and j varies over time and by sector in order to have significant results. From 2014 to 2018, very few trade agreements were signed and entered into force, the predominant trade agreements being the EU, NAFTA, and EEA. Moreover, these trade agreements do not vary according to the food sector. Therefore, the inclusion of country pair fixed effects will give non-significant results on pooled food exports. Our trade policy variables are constant across the four food sectors.
To reduce the endogeneity bias of our restrictiveness variables, we will consider the lagged variable in a robustness test. Indeed, the restrictiveness to trade in services index is invariant across the food sector, so that the measure implemented this year explains the measure of the next year in this sector.

VII. Empirical Results and Discussion

We estimate the effects of restrictions in 4 service sectors on food trade between OECD countries from 2014 to 2018. We use the OLS as the estimation method and, to account for heteroskedasticity and zero trade, we apply the PPML estimator. We also include the importer and exporter sector fixed effects to control for structural multilateral resistances and omitted variables. The results from equation 3 are presented in tables 4 and 5 below. Table 4 presents the results on pooled trade in food goods (columns 1 to 6). In the other cases, we have the results on disaggregated food trade according to the SITC classification and the PPML as an estimator.

In the different estimates, we find the following effects: our dummy variables, representing the common border, common language and regional trade agreements, have positive and significant impacts on food trade among OECD countries. Bilateral distance has significant negative effects on trade flows (Disdier and Head, 2008). Tariffs on food products imposed by the importing country on the exporting country have significant negative effects on food exports (Niven, W et al., 2012).

If we examine our variables of interest, restrictions in both countries, particularly on logistics and financial services and other business sectors, have a significant negative impact on food exports. The transport sector has non-significant effects on trade. By contrast, restrictions in

[16] They show that country pair fixed effects are a better measure of bilateral trade costs than the standard set of gravity variables.

distribution services have significant positive effects on trade. The results are robust to the inclusion of country time and sector fixed effects and country time sector fixed effects. The two estimators yield similar results. A 0.05 point rise in restrictions in logistics, financial and other business sectors leads respectively to a drop in exports of about 7% and 6% and a 9% increase in exports for distribution restrictions (columns 5 and 6).

The supply of finished and semi-finished food products depends on the quality of logistics and transport services. Food products are very sensitive to time. Many food products go bad quickly (for example, vegetables such as tomatoes and cucumbers and fruits like bananas and grapes) or reach an expiry date (e.g. dairy products). They must be delivered quickly, be stored in good conditions (temperatures, packaging), and meet hygiene and cleanliness standards. Transport and logistics play a key role in the food supply chain. Table A. 3 shows significant restrictions in these two sectors. More restrictions result in fewer logistics and transport service providers and higher transaction costs, which negatively affect the decision to export. Therefore, transport services do not have significant effects on exports, for two reasons. First, the transport sector is smaller than the logistics sector. While the former focuses just on the movement of food products from one place to another, the latter covers a broader spectrum and deals with the complete management of freight. The services of the logistics industry are not limited to the delivery of goods, but also relate to storage, handling, packaging, inventory, etc. So logistics activities take precedence over transport activities. Finally, this sector also focuses on the transport of people, if we consider air transport.

Financial and other business activities play a very key role in the export of food products. The banking sector guarantees a commercial presence through the funding of foreign investments and food export and import activities. Table A. 3 shows significant restrictions in this sector, and more restrictions exist on foreign market entry conditions (Rouzet, D. et al., 2014). This sector has become more restrictive with the introduction of macroprudential policies in response to the global financial crisis. Banking sector barriers in OECD countries hamper export financing through higher market interest rates, which increase the cost of lending (Paravisini et al., 2014). The insurance sector reduces the risks associated with commercial activities. It protects both the exporter and the importer against their risks. It enables them to cope with the risks of non-payment by the customer, loss and damage of products, political or economic instability in the buyer's country, and currency fluctuations, as well as the failure to supply, transport delays and potential delays in ports. Accounting services clean up the accounts and provide an idea about the profitability of activity, the variation in stocks and expected investment. The accounting sector is still highly regulated with regulatory differences between countries. This sector has high entry conditions, such as legal and accounting knowledge and qualifications, nationality requirements, and foreign competition closed in some countries (apart from any preferential trade) (Geloso Grosso et al., 2014). Restrictions in this sector limit all the services mentioned above or affords access at very high prices.

The distribution sector is highly competitive and links buyers to sellers. This sector accounts for between 8 and 15% of GDP in OECD countries and has a large number of firms and relatively high entry and exit rates (Ueno, A. et al., 2014). The positive sign is due to the level of restriction in the distribution sector. Table A. 3 shows low restrictions in distribution ranging from 0.11 to 0.33, with a sample average of 0.17. The distribution sector has become less restrictive with the e-commerce channel, which has significantly reduced transaction costs,

and increased market concentration, vertical integration of wholesale and retail trade (with ICT developments), private label sales, and the internationalization of retailers (Nordås et al., 2008).

The most affected food sectors are food, live animals and perishable products. These products are the most traded between OECD countries and are very sensitive to time and to the quality of logistics and transport. Perishable products are the most widely sold in retail and wholesale markets. This study shows the detrimental impact of service restrictions on global value chains and quality of products. The novel conclusion is that services are strongly linked to commodities through their use as inputs in the production and trade of goods. It also shows that service restrictions implemented by a country have negative effects on export performance (Nordås and Rouzet, 2016). The negative correlation assumes a competitiveness channel linking service regulation and exporter performance. These restrictions notably exclude small food exporters because export costs are very high.

Table 4: Gravity Estimation Results of Impacts of Service Restrictions on Cross-Border Exports of Food Commodities.

Specification	OLS-PPML Estimate									
Dependant variable	All Food Products (Pooled)						Disaggregated Food Items			
	SITC 0+1+22+4						Food and Live Animal SITC 0		Beverage and Tobacco SITC 1	
	Log-linear OLS			Poisson-PML			Poisson-PML		Poisson-PML	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$STRI_{Logistics}$	-2.2040***	-3.6592***	-3.5890***	1.1673	-7.6906***	-7.3176***	1.0270	-8.7171***	0.3956	-3.9922**
	(0.8417)	(1.0686)	(0.8872)	(1.0627)	(1.8916)	(1.5895)	(1.2753)	(1.9182)	(1.7309)	(1.8484)
$STRI_{Financial-Business}$	-3.7262***	-7.4321***	-8.2251***	-5.4759***	-6.8823***	-6.6244***	-5.7850***	-5.5933**	-0.2720	-9.2144**
	(1.0393)	(1.6834)	(1.4040)	(1.4605)	(2.3890)	(2.0004)	(1.7260)	(2.4400)	(1.8983)	(3.8924)
$STRI_{Transports}$	-2.6893***	0.1284	0.3055	0.3198	1.9993	2.1451	0.1760	1.0772	0.2431	4.5805
	(0.9855)	(1.0304)	(0.8870)	(1.3027)	(2.3698)	(2.1118)	(1.5091)	(2.4268)	(2.3164)	(3.6618)
$STRI_{Distribution}$	0.6063	3.3974***	3.7232***	-0.1561	9.7833***	8.7531***	-0.4111	9.8613***	-1.5779	3.7368
	(1.1014)	(1.1616)	(0.9812)	(1.0055)	(2.0444)	(1.7437)	(1.2266)	(1.9847)	(1.4468)	(2.4762)
$RTA_{ij,t}$	0.8347***	0.5558***	0.5546***	0.7477***	0.3806***	0.4912***	1.0001***	0.6635***	-0.0452	-0.0973
	(0.1087)	(0.1210)	(0.1021)	(0.1755)	(0.1156)	(0.1059)	(0.2186)	(0.1245)	(0.2939)	(0.1771)
$Ln(1+tariff_{ji,t})$	-0.2838***	-0.3402***	-0.3242***	-0.1216***	-0.2962***	-0.3299***	-0.0970*	-0.3430***	-0.3427***	-0.2363**
	(0.0335)	(0.0431)	(0.0354)	(0.0444)	(0.0542)	(0.0470)	(0.0522)	(0.0517)	(0.0601)	(0.1004)
$Ln\ dist_{ij}$	-1.4801***	-2.6728***	-2.7729***	-1.0980***	-1.8028***	-1.8199***	-1.0622***	-1.8171***	-1.1017***	-1.6341***
	(0.0988)	(0.1621)	(0.1517)	(0.1454)	(0.1036)	(0.0936)	(0.1736)	(0.1091)	(0.2211)	(0.1787)
$lang_{ij}$	0.2324	0.3663***	0.3947***	0.0175	0.2071**	0.2379***	0.0107	0.2145**	0.3403	0.5555***
	(0.1415)	(0.1386)	(0.1076)	(0.1519)	(0.1049)	(0.0867)	(0.1763)	(0.1038)	(0.2484)	(0.1127)
$border_{ij}$	1.8042***	1.4345***	1.4196***	0.8916***	0.7335***	0.7499***	0.9583***	0.8148***	0.3435	0.1775
	(0.1207)	(0.1402)	(0.1355)	(0.1579)	(0.0876)	(0.0810)	(0.1842)	(0.0916)	(0.2640)	(0.1529)
$Exporter-Importer\ Controls$	Yes	No	No	Yes	No	No	Yes	No	Yes	No
$Time-FE$	Yes	No	No	Yes	No	No	Yes	No	Yes	No
$Sector-FE$	Yes	Yes	No	Yes	Yes	No	No	No	No	No
$Exporter-Time-FE$	No	Yes	No	No	Yes	No	No	Yes	No	Yes
$Importer-Time-FE$	No	Yes	No	No	Yes	No	No	Yes	No	Yes
$Exporter-Sector-Time-FE$	No	No	Yes	No	No	Yes	No	No	No	No
$Importer-Sector-Time-FE$	No	No	Yes	No	No	Yes	No	No	No	No
R^2	0.563	0.670	0.753	0.686	0.922	0.9396	0.688	0.943	0.465	0.857
$Observations$	21314	21314	21314	24867	24867	24763	6217	6217	6217	6217
$Wald\ chi2(9)$						2321.34***				

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Regression 6 is performed using the ppmlhdfe STATA command written by Correia, Guimarães, Zylkin (2019). It is a Pseudo-Maximal Likelihood Poisson estimator (PPML) with multi-way fixed effects. Exporter-importer controls are the GDP of both countries. Standard errors are reported in parentheses and clustered by country-pair level. *, **, *** denote signicance at the 10% 5% and 1% level respectively

Table 5: Gravity Estimation Results of Impacts of Service Restrictions on Cross-Border Exports of Food Commodities: Continued.

Specification	Poisson-PML Estimate							
Dependant variable	Disaggregated Food Products: Continued							
	Animal and Vegetable Oil SITC 4		**Oils Seeds and oleaginous fruits SITC 22**		**Perissable Products SIT 01+02+03**		**Agricultural Raw Materials SITC 2-22-27-28**	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$STRI_{Logistics}$	5.5133*	-9.1559**	1.7973	1.8751	-2.0541	-5.8127***	-0.6668	-4.5768**
	(2.8967)	(4.4723)	(3.2355)	(5.3077)	(1.6099)	(1.7456)	(1.9363)	(1.7919)
$STRI_{Financial-Business}$	-4.9304	-11.8046**	-22.3322***	-9.6235*	-2.7303	-7.7929***	-7.1694***	-0.7987
	(4.0123)	(5.6818)	(5.1395)	(5.4747)	(1.9420)	(2.9628)	(2.3205)	(2.3679)
$STRI_{Transports}$	-0.8465	10.1418*	3.1490	8.0895	-2.8991	2.3046	4.5795**	1.2332
	(3.0821)	(5.7410)	(5.0761)	(7.3048)	(1.8701)	(3.0008)	(1.9481)	(2.5449)
$STRI_{Distribution}$	-1.5097	4.9427	10.9460***	3.0329	-2.3521	10.8735***	0.9511	-1.6446
	(2.4359)	(4.4101)	(2.6604)	(6.1658)	(1.6748)	(2.3696)	(1.5969)	(3.1360)
$RTA_{ij,t}$	0.3047	-0.4210	-0.0584	-0.4036	1.0733***	0.9627***	0.4598**	0.3697***
	(0.3820)	(0.2625)	(0.3233)	(0.3388)	(0.2534)	(0.1753)	(0.2117)	(0.1432)
$Ln(1+tariff_{ji,t})$	-0.2305*	-0.2962***	0.3657***	-0.5692**	-0.0812	-0.4023***	0.0204	-0.3178***
	(0.1203)	(0.1008)	(0.0977)	(0.2458)	(0.0666)	(0.0771)	(0.0612)	(0.0785)
$Ln\ dist_{ij}$	-1.8587***	-2.7756***	-0.9175**	-0.9930**	-0.7795***	-1.4888***	-1.3007***	-1.4064***
	(0.2992)	(0.3036)	(0.3601)	(0.4222)	(0.1823)	(0.1479)	(0.2275)	(0.1469)
$lang_{ij}$	-0.2381	-0.2388	-0.7881***	-0.3022	0.0869	0.4280***	-0.0483	-0.1192
	(0.3161)	(0.1850)	(0.2980)	(0.3665)	(0.1879)	(0.1182)	(0.2260)	(0.1830)
$border_{ij}$	0.8501***	0.8630***	1.6517***	1.2367***	0.8593***	0.7475***	0.9749***	1.0363***
	(0.2898)	(0.1843)	(0.3843)	(0.2165)	(0.1834)	(0.1021)	(0.2422)	(0.1035)
$Exporter-Importer\ Controls$	Yes	No	Yes	No	Yes	No	Yes	No
$Time-FE$	Yes	No	Yes	No	Yes	No	Yes	No
$Exporter-Time-FE$	No	Yes	No	Yes	No	Yes	No	Yes
$Importer-Time-FE$	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.395	0.875	0.381	0.782	0.553	0.878	0.637	0.959
Observations	6217	6217	6216	6112	6217	6217	6217	6217

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Exporter-importer controls are the GDP of both. countries. Standard errors are reported in parentheses and clustered by country-pair level. *, **, *** denote signicance at the 10% 5% and 1% level respectively

VIII. Regulatory Differences in Services and Food Trade

In this section, we investigate the impact of the regulatory differences in services between pairs of countries on food exports. Following Kox and Nordås (2007), the regulatory difference between pairs of countries emerges as the most restrictive trade policy compared to individual country restrictions. Indeed, this regulatory disparity is considered as a bilateral trade cost and affects trade through gravity estimation.

Using the index of regulatory heterogeneity between country pairs of OECD countries in services, we estimate its effects on food exports. The index is constructed as follows: from the database of country-specific STRIs, for each sector we create a matrix where each cell contains countries i and j for measure m.[17] If the pair of countries has the same answer for measure m, the cell is scored as zero and 1 otherwise. For each country pair and each measure, a heterogeneity index is created by computing a weighted average of these scores (an average of the 5 measures).
We have two types of index, one based on qualitative responses in the presence or absence of regulations and another on the score that highlights the restrictiveness of regulations. Similarly to the individual STRI measures, they are scored on a scale of 0 to 1 (less restrictive to completely closed to foreign suppliers).
To capture the effect of the regulatory difference on bilateral food flows, we construct an interaction variable between the individual STRI variables (exporter and importer) and the regulatory heterogeneity variable. Indeed, regulatory disparity has lower effects on trade if the importer or exporter country is completely closed to service providers, and significant impacts if the countries are open to services (Nordås and Rouzet, 2016).
Our gravity equation is as follows:

$$X_{ij,t}^{k} = exp[\alpha_0 + \alpha_1 t_{ij} + \alpha_2 Z_{ij,t} + \alpha_3 STRIheter_{ij,t} + \alpha_4 STRIheter_{ij,t} * STRI_{i,t} + \alpha_5 STRIheter_{ij,t} * STRI_{j,t} + \mu_{ik,t} + \gamma_{jk,t} + \epsilon_{ijt}] \quad (5)$$

With $STRIheter_{ij,t}$ the overall regulatory difference between country pair (ij) in the four service sectors at year t,[18]; $STRI_{i,t}$, $STRI_{j,t}$ are STRIs of exporting and importing countries [19]; $\mu_{ik,t}$, $\gamma_{jk,t}$ dummy variables that represent the exporter-importer sector-time fixed effects (inward and outward multilateral resistance) (Olivero and Yotov, 2012). The regulatory disparity between country pairs is constant for all food sectors; an estimation by country pair fixed effects gives non-significant results.

The results with PPML as an estimator are presented in Table 6. Columns 1 to 6 represent the results of the sectoral regulatory disparity on trade flows, columns 4 to 6 the impacts of overall regulatory heterogeneity and the other columns the effects of our interaction terms. The regulatory difference in logistics has negative and significant values in our regression. Moreover, disparity in the transport sector has positive and significant effects on exports. The positive sign is explained by the easing of restrictions in this sector through open sky

[17] Barriers to entry, competition, restrictions on movement of persons, other discrimination, regulatory transparency.
[18] We use the score index to compare it to each country's STRI score.
[19] We consider the overall STRI and regulatory disparity index in the four service sectors for the analysis of our intercation terms.

agreements[20] and the liberalization of the national road freight transport regime (Geloso Grosso et al., 2104). There are few disparities in this sector among OECD countries. The index of global regulatory disparity has negative and significant effects.

Further, our interaction variables have positive and significant signs between the exporter's STRI and the regulatory heterogeneity index. The negative sign of the regulatory difference and the positive sign of our interaction term suggest that the negative effect of the regulatory difference on food exports decreases with exporting country restrictions. Indeed, the impacts of regulatory heterogeneity decrease if the exporting country is closed to service providers. The regulatory difference has significant effects on trade in services if both countries are open to service providers and less significant effects if they are completely closed (Nordås and Rouzet, 2016). In this case, the restrictions imposed by each country are still the main barrier to entry for service providers. In the food industry, we find the same effects only with the service restrictions of the exporting country. The services of the exporting country are key factors for production and export: if the exporting country is closed to service sectors this will impact its trade activities. This explains the positive and non-significant sign of the second interaction term, as the exporting country's restrictions have a greater impact on the export decision than those of the importing country.

[20]Open Sky agreements have vastly expanded international passenger and cargo flights to and from the United States. This agreement eliminates government interference in the commercial decisions of air carriers.

Table 6: Gravity Estimation Results of impacts of Heterogeneity Regulatory on Cross-Border Exports of Food Commodities

Specification	Poisson-PML Estimate								
Dependant variable	All Food Products (Pooled)								
	Sectoral Regulatory Heterogeneity Score			Overall Regulatory Heterogeneity Score			Overall Country STRI and Heterogeneity Score		
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Heterogeneity\ score_{logistics}$	-5.9125***	-5.8121***	-5.2438***						
	(1.0389)	(1.3933)	(1.2148)						
$Heterogeneity\ score_{Financial-Business}$	-2.1570	0.0433	-0.4160						
	(1.3698)	(1.1906)	(1.0131)						
$Heterogeneity\ score_{Transports}$	7.4270***	4.5802***	4.5381***						
	(0.9062)	(1.5054)	(1.3336)						
$Heterogeneity\ score_{Distribution}$	-2.6660**	-0.0479	-0.1760						
	(1.2635)	(1.2973)	(1.1358)						
Overall Heterogeneity score				-0.7852	-1.9970**	-1.9580**	-3.6874	-10.5708***	-10.5012***
				(1.4685)	(0.9403)	(0.7790)	(2.5580)	(4.0160)	(3.6055)
Overal Heterogeneity score ∗STRI Exporter							1.7508	24.4308*	24.7316**
							(6.3114)	(12.7067)	(10.1813)
Overal Heterogeneity score ∗STRI Importer							7.1536	13.6079	13.1990
							(5.2705)	(11.8198)	(11.3372)
$RTA_{ij,t}$	0.4871***	0.2977**	0.4308***	0.6589***	0.3469***	0.4748***	0.5916***	0.3624***	0.4876***
	(0.1688)	(0.1251)	(0.1169)	(0.1711)	(0.1204)	(0.1127)	(0.1767)	(0.1196)	(0.1116)
$Ln(1+tariff_{ji,t})$	-0.2104***	-0.3201***	-0.3496***	-0.1444***	-0.3055***	-0.3335***	-0.1609***	-0.2592***	-0.2875***
	(0.0438)	(0.0527)	(0.0470)	(0.0413)	(0.0548)	(0.0488)	(0.0425)	(0.0600)	(0.0533)
$Ln\ dist_{ij}$	-1.3052***	-1.7233***	-1.7478***	-1.0835***	-1.6728***	-1.6967***	-1.0834***	-1.6838***	-1.7086***
	(0.1466)	(0.1127)	(0.1023)	(0.1592)	(0.1127)	(0.1006)	(0.1612)	(0.1119)	(0.1001)
$lang_{ij}$	0.0362	0.1300	0.1800**	-0.0065	0.1336	0.1756**	0.0022	0.1562	0.1977**
	(0.1256)	(0.0983)	(0.0857)	(0.1543)	(0.1011)	(0.0890)	(0.1516)	(0.1004)	(0.0884)
$border_{ij}$	0.8252***	0.7224***	0.7311***	0.9328***	0.7606***	0.7735***	0.9195***	0.7523***	0.7654***
	(0.1355)	(0.0793)	(0.0751)	(0.1631)	(0.0850)	(0.0799)	(0.1600)	(0.0832)	(0.0786)
$Exporter-Importer\ Controls$	Yes	No	No	Yes	No	No	Yes	No	No
$Time-FE$	Yes	No	No	Yes	No	No	Yes	No	No
$Sector-FE$	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
$Exporter-time-FE$	No	Yes	No	No	Yes	No	No	Yes	No
$Importer-time-FE$	No	Yes	No	No	Yes	No	No	Yes	No
$Exporter-sector-time-FE$	No	No	Yes	No	No	Yes	No	No	Yes
$Importer-sector-time-FE$	No	No	Yes	No	No	Yes	No	No	Yes
Wald chi2(9)			2196.98***			1848.69***			1925.97***
R^2	0.732	0.923	0.9374	0.666	0.919	0.9361	0.671	0.920	0.9365
Observations	24867	24867	24763	24867	24867	24763	24867	24867	24763

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Regressions 3, 6, 9 are performed using the ppmlhdfe STATA command written by Correia, Guimarães, Zylkin (2019). It is a Pseudo-Maximal Likelihood Poisson estimator (PPML) with multi-way fixed effects. Exporter-importer controls are the GDP of both countries. Standard errors are reported in parentheses and clustered by country-pair level. *, **, *** denote signicance at the 10% 5% and 1% level respectively

IX. Robustness Check

Our main estimates of the gravity model suggest negative and significant results of restrictions in the logistics, financial and other business sectors on food exports. Restrictions in the distribution sector have positive effects on trade. We performed various robustness tests to assess the sensitivity of our results.

The first tests focus on the effects of individual importing and exporting country restrictions on bilateral food exports. The first estimate addresses the issue of adjustment of trade policies discussed above. Using two-year time intervals, the different effects of restrictions on trade are studied. The second test attempts to reduce the issue of endogeneity between our restrictiveness variables and trade. It takes the one-year lags of our restrictiveness variables and sees their effects on trade. The results presented in table A. 4 (columns 3 and 4, 5 and 6) show negative and significant effects of restrictions in logistics and financial services on food trade. Restrictions in the distribution sector have positive and significant effects.

Thirdly, we study the effects of country-specific restrictions on food trade. Adding the importing and exporting STRIs into our equation, we examine their effects on trade. Both indices have significant and negative effects on food trade (column 7 of Table A. 4), but the STRI of the exporting country has much greater impacts than the importing country's STRI: a 0.05 point increase in restrictions in the exporting and importing countries respectively leads to a decrease of nearly 3% and 1.5% in food exports. The results are carefully considered because we did not consider the country sector time fixed effects to control for the omitted variables. If we compare these results with those of our terms of interactions we can see that the exporting country's restrictions have a higher significant negative impact on food trade (Nordås and Rouzet, 2016).[21] The same results are found when controlling for variables omitted by the country fixed effects and this confirms the negative and significant effect of restrictions in both countries on food exports.

The last test in this section considers other control variables. We consider dummy variables that control for economic integration such as the EEA, and NAFTA.[22]. We also consider economic integration agreements (EIA) with provisions for harmonization of SPS and TBT standards.[23]. We find the same effects observed above (see columns 8, 9, 10 and 11 of table A. 4).

The analysis of the sectoral STRI shows negative and significant impacts in the sectors of cargo-handling, storage, warehousing and customs brokerage logistics. In the financial and other business sector, the banking and accounting sectors have limiting and significant effects on food trade. In transportation, the restrictions in road freight and sea are barriers to food trade (table A. 5).

The last robustness tests attempt to study the performance of our results on the negative

[21] These authors find that the STRI of the exporting country has greater negative effects on services export performance.

[22] We include dummy variables that represent the European Economic Area (Intra EEA) to control for the deeper integration in services, and North American Free Trade Agreement (NAFTA), which is a major trade agreement on commodities.

[23] The EIA database was compiled by Baier and Bergstrand (http://www.nd.edu/~jbergstr/) It provides detailed and useful information on EIAs and links to the legal text of the agreements.

impacts of regulatory disparity on food exports. To evaluate these results, we consider the regulatory disparity between net food exporting and net food importing countries, and the regulatory disparity between OECD countries and emerging countries, which is still greater than the disparity between OECD countries (see Table A. 3). The disparity between countries with high and low value added of services to GDP and that between EEA and EU countries (lower restrictions) are evaluated. The results are presented in table A. 6. Overall, the disparities in logistics, finance, and other business sectors have negative effects, while transport has positive effects on exports. Disparities between net exporting and net importing countries and between OECD and emerging market countries do not have significant effects on the sectors considered, although the free movement of goods, services and people in the EU and EEA countries, the regulatory disparity in logistics, finance and other business sectors are barriers to trade in food products.

X. Conclusion

This study is an extension of previous studies on the impacts of services restrictions on international trade. However, it differs from earlier studies because we examine restrictions in the services sector on food trade, a topic not widely studied in the literature. Our analysis suggests that deregulation of the services sector and harmonization policy are highly beneficial for food trade.

Our paper, which investigates the impacts of service regulations on food trade, presents a tool for quantifying service restrictions and assesses these effects on trade flows. We start with a gravity analysis using panel data on pooled bilateral trade in food products between OECD countries from 2014 to 2018. To estimate restrictions in services, we use the Service Trade Restrictiveness Index and the Regulatory Heterogeneity Index of the OECD. Restrictions in logistics, transportation, financial, other business sectors, and distribution are considered in our study.
Using the PPML and OLS as an estimator with country and sector fixed effects, we found different effects: restrictions in both countries in the logistics, finance and other business sectors have negative and significant effects on food exports between OECD countries. Restrictions in the distribution sector have positive and significant effects on exports. The most strongly affected sectors are food, live animals and perishable products (milk, eggs, and meat). A sectoral analysis shows that restrictions in cargo-handling, customs brokerage, freight forwarding logistics, banking, accounting, sea and road transport are barriers to trade in food products. Regulatory disparity in the logistics sector is a barrier to trade, but disparity in the transport sector has positive and significant effects on food exports. By contrast, the overall disparity in the services sector has a significant negative impact on food trade. This impact disappears when the exporting country is closed to service providers.

The results appear robust to alternative specifications. Several different aspects were analyzed. First, we estimate the effects of restrictions in services on food exports considering the issue of adjustment of trade policies and endogeneity. Second, other control variables were introduced into our estimates. The results of these tests confirm our findings that restrictions in logistics, financial and other business sectors have negative effects and those in distribution have positive effects. The effects of regulatory disparity on exports are tested further. Regulatory disparity was analyzed between net exporting and net importing countries, countries with

high and lower services value added to GDP, between OECD and emerging countries, and EEA and EU member countries. The results show that regulatory disparities in logistics, finance, and other business sectors have significant negative effects, while regulatory disparity in transportation has positive effects. The disparity between OECD and emerging countries has less significant effects on exports.

Our study differs from the existing literature, but is limited by the data. Indeed, service restriction indices are time-invariant composite measures for some sectors, and the data are also short-run in order to capture the effects (2014-2018). Regulations are adjustment policies that require time for firms or exporters to comply with them. Therefore, the data do not capture the effects on trade over the long run. However, we can improve our study by considering subsidy policy coupled with regulation. It may be useful to consider a dummy variable that indicates the existence of a "Most-Favoured-Nation" and "National Treatment" clause to account for the treatment provided to the foreign exporter in the domestic market.

This study of the impacts of service restrictions on food products shows that the regulation of services has detrimental effects on the export performance of OECD countries. The novel conclusion of this study is that regulatory cooperation between countries has become a relevant factor in global food trade. Regulatory harmonization in economic integration areas significantly boosts trade flows.

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XI. APPENDIX

Table A. 1:
OECD, non OECD, EEA, Major Net Food-Exporting and High Value-Added Service Countries.

OECD countries	**Non-OECD (Emerging countries)**	**EEA countries**	**Major net food-exporting economies**	**High value -added service countries**
Australia	China	Austria	Australia	Belgium
Austria	(People's Republic of)	Belgium	Belgium	France
Belgium	Colombia	Czech Republic	Canada	Greece
Canada	Costa Rica	Denmark	Denmark	Israel
Chile	India	Estonia	Hungary	Japan
Czech Republic	Indonesia	Finland	Iceland	Luxembourg
Denmark	Malaysia	France	Ireland	Netherlands
Estonia	Russia	Germany	Mexico	Switzerland
Finland	South Africa	Greece	Netherlands	United Kingdom
France	Thailand	Hungary	New-Zealand	United States
Germany		Iceland	Norway	of America
Greece		Ireland	Poland	
Hungary		Italy	Spain	
Iceland		Latvia	Thailand	
Ireland		Lithuania	Turkey	
Israel		Luxembourg	United States	
Italy		Netherlands	of America	
Japan		Norway		
Korea		Poland		
Latvia		Portugal		
Lithuania		Slovak Republic		
Luxembourg		Slovenia		
Mexico		Spain		
Netherlands		Sweden		
New Zealand		Switzerland		
Norway		United Kingdom		
Poland				
Portugal				
Slovak Republic				
Slovenia				
Spain				
Sweden				
Switzerland				
Turkey				
United Kingdom				
United States of America				

Table A. 2: Cross-Correlation Table of STRI Intercation Variables.

Variables	$STRI_{Logistics}$	$STRI_{Financial-Business}$	$STRI_{Transports}$	$STRI_{Distribution}$
$STRI_{Logistics}$	1.000			
$STRI_{Financial-Business}$	0.416	1.000		
$STRI_{Transports}$	0.401	0.758	1.000	
$STRI_{Distribution}$	0.404	0.372	0.221	1.000

Table A. 3:
Descriptive statistics: Country STRI and Regulatory Heterogeneity Score.

	Country STRI									
	Emerging					OECD				
Variables	**obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
$STRI_{Logistics}$	1,800	0.37385	0.1177508	0.2425	0.675	1,800	0.2074583	0.0698443	0.125	0.4825
$STRI_{Transports}$	1,800	0.41395	0.133193	0.225	0.6425	1,800	0.280588	0.0686114	0.1825	0.4875
$STRI_{Financial-Business}$	1,800	0.4134	0.1592639	0.23	0.6766667	1,800	0.2271481	0.0669939	0.13	0.4366667
$STRI_{Distribution}$	1,800	0.3116	0.1464287	0.14	0.67	1,800	0.1712778	0.0464173	0.11	0.33
	Heterogeneity score									
	OECD-Emerging					**Intra-OECD**				
$Heterogeneity\ score_{logistics}$	1,800	0.3330199	0.0929693	0.143775	0.6092	6,300	0.2194039	.0759028	0.061	0.508075
$Heterogeneity\ score_{Transports}$	1,800	0.3608861	0.0787094	0.1793	0.5776667	6,300	0.2229697	0.0888589	0.0621333	0.4946
$Heterogeneity\ score_{Financial-Business}$	1,800	0.3806987	0.1048084	0.1582	0.6029	6,300	0.2467414	0.0656446	0.0576667	0.4976667
$Heterogeneity\ score_{Distribution}$	1,800	0.3124304	0.1336789	0.0952	0.7131	6,300	0.1863441	0.0533533	0.058	0.364
Overall Heterogeneity score	1,800	0.3523719	0.0719307	0.1896	0.5192667	6,300	0.2252233	0.0678211	0.0763273	0.4435333

	Country STRI									
	Intra-EEA					EU				
Variables	**obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**	**obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
$STRI_{Logistics}$	3,250	0.2022115	0.0551502	0.1175	0.405	2,530	0.1901304	0.040993	0.1175	0.2875
$STRI_{Transports}$	3,250	0.2572115	0.0516674	0.14	0.4066667	2,530	0.2466159	0.0414625	0.14	0.3275
$STRI_{Financial-Business}$	3,250	0.2184615	0.0568032	0.13	0.3566667	2,530	0.2070435	0.0488172	0.13	0.31
$STRI_{Distribution}$	3,250	0.1764615	0.053479	0.11	0.37	2,530	0.1643478	0.0398801	0.11	0.28
	Heterogeneity score									
$Heterogeneity\ score_{logistics}$	3,250	0.177359	00.0505442	0.061	0.34445	2,530	0.1644931	0.039781	0.061	0.2879
$Heterogeneity\ score_{Transports}$	3,250	0.1562369	0.0421006	0.0621333	0.29	2,530	0.1465914	0.0348444	0.0621333	0.25915
$Heterogeneity\ score_{Financial-Business}$	3,250	0.2115703	0.0470254	0.0576667	0.36	2,530	0.2008896	0.0420443	0.0576667	0.3096667
$Heterogeneity\ score_{Distribution}$	3,250	0.1626689	0.0473591	0.058	0.364	2,530	0.1502917	0.0346274	0.058	0.239
Overall Heterogeneity score	3,250	0.1790437	0.0427934	0.0763273	0.3236727	2,530	0.167438	0.0329199	0.0763273	0.26495

Table A. 4: Issues of Adjustment of Trade Policies, Endogeneity, Country-STRI, and Other Control Variables.

Specification	Poisson-PML Estimate										
Dependant variable	All Food Products (Pooled)										
	Baseline		2-years interval		Laggued variables		Country-STRI	Other control variables			
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$STRI_{Logistics}$	-7.6906***	-7.3176***	-7.7933***	-7.8234***	-4.1104***	-5.6439***		-7.8344***	-7.1746***	-7.9510***	-8.1397***
	(1.8916)	(1.5895)	(1.9973)	(1.6328)	(1.1407)	(1.2749)		(1.8738)	(1.6509)	(1.9764)	(1.7900)
$STRI_{Financial-Business}$	-6.8823***	-6.6244***	-7.2034***	-6.6016***	-6.7673***	-6.1486***		-7.3817***	-7.5066***	-6.7848***	-6.5539***
	(2.3890)	(2.0004)	(2.4470)	(2.0447)	(1.7001)	(1.6364)		(2.4483)	(2.1036)	(2.4149)	(2.0977)
$STRI_{Transports}$	1.9993	2.1451	2.2527	2.0845	2.6662	2.4567		3.1682	3.3905	1.9463	1.9549
	(2.3698)	(2.1118)	(2.4201)	(2.1318)	(1.6650)	(1.8763)		(2.3736)	(2.1755)	(2.4513)	(2.1959)
$STRI_{Distribution}$	9.7833***	8.7531***	9.8120***	9.2218***	9.5453***	8.2561***		9.1919***	8.7872***	9.9410***	9.6181***
	(2.0444)	(1.7437)	(2.1314)	(1.7491)	(1.8162)	(1.6680)		(2.1922)	(1.8512)	(2.1317)	(1.8891)
$STRI - Importer$							-1.4287**				
							(0.6991)				
$STRI - Exporter$							-2.9249***				
							(0.8376)				
$RTA_{ij,t}$	0.3806***	0.4912***	0.4677***	0.5307***	0.4144***	0.5149***	0.7647***				
	(0.1156)	(0.1059)	(0.1195)	(0.1086)	(0.1155)	(0.1086)	(0.0959)				
$Intra - EEA$								1.2530***	1.3279***		
								(0.2045)	(0.1878)		
$NAFTA$								0.1689	0.4014*		
								(0.2475)	(0.2254)		
$EIA - SPS\ harmonization$										-0.1510	-0.2364
										(0.1499)	(0.1462)
$EIA - TBT\ harmonization$										0.3147**	0.4901***
										(0.1502)	(0.1410)
$Ln(1 + tariff_{ji,t})$	-0.2962***	-0.3299***	-0.2921***	-0.3231***	-0.3084***	-0.3338***	-0.1038***	-0.0058	-0.0344	-0.3120***	-0.3329***
	(0.0542)	(0.0470)	(0.0557)	(0.0472)	(0.0531)	(0.0465)	(0.0250)	(0.0519)	(0.0472)	(0.0624)	(0.0593)
$Ln\ dist_{ij}$	-1.8028***	-1.8199***	-1.8222***	-1.8308***	-1.7773***	-1.8009***	-1.0412***	-1.7563***	-1.7552***	-1.8469***	-1.8754***
	(0.1036)	(0.0936)	(0.1060)	(0.0948)	(0.1025)	(0.0936)	(0.0885)	(0.1088)	(0.0996)	(0.1052)	(0.0978)
$lang_{ij}$	0.2071**	0.2379***	0.2458**	0.2454***	0.1913*	0.2288***	0.0074	0.2532**	0.3026***	0.2172**	0.2551***
	(0.1049)	(0.0867)	(0.1052)	(0.0878)	(0.1041)	(0.0878)	(0.1034)	(0.1050)	(0.0860)	(0.1056)	(0.0885)
$border_{ij}$	0.7335***	0.7499***	0.7313***	0.7435***	0.7602***	0.7666***	0.9706***	0.7356***	0.7403***	0.7162***	0.7209***
	(0.0876)	(0.0810)	(0.0894)	(0.0821)	(0.0843)	(0.0787)	(0.1111)	(0.0890)	(0.0820)	(0.0880)	(0.0826)
$Exporter - importer\ controls$	No	No	No	No	No	No	Yes	No	No	No	No
$Sector\ FE$	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No
$Time\ FE$	No	No	No	No	No	No	Yes	No	No	No	No
$Exporter\ time - FE$	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	No
$Importer\ time - FE$	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	No
$Exporter\ sector\ time - FE$	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes
$Importer\ sector\ time - FE$	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes
$Wald\ chi2(9)$		2321.34***		2305.15***		2236.85***			2337.29***		2314.19***
R^2	0.922	0.9396	0.922	0.9380	0.922	0.9386	0.664	0.925	0.9404	0.922	0.9372
$Observations$	24867	24763	18651	18651	24866	24762	24867	24867	24763	24867	18651

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Regressions 2, 4 ,6, 8 and 10 are performed using the ppmlhdfe STATA command written by Correia, Guimarães, Zylkin (2019). It is a Pseudo-Maximal Likelihood Poisson estimator (PPML) with multi-way fixed effects. Exporter-importer controls are the GDP of both countries. Standard errors are reported in parentheses and clustered by country-pair level except regression 7 where they are clustered by importer and exporter
*, **, *** denote signicance at the 10% 5% and 1% level respectively, .

Table A. 5: Impact of Disaggregated Sectoral STRIs on Cross-Border Exports of Food Commodities.

Specification	**Poisson-PML Estimate**					
Dependant variable	**All food products (Pooled)**					
Model	(1)	(2)	(3)	(4)	(5)	(6)
$RTA_{ij,t}$	0.2262**	0.3428***	0.3453***	0.4686***	0.4276***	0.5232***
	(0.1123)	(0.1074)	(0.1129)	(0.1045)	(0.1181)	(0.1108)
$Ln(1+tariff_{ji,t})$	-0.3078***	-0.3384***	-0.3045***	-0.3369***	-0.2986***	-0.3345***
	(0.0567)	(0.0492)	(0.0566)	(0.0497)	(0.0585)	(0.0538)
$Ln\ dist_{ij}$	-1.7712***	-1.7945***	-1.7551***	-1.7764***	-1.7604***	-1.7711***
	(0.1074)	(0.0970)	(0.1029)	(0.0941)	(0.1114)	(0.1007)
$lang_{ij}$	0.1989*	0.2326***	0.1610	0.1987**	0.1441	0.1826*
	(0.1061)	(0.0882)	(0.1054)	(0.0890)	(0.1272)	(0.1091)
$border_{ij}$	0.7141***	0.7333***	0.7432***	0.7616***	0.7603***	0.7772***
	(0.0864)	(0.0799)	(0.0903)	(0.0833)	(0.0950)	(0.0894)
Logistics Sector						
$STRI_{Warehouse}$	5.9945	6.7194*				
	(4.5835)	(3.9413)				
$STRI_{Freight}$	-4.5174***	-4.1346***				
	(1.7025)	(1.5321)				
$STRI_{Handling}$	-6.0579*	-7.5224**				
	(3.5519)	(3.2490)				
$STRI_{Customer}$	-2.6590**	-2.2604**				
	(1.0789)	(0.9650)				
Financial-Other Business Sectors						
$STRI_{Accounting}$			-1.8437***	-1.7654***		
			(0.6868)	(0.5489)		
$STRI_{Banking}$			-5.8073***	-4.9442***		
			(1.6360)	(1.4730)		
$STRI_{Insurance}$			-0.6933	-1.0485		
			(2.1983)	(1.7472)		
Transports and Distribution Sector						
$STRI_{Air\ transport}$					-0.9819	-0.9214
					(1.3218)	(1.2366)
$STRI_{Rail\ freight\ transport}$					-0.9889	-1.1404
					(0.9119)	(0.7521)
$STRI_{Road\ freight\ transport}$					-2.9675**	-2.6602**
					(1.1906)	(1.1050)
$STRI_{Sea\ transport}$					-6.1879**	-5.0457*
					(3.0645)	(2.6837)
$STRI_{Distribution}$					9.4034***	7.9703***
					(2.5192)	(2.1428)
Sector FE	Yes	No	Yes	No	Yes	No
Exporter time − FE	Yes	No	Yes	No	Yes	No
Importer time − FE	Yes	No	Yes	No	Yes	No
Exporter sector time − FE	No	Yes	No	Yes	No	Yes
Importer sector time − FE	No	Yes	No	Yes	No	Yes
Wald chi2(9)		2253.54***		2113.76***		1972.41***
R^2	0.923	0.9384	0.917	0.9376	0.927	0.9433
Observations	24867	24763	24867	24763	15996	15996

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Regressions 2, 4, 6 are performed using the ppmlhdfe STATA command written by Correia, Guimarães, Zylkin (2019). It is a Pseudo-Maximal Likelihood Poisson estimator (PPML) with multi-way fixed effects. Exporter-importer controls are the GDP of both countries. Standard errors are reported in parentheses and clustered by country-pair level.
*, **, *** denote signicance at the 10% 5% and 1% level respectively

Table A. 6: Major Exporter-Importers Countries, OECD-Emerging countries, High-Low Services value added countries, Economic Integretation and Heterogeneity Regulatory.

Specification	Poisson-PML Estimate									
Dependant variable	Export of Food Products (Pooled)									
	Net Food Exporting-Importing countries		**OECD-Emerging countries**		**High services value added Vs Low services value added**		**Intra-EEA Countries**		**European Union Countries**	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Heterogeneity\ score_{logistics}$	-3.8681	-4.3965*	-3.6917	-0.3897	-5.8123***	-5.2440***	-3.8588**	-3.9080**	-3.3777*	-3.4764*
	(2.4214)	(2.4164)	(4.1156)	(1.9373)	(1.3934)	(1.2148)	(1.7619)	(1.6664)	(1.9130)	(1.8180)
$Heterogeneity\ score_{Financial-Business}$	-0.5337	-0.3509	-0.8464	1.2619	0.0433	-0.4160	-3.4637***	-3.4275***	-3.3689***	-3.2980***
	(1.5046)	(1.4992)	(3.0913)	(1.9871)	(1.1906)	(1.0131)	(1.0526)	(0.9792)	(1.0949)	(1.0109)
$Heterogeneity\ score_{Transports}$	1.6938	2.1404	4.1827	3.1601*	4.5802***	4.5382***	6.2900***	6.2427***	5.6697***	5.6745***
	(2.6602)	(2.4901)	(2.7422)	(1.9195)	(1.5053)	(1.3335)	(2.0520)	(1.9372)	(2.1753)	(2.0524)
$Heterogeneity\ score_{Distribution}$	-1.1836	-1.0213	-3.7817	-4.4993**	-0.0478	-0.1760	-0.4756	-0.4091	-0.8273	-0.7673
	(2.0846)	(2.0976)	(3.0041)	(1.8964)	(1.2973)	(1.1358)	(1.2267)	(1.1888)	(1.2178)	(1.1579)
$RTA_{ij,t}$	0.8740***	0.9283***	0.3247	0.3230*	0.2976**	0.4308***				
	(0.2120)	(0.2097)	(0.1991)	(0.1681)	(0.1251)	(0.1169)				
$Ln(1+tariff_{ji,t})$	-0.4081***	-0.4116***	-0.3824***	-0.3832***	-0.3201***	-0.3496***	-0.1264**	-0.1361**	-0.1310*	-0.1407**
	(0.0883)	(0.0888)	(0.1008)	(0.0839)	(0.0527)	(0.0470)	(0.0634)	(0.0622)	(0.0722)	(0.0684)
$Ln\ dist_{ij}$	-1.5199***	-1.5297***	-2.7729***	-2.7365***	-1.7233***	-1.7478***	-1.6911***	-1.6914***	-1.7259***	-1.7261***
	(0.1901)	(0.1870)	(0.4369)	(0.3592)	(0.1127)	(0.1023)	(0.1390)	(0.1351)	(0.1357)	(0.1318)
$lang_{ij}$	0.1574	0.1796	0.8255***	1.0013***	0.1300	0.1800**	0.5935***	0.5890***	0.6130***	0.6129***
	(0.1391)	(0.1243)	(0.2954)	(0.2185)	(0.0983)	(0.0857)	(0.1119)	(0.1088)	(0.1217)	(0.1180)
$border_{ij}$	0.7671***	0.7810***	1.3295***	1.2305***	0.7224***	0.7311***	0.6572***	0.6601***	0.6525***	0.6551***
	(0.1191)	(0.1187)	(0.3862)	(0.2324)	(0.0793)	(0.0751)	(0.0812)	(0.0793)	(0.0816)	(0.0794)
$Sector-FE$	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
$Exporter-time-FE$	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
$Importer-time-FE$	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
$Exporter-sector-time-FE$	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
$Importer-sector-time-FE$	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
$Wald\ chi2(9)$		630.98***		194.35***		2196.94***		884.04***		875.01***
R^2	0.935	0.9482	0.541	0.9434	0.923	0.9374	0.946	0.9514	0.949	0.9545
Observations	6336	6257	6700	6537	24867	24763	13000	12925	10120	10120

Notes: The dependent variable is nominal bilateral food product from i to j at to t in sector k as in equation (3). Regressions 2, 4, 6, 10 are performed using the ppmlhdfe STATA command written by Correia, Guimarães, Zylkin (2019). It is a Pseudo-Maximal Likelihood Poisson estimator (PPML) with multi-way fixed effects. Exporter-importer controls are the GDP of both countries. Standard errors are reported in parentheses and clustered by country-pair level. *, **, *** denote signicance at the 10% 5% and 1% level respectively

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