Estimating Tariff Equivalents of Service Trade Restrictions

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Abstract

This paper provides new ad-valorem tariff equivalents of trade restrictions in seven service sectors for 50 countries. I utilise the novel International Trade and Production Database for Estimation (ITPD-E) Release 2 developed by Borchert et al. (2022b) and the OECD's Services Trade Restrictiveness Index (STRI) in a detailed sector level structural gravity model to obtain estimates for the impact of restrictions to trade in services. There are three main findings. First, more restrictive services trade policies are associated with lower international trade in all seven service sectors analysed. Second, estimated trade costs are considerably lower for trade between European Economic Area (EEA) members than between countries on a most-favoured nation (MFN) status. Third, there is significant sectoral heterogeneity in the estimated trade costs across service sectors. The findings show that trade costs in services are high. However, there are large differences in trade costs across service sectors, suggesting that policymakers should be aware of different business models, competition challenges, and regulatory barriers within service sectors.

Key words: structural gravity, trade in services, services trade restrictions

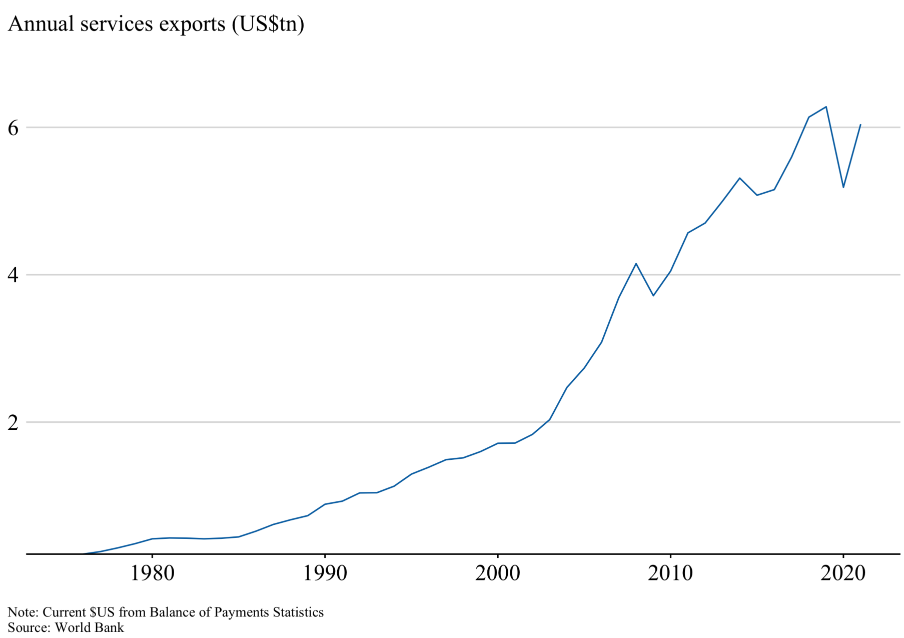
JEL Classification: F13, F14, F15, F68

Contents

1 Introduction

Service sectors produce more than two-thirds of global gross domestic product (GDP) (*OECD,* 2022). Technological advances in information and communication technologies (ICTs) in the 1980s and 1990s enabled an increasing number of services to be traded from a distance. For example, a firm could easily receive financial advice from a financial advisor in another country by email, fax or messaging services. Subsequently, services trade became an increasingly important part of the world economy, with global service exports increasing from $886 billion in 1990 to $6.28 trillion in 2019 (see Figure 1).

Figure 1: Global services exports, 1976 to 2021



Globalisation has led to increasingly complex Global Value Chains (GVCs), where finished goods are not only the result of production and assembly. An increasing share of value in products is created from R&D and marketing activities (AiGroup, 2019), making services an enabling condition for manufacturing growth (Hoekman and Shepherd, 2017). As a result, manufacturing and services have become more interwoven, leading to the so-called "servitisation" of manufacturing (Miroudot and Cadestin, 2017). As an example, services value-added content accounted for 34% of gross manufacturing exports in the United Kingdom in 2021 (*Trade in Value Added: United Kingdom Country Note - OECD* 2022). Goods and services are often combined and sold locally or exported. Although the impact of tariffs and non-tariff measures on manufacturing trade has been comprehensively studied, there has been little focus on the impact of trade restrictions in services (H. K. Nordås and Rouzet, 2017).

The relatively limited amount of research on trade in services is partly due to the difficulty of measuring the restrictiveness of trade in services compared to measuring it for goods. Border taxes (tariffs and customs duties), quantitative limitations (quotas), and other non-tariff measures (NTMs) create trade barriers for goods. Regulations and standards are often implemented at the border, although some NTMs are also implemented 'behind-the-border' in the form of standards and regulations that have an impact on all local and foreign goods[1]. For services trade, frictions are mainly due to regulatory measures that are more similar to NTMs in goods. Because of the intangible nature of a transaction in services trade, almost all trade barriers are effectively NTMs. The OECD measures barriers to services trade with

[1] See De Melo and Shepherd (2018) for an introduction on NTMs.

their Services Trade Restrictiveness Index (STRI), which provides information on service trade restrictions and behind the border regulations in 22 sectors across 50 countries from 2014 to 2021.

I utilise the novel ITPD-E Release 2 developed by Borchert et al. (2022b) and the OECD's STRI to provide new estimates of ad-valorem[2] tariff equivalents (AVEs) of cross-border trade restrictions in seven service sectors for 50 countries. There are three inputs required to calculate AVEs of a particular STRI score.

1. The STRI score, which is sourced from the OECD STRI database.
2. The elasticity of substitution between varieties of traded services, which are obtained from four recent studies.
3. The elasticity of cross-border trade flows with respect to services trade restrictiveness (henceforth, the 'trade elasticity'). A detailed sectoral structural gravity model is utilised to estimate the trade elasticity in seven service sectors, including: transport, distribution, construction, insurance, finance, business services and information services. These estimates are theory-consistent, incorporating domestic consumption of domestic production (henceforth, called 'domestic trade') and control for multilateral resistance.

This paper estimates AVEs of trade restrictions in seven service sectors from 50 countries for 2021. It also uses the latest release of ITPD-E, which allows estimates to be made using a longer panel than previously conducted. Additionally, the AVE estimates could also be used as input for further analysis, such as CGE modelling.

This paper finds that a more restrictive services trade policy is associated with lower international trade in all seven service sectors analysed. The findings show that trade costs in services are high, but that there is significant sectoral heterogeneity in the estimated trade costs across service sectors. Finally, estimated trade costs are considerably lower for trade between EEA members than between countries on a most-favoured nation status. The results from the robustness check of running a similar regression with country-pair fixed effects are more ambiguous, with estimates for the trade elasticity negative in most services sectors, but only two sectors are found to be significant. A longer panel may be needed to identify an effect, as regressions with country-pair fixed effects are generally unsuitable in estimations attempting to identify the effect of variables with limited time variation.

There are a number of limitations to consider in this paper, including the relatively short time span of the panel (2014 to 2019), the ability to control for preferential trade agreements (PTAs), and the level of sector granularity for services trade data. It is also out of this paper's scope to establish causality between services trade policy, services trade and services sector performance. The Uruguay Round of multilateral trade negotiations in 1995 established the General Agreement on Trade in Services (GATS), where international trade in services was classified into four modes of supply[3]. Khachaturian and Oliver (2021) finds that several

[2]Latin for 'to value'.

[3]The four modes of services delivery are: Mode 1 - remote delivery (e.g. digitally); Mode 2 - travel of consumers to suppliers; Mode 3 - suppliers' commercial presence in foreign markets; and Mode 4 - movement of people.

modes of supply are utilised by firms when providing services to foreign consumers. The different modes of supply in services trade are also outside the scope of this paper.

High trade costs reduce domestic welfare, but deregulating many policies in the STRI might be inappropriate, as these rules could be used to achieve other policy objectives (Benz and Jaax, 2020), such as consumer and environmental protection. However, calculations of the AVEs may assist policy makers identify important trade-offs in the use of trade restrictive measures for domestic policy priorities.

Section 2 provides the theoretical justification for using the structural gravity model and its application to service trade restrictions in the literature. Section 3 specifies the main estimation strategy for obtaining the sectoral trade elasticities, while Section 4 details the data used. Section 5 presents the results for estimating the trade elasticity and findings from the robustness checks. Section 6 converts the trade elasticity estimates and the STRI into AVEs of service trade restrictions, before I conclude in Section 7.

2 Related Literature

2.1 The Gravity Model

The gravity model of trade is derived from Newton's Law of Universal Gravitation. Economics has a long history of applying Newton's Law of Universal Gravity, dating back to Ravenstein (1885) who applied the Newton's gravity equation to migration flows. Tinbergen (1962) is widely cited as the first to apply the gravity equation to international trade. It explains that cross-border trade (gravitational force) between two countries (objects) is an increasing function of the trading economies size (masses) and inversely proportional to the trade costs (distance squared) between them. This can be seen in equations 1 and 2, adapted from Y. V. Yotov et al. (2016).

Newton's Law of Universal Gravitation

$$F_{ij} = G\frac{M_i M_j}{D_{ij}^2} \tag{1}$$

Where:

- F_{ij} is the magnitude of the gravitational force between objects i and j
- G is the gravitational constant
- M_i is object i's mass
- M_j is object j's mass
- D_{ij} is the distance between objects i and j

Gravity Trade Model

$$X_{ij} = G\frac{Y_i E_j}{T_{ij}^{\theta}} \tag{2}$$

Where:

- X_{ij} is trade from country i to j
- G is the inverse of world production $G = \frac{1}{Y}$
- Y_i is country i's domestic production
- E_j is country j's aggregate expenditure
- T_{ij} is total trade frictions between countries i and j
- θ is the trade elasticity

Other early uses of applying gravity to trade include Pulliainen (1963) and Pöyhönen (1963). However, all early uses of the gravity model were a-theoretical. Anderson (1979) was the first to provide a theoretical economic basis for the gravity model presented by Tinbergen (1962). Despite its intuitiveness, strong empirical performance, and solid theoretical foundation, the gravity model fell into disrepute with economists in the 1970s and 1980s (R. Baldwin and Taglioni, 2006), with some claiming it was too complex (Leamer and Levinsohn, 1994), and that its theoretical basis was questionable (Deardorff, 1984). The gravity model continued to have a weak reputation among eminent economists (R. E. Baldwin, 1994) until the early 2000s.

2.2 From Traditional Gravity to Structural Gravity

The shift from traditional gravity models to structural gravity models led to what Y. Yotov (2022) describes as the "golden age of structural gravity". The difference between the traditional gravity model and the structural gravity model is the inclusion of multilateral resistance terms. Anderson and van Wincoop (2003) showed the importance of multilateral resistance – that it is important to consider each country's total trade costs with the rest of the world (multilateral trade resistance), as well as the bilateral trade costs between two countries (bilateral trade resistance). Benz and Jaax (2020) provides a good example: two countries will trade more for a given level of bilateral trade costs if they are both surrounded by oceans (like New Zealand and Australia), rather than being bordered by large economies, like Belgium being close to the large economies of Germany and France. Country-specific fixed effects are used in Poisson Pseudo Maximum Likelihood (PPML) estimations (see Section 2.3), while other methods use indexes to account for these multilateral resistances.

While Anderson and van Wincoop (2003) derived the 'demand-side gravity' model, Eaton and Kortum (2002) derived the 'supply-side gravity' model. These models were further expanded by Anderson and van Wincoop (2004), who derived the 'demand-side sectoral gravity' model, while Chor (2010) and A. Costinot, Donaldson, and Komunjer (2012) derived the 'supply-side sectoral gravity' model. Arkolakis, Arnaud Costinot, and Rodríguez-Clare (2012) demonstrated that different micro-theoretical foundations converge to the same gravity equation.

Equation 3 provides the demand side sectoral structural gravity model from Anderson and van Wincoop (2004):

$$X_{ij}^k = \frac{Y_i^k E_j^k}{Y^k} \left(\frac{t_{ij}^k}{\Pi_i^k P_j^k} \right)^{1-\sigma^k} \tag{3}$$

Where:

- $X_{ij,t}^k$ is trade flow in sector k from exporter i to importer j
- $\frac{Y_i^k E_j^k}{Y}$ takes into account output in sector k proportionally
- $t_{i,t}^k$ bilateral trade costs in sector k between countries i and j
- $\Pi_{i,t}^k$ is the outward multilateral resistance term
- $P_{i,t}^k$ is the inward multilateral resistance term
- σ^k is the elasticity of substitution in sector k between foreign and domestic goods and services

The multilateral resistance terms aggregate exporter i and importer j specific trade costs, as they import and export services in sector k in the global market. The outward multilateral resistance term is formulated in equation 4 and the inward multilateral resistance term is specified in equation 5.

$$(\Pi_i^k)^{1-\sigma} = \sum_j \left(\frac{t_{ij}^k}{P_j^k} \right)^{1-\sigma} \frac{E_j^k}{Y^k} \tag{4}$$

The outward multilateral resistance term indicates how exports from country i are influenced by trade costs in all export markets, including bilateral costs (t_{ij}^k), over trade costs encountered by customers in each destination market (P_j^k), total spending on sector k in each destination E_j^k, and total production in sector Y^k.

$$(P_j^k)^{1-\sigma} = \sum_i \left(\frac{t_{ij}^k}{\Pi_i^k} \right)^{1-\sigma} \frac{Y_i^k}{Y^k} \tag{5}$$

The inward multilateral resistance terms add total trade costs faced when country j imports from all other markets, including bilateral costs (t_{ij}^k), trade costs faced by exporters in each origin market (Π_i^K), production in sector in each market Y_i^k and total production in sector Y^k.

2.3 Best Practice Structural Gravity Modelling

To move from a theoretical to an empirical specification that can be estimated, equation 3 is log-linearised as in equation 6:

$$ln(X_{ij}^k) = (1-\sigma)ln(t_{ij}^k) - ln(Y^k) + ln(Y_i^k) + ln(E_j^k) + (1-\sigma)ln(\Pi_i^k) + (1-\sigma)ln(P_j^k) + \epsilon_{ij}^k \tag{6}$$

Where Π_i^k, P_j^k and t_{ij}^k are unobserved. When using panel data, the importer (P_j^k) and exporter (Π_i^k) multilateral resistance terms can be accounted for by using country-year fixed effects (Hummels, 1999; Olivero and Y. V. Yotov, 2012). Country-pair fixed effects absorb possible time-invariant bilateral trade costs (t_{ij}^k) and can also help alleviate endogeneity problems with respect to bilateral trade policy variables with time variation (Baier and Bergstrand, 2007).

Finally, heteroscedasticity often affects trade data. Silva and Tenreyro (2006) show that OLS estimates of the log-linearised form (as in equation 6) are biased and inconsistent in the presence of heteroscedasticity. Further, OLS estimation requires the removal of observations with zero trade value, which are common in trade data. Instead, an alternative and widely popular approach in the gravity setting is to use the Poisson Pseudo Maximum Likelihood (PPML) estimator proposed by Silva and Tenreyro (2006). PPML quickly became the primary gravity estimator due to its ability to successfully manage heteroscedasticity and zero trade flows. This requires the following exponential mean model for estimation:

$$X_{ij}^k = exp(T_{ij}^k \beta + \Pi_i^k + P_j^k)\epsilon_{ij}^k \tag{7}$$

Where T_{ik}^k is a vector of bilateral trade costs, proxying for t_{ij}^k and β is a vector of coefficients.

Y. Yotov (2022) list eleven best practice recommendations for gravity estimations. In Table 1, I list these recommendations and whether they are applied in the estimation strategy (see Section 3) employed in this paper.

Table 1: Best practices for gravity estimation and application in this paper

Recommendation	Description	Applied in this paper
Recommendation 1: Use Panel Data	When available, panel data should be used for gravity estimations.	Yes
Recommendation 2: Use Directional Time-varying Fixed Effects	Use exporter-time and importer-time fixed effects.	Yes
Recommendation 3: Employ Pair Fixed Effects	When possible, gravity should be estimated with pair fixed effects.	Robustness check
Recommendation 4: Include Domestic Trade Flows	Consistent with theory, gravity should be estimated with domestic trade flows.	Yes
Recommendation 5: Use Consecutive-year Data	Estimations with consecutive-year data should be favoured over averaged or interval data.	Yes
Recommendation 6: Estimate Gravity with PPML	The PPML estimator is the leading estimator for (structural) gravity regressions.	Yes
Recommendation 7: Allow for Adjustment in Trade Costs	Gravity estimations should allow for changes in the trade costs estimates over time.	Yes
Recommendation 8: Allow for Hetergeneous Policy Effects	Gravity estimations should allow for heterogeneous trade policy effects.	Yes
Recommendation 9: Use Estimation Commands from the 'HDFE' Family	Consider estimating gravity with ppmlhdfe (and reghdfe).	N/A
Recommendation 10: Implement Incidental Parameter Bias Correction	Consider implementing corrections for incidental parameter bias.	N/A
Recommendation 11: Use Clustered Standard Errors.	The standard errors in the gravity regressions should be clustered by pair or three-way.	Yes

Note: Recommendation 9 is not applicable (N/A) in this paper, as ppmlhdfe is a STATA package that performs fast Poisson estimation with high-dimensional fixed effects. Estimations in this paper are coded in the R programming environment. Recommendation 10 is also not applicable, as incidental parameter bias relates to a three-way gravity model and accounts for panel data asymptomatic error.
Table 1 adapted from Y. Yotov (2022).

2.4 Structural Gravity Modelling of Service Trade Restrictions

Most gravity models have been used to analyse trade in goods. However, Kimura and Lee (2006) and Head, Mayer, and Ries (2009) and more recently Anderson, Borchert, et al. (2018), find that gravity models work well with services trade data. Several studies have estimated services trade costs using indirect methods without relying on STRI information, such as using a reduced form of the gravity approach to estimate services trade (Fontagne, Guillin, and Mitaritonna, 2011; Fontagné, 2016). Recent improvements in the availability of data on regulatory restrictions in services have enabled an increasing amount of gravity literature to estimate a direct relationship between services trade and regulatory restrictions. The effects of regulatory barriers and variations on services trade in a gravity framework have been evaluated using the OECD Product Market Regulation Index (Conway and Nicoletti, 2006) and the World Bank's Database on Services Trade Restrictions (van der Marel and Shepherd, 2013; Riker, 2014).

H. K. Nordås and Rouzet (2017) were the first to examine the effect of services trade restrictions, measured by the OECD's STRI, on services trade. They estimated the impact of services trade restrictions in 2014 on both imports and exports, and found that higher STRI scores are negatively associated with services imports, and an unexpectedly stronger negative relationship between a higher STRI score and exports. There were several drawbacks to these estimates. First, domestic consumption was not used, deviating from theory consistent estimates, which likely biased the results (Y. V. Yotov et al., 2016). Second, the multilateral resistance terms were collinear with the importer and exporter STRIs, because only the published most-favoured nation (MFN) version of the STRI was used[4]. Finally, only STRI data from 2014 was available at the time, meaning no time variation was captured.

Ciuriak, Dadkhah, and Lysenko (2020) compared national commitments under GATS or free trade agreements (FTAs) to its MFN policies in services, as measured by the OECD STRI. One of the main objectives of service FTAs is to reduce ‘water’, defined as the disparity between the system utilised by a country and the one it actually enforces. This is a source of risk premium for firms related to future market access, in addition to actual trade costs (Fraser, 2021). Ciuriak, Dadkhah, and Lysenko (2020) finds that a reduction in uncertainty from trade agreements is associated with an increase in services trade and seeks to address the fixed effects problem that H. K. Nordås and Rouzet (2017) encountered by pooling across sectors and incorporating importer-year and exporter-year fixed effects. By pooling across sectors, the STRI variable is no longer correlated with the fixed effects. However, as noted by Ciuriak, Dadkhah, and Lysenko (2020), this specification removes the impact of sectoral heterogeneity, which Borchert et al. (2022a) finds may result in statistically different results compared to specifications using theory-consistent fixed-effects. Borchert et al. (2022a) also argues that there is significant sectoral heterogeneity across services sectors.

Shepherd, Décosterd, Castillo Comabella, and Stivas (2019) examined possible scenarios for various services sectors in Northern Ireland following the United Kingdom’s decision to exit the European Union. They applied the OECD’s STRI methodology to calculate STRIs for different services sectors in Northern Ireland on baseline and counterfactual policy settings. They find that higher STRIs are associated with reduced trade, but there is significant sectoral heterogeneity across service sectors. To prevent collinearity of the MFN STRI with fixed effects, Shepherd, Décosterd, Castillo Comabella, and Stivas (2019) employs the methodology suggested by Heid, Larch, and Y. Yotov (2017). The inclusion of domestic consumption allows for an international trade dummy variable to be constructed, which is then interacted with the STRI. This results in enough variation along the fixed effect dimension for an effect to be discernible. Further, they introduce more heterogeneity by using the OECD’s intra-EEA STRIs for intra-regional trade observations among EEA members. Previous work only used MFN STRIs, sometimes with a dummy interaction term, to account for EEA membership.

Hoekman and Shepherd (2019) apply a machine learning algorithm to regulatory data from the World Bank and the World Trade Organisation to create OECD STRIs for developing countries. At the cross-sectional level, they identify the STRI effect with theory-consistent fixed effects using the methodology applied by Heid, Larch, and Y. Yotov (2017). They also interact an FTA variable with the STRI to partially account for FTAs. Three main findings are presented. First, services policies are often much more restrictive than tariffs on imports of goods. Second, developing countries tend to have higher trade restrictions on services than developed countries, but less so than previous research suggested. Third, their created OECD STRIs are negatively associated with bilateral services trade.

Shepherd, Décosterd, Castillo Comabella, Stivas, et al. (2022) analyse NTMs in services

[4] The intra-EEA STRI was first published in 2019 (Benz and Gonzales, 2019)

sectors in the four UK constituent nations: England, Scotland, Wales and Northern Ireland. They follow the Shepherd, Décosterd, Castillo Comabella, and Stivas (2019) methodology for Northern Ireland and convert STRI scores to AVEs. Shepherd, Décosterd, Castillo Comabella, Stivas, et al. (2022) observe that STRIs are negative and statistically significant, suggesting that a higher STRI corresponds to decreased trade, but that the magnitude varies across sectors.

Benz and Jaax (2020) estimate cross sectional, panel and the short-term trade effects from regulatory barriers. They also use the Heid, Larch, and Y. Yotov (2017) interaction to identify an STRI effect in five services sectors for 46 countries. They found more restrictive services trade policies was associated with lower international trade relative to domestic services trade in all five service sectors analysed. (Benz and Jaax, 2020) also introduced asymmetric country-pair fixed effects to the current fixed effects structure to identify short-run trade effects. These country-pair fixed effects replace all time-invariant explanatory variables normally included in gravity analysis, such as bilateral distance, contiguity and common language, while other macroeconomic aspects like productivity shocks, exchange rate fluctuations, and terms of trade variations are controlled by exporter-year and importer-year fixed effects (Baier, Y. V. Yotov, and Zylkin, 2019). As trade policy is not exogenous, the specification with country-pair fixed effects allows for a more robust causal interpretation of the resulting coefficients on the STRI and on PTAs.

Fraser (2021) aggregates the OECD STRI sectors to match ITPD-E trade data for seven services sectors and utilises data from Benz and Rozensteine (2021) to code FTAs into the STRI index, creating new bilateral country-pair STRIs. They also invoke a 'water' variable using the GATS trade restrictiveness index (GTRI) provided by the OECD to calculate its trade-inhibiting effect in their gravity model. All STRI coefficients are negative and of a sensible magnitude, which is consistent with the previous body of literature. However, the 'water' estimates are more ambiguous, showing a lot of noise. Fraser (2021) argues these contradictory findings should not be interpreted as disproving the idea that 'water' has an impact. Table 2 provides an overview of the recent OECD STRI Gravity Literature and the theory that is applied in this paper.

Table 2: Review of OECD STRI gravity literature

Paper	Theory-consistent FEs	Domestic trade data	Bilateralised STRI	Measures water	Panel data, including time-varying STRI	Country-pair fixed effects	AVEs	Trade data
Nordas and Rouzet (2017)	No	No	No	No	No	No	No	World Integrated Trade Solution (WITS)
Ciuriak and Lysenko (2019)	No	No	Yes	Yes	No	No	No	OECD's Trade in Services database
Shepherd and Hoekman (2020)	Yes	Yes	No	No	No	No	Yes	Eora multi-region input-output table
Benz and Jaax (2020)	Yes	Yes	EEA Only	No	Robustness check	Robustness check	Yes	OECD's Trade in Services database
Shepherd, et al. (2019), Nth Ireland paper	Yes	Yes	EEA Only	No	No	No	Yes	OECD-WTO TiVA database
Shepherd, et al. (2022), Internal UK paper	Yes	Yes	EEA Only	No	No	No	Yes	OECD-WTO TiVA database
Fraser (2021)	Yes	Yes	Yes*	Yes	Yes (2014-2016)	No	No	ITPD-E
This paper (2022)	Yes	Yes	EEA Only	No	Yes (2014-2019)	Robustness check	Yes	ITPD-E

*Includes service FTAs in STRI framework.

Table 2 adapted from Fraser (2021).

3 Estimation Strategy

There are three inputs required to calculate AVEs of a particular STRI score:

1. The STRI score for sector k in importing country j in year t, which is retrieved from the OECD STRI database.
2. The elasticity of substitution between varieties of traded services, which is derived from estimates in four recent studies.
3. The elasticity of cross-border trade flows with respect to services trade restrictiveness (the 'trade elasticity'). This is estimated using a structural gravity model.

The details on the calculation of the AVEs are provided in Section 6. The following sections focus on the estimation of the sectoral trade elasticities.

3.1 Estimation of Sectoral Trade Elasticities

In accordance with best practice structural gravity modelling from Table 1 and the available data, I estimate a PPML gravity model (Silva and Tenreyro, 2006) at the sectoral level in equation 8. This specification follows the Anderson and van Wincoop (2004) demand-driven approach and incorporates importer and exporter-time fixed effects to control for multilateral resistance (Feenstra, 2002). I also include both domestic and international trade data (Anderson and van Wincoop, 2003; Heid, Larch, and Y. Yotov, 2017), which allows for the inclusion of an interaction term ($STRI^k_{j,t} * INTER_{ij}$) that varies across partner countries, as domestic trade flows do not cross the border. This is the variable of interest and represents the elasticity of cross-border trade flows with respect to services trade restrictiveness (the 'trade elasticity'). This trade elasticity is not absorbed by the fixed effects of the exporter and importer due to the interaction term. This method can determine the impact of multilateral policies, while including the fixed effects that are required to control multilateral resistance.

$$X^k_{ij,t} = exp[\beta_1 STRI^k_{j,t} * INTER_{ij} + \beta_2 INTER_{ij} + Z_{ij,t} + \pi^k_{i,t} + \chi^k_{j,t}] * \epsilon^k_{ij,t} \tag{8}$$

Where:

- $X^k_{ij,t}$ is exports from country i to country j in sector k in year t
- $STRI^k_{jt} * INTER_{ij}$ represents the interaction between international trade and sector-specific STRI score k of the importing country j in year t (that is, the trade elasticity)
- $INTER_{ij}$ is a dummy for international trade observations
- $\pi^k_{i,t}$ is an exporter-year fixed effect
- $\chi^k_{j,t}$ is an importer-year fixed effect
- $\epsilon^k_{ij,t}$ is the error term
- $Z_{ij,t}$ is a vector of bilateral gravity covariates that includes:

- $ln(DIST_{ij})$ is the log of population weighted distance between country pairs
- $CNTG_{ij}$ is a dummy for contiguity (country pairs share a common border)
- $CLNY_{ij}$ is a dummy for ever being in a colonial relationship
- $LANG_{ij}$ is a dummy for common language
- $SPTA_{ij,t}$ is a dummy for services preferential trade agreement (PTA)
- EEA_{ij} is a dummy if both countries are in the EEA

This strategy reduces endogeneity concerns, as the border dummy is uncorrelated with country-specific services restrictiveness (Nizalova and Murtazashvili, 2011). I cluster standard errors in the panel regressions by exporter-year and importer-year, as recommended in recent literature (Peter H. Egger and Tarlea, 2015; Larch et al., 2019).

4 Data

4.1 Trade Data

International trade and domestic trade data are largely sourced from the ITPD-E. Borchert et al. (2021) compiles the ITPD-E for the United States International Trade Commission (USITC), which contains cross-border and domestic trade data at the sectoral level, covering agriculture, mining, energy, manufacturing, and services. This paper utilises the second release of the ITPD-E, published in July 2022, which covers 265 countries and 170 industries, including 17 in service industries from 2000 to 2019 (Borchert et al., 2022b).

Domestic trade data is calculated as the difference between the gross value of total production and total exports, where total exports are the sum of bilateral trade reported in the ITPD-E for each export country. Both the importer and exporter report international trade flows. When there is a discrepancy between import and export data, import data for any country is chosen over export data. Borchert et al. (2021) argue that trade data from imports is more reliable, because countries are inclined to report import data more accurately due to regulations and better surveillance.

The ITPD-E has many advantages compared to other datasets used in gravity estimation. First, it is designed to cover all sectors and is not restricted to only manufacturing industries (e.g. World Bank TPP, CEPII TradeProd) and provides extensive sectoral detail for services trade. Second, it offers superior country coverage, covering 265 countries, and includes data on domestic trade for most countries, which is required for theory consistent estimates (Heid, Larch, and Y. Yotov, 2017). Third, ITPD-E provides consistent panel data over many years and is developed using administrative data, which does not include information estimated by statistical techniques. Statistically constructed data should be avoided in estimation, as it is likely to bias the estimates through overfitting (Fraser, 2021). This makes the ITPD-E well suited for estimation with the structural gravity model of trade (Borchert et al., 2021), rather than Global Trade Analysis Project (GTAP) and World Input-Output Database (WIOD), which are more suitable for simulation.

I analyse seven ITPD-E services sectors, which generally align with ISIC Rev. 4 coding, as outlined in Table 3. Further granularity would be better to align with the STRI data from the OECD. In particular, 'other business services', which comprises of both ISIC codes M and N. However, granularity beyond this level is unattainable from any comprehensive services dataset to use in gravity estimation. For clarity, I henceforth refer to the 'Telecommunications, computer and information services' ITPD-E sector as *Info. services*[5], 'Other business services' ITPD-E sector as *Business services* and the 'Trade-related services' ITPD-E sector as *Distribution*.

[5]Information services

Table 3: ITPD-E sectors analysed and ISIC Rev. 4 correspondence

ITPD-E Code	ITPD-E Description	ISIC Rev. 4 Code	ISIC Rev. 4 Description
156	Transport	H	Transportation and storage
158	Construction	F	Construction
159	Insurance and pension services	K (40%)	Financial and insurance activities
160	Financial services	K (60%)	Financial and insurance activities
162	Telecommunications, computer and information services	J	Information and communication
163	Other business services	M + N	Professional, scientific and technical activities + Administrative and support service activities
169	Trade-related services	G	Wholesale and retail trade; repair of motor vehicles and motorcycles

Note: Borchert et al. (2022a) keep financial and insurance services separate and split ISIC K by a fixed fraction.

I supplement the ITPD-E data by appending missing domestic trade data for a small group of countries (See Appendix C for list of countries). For example, Australia is missing domestic trade data from 2014 to 2019 and the United Kingdom is missing all domestic trade data for 2019. Production data is sourced from the OECD STAN (Horvát and Webb, 2020), OECD supply-use tables (*Supply and Use Tables, Database - OECD* 2022) and OECD input-output tables (*OECD Inter-Country Input-Output (ICIO) Tables - OECD* 2022). I follow the same procedure for calculating domestic trade as in the ITPDE, which is calculated as the difference between domestic production and exports. Export data is sourced from the ITPD-E.

Furthermore , I use consecutive year data, as argued by Peter H. Egger, Larch, and Y. V. Yotov (2022), who question the use of interval data, on the basis that potentially useful information in the data are discarded. Peter H. Egger, Larch, and Y. V. Yotov (2022) argue that estimation efficiency is improved through the use of consecutive data and will provide a better assessment of the effect of trade policies, which could have been biased due to randomly omitting observations for estimation with interval data.

Table 4 shows the summary statistics for the data used in the estimation of the trade elasticity in Section 5. Trade data in every sector is negatively skewed as indicated by the median being much lower than the mean. The dispersion of trade observations is widest in the construction and distribution sectors, while the dispersion is lowest in finance, transport and insurance as indicated by the standard deviations. Following Fraser (2021), I exclude observations where data is missing and assigned as zero in the ITPD-E, but include all observed zero trade observations. This is because the true value of the missing and assigned data could be large. The proportion of zero observations left in the dataset range from 2.44% in business services to 27.16% in construction services. Regardless, the PPML estimator assigns less weight to smaller observations.

Table 4: ITPD-E sectoral summary statistics ($USD million)

Sector	Obs	Median	Mean	Min	Max	Std. Dev.	% obs. zero's
Transport	10153	71.51	3909.65	0	1447138	45573.88	2.51
Construction	7865	2.26	7741.66	0	3483047	100631.89	27.16
Insurance	8479	2.99	2891.32	0	1858612	46599.28	17.29
Finance	9218	5.50	2195.36	0	1157263	31686.65	17.56
Info. services	10079	23.25	3622.87	0	2315396	55414.54	4.71
Business services	10393	52.36	6129.20	0	3842434	93025.89	2.44
Distribution	7729	3.20	9758.62	0	3700353	115651.98	15.76

Note: Obs = observations.
Only includes data from the 50 countries in the final analysis.

4.2 Services Trade Restrictiveness Index (STRI)

I utilise the OECD's STRI as the policy variable for restrictions to trade in service sectors. The OECD STRI is a composite index of five standard policy classifications that assesses the potential limitations to the importation of services. The STRI indexes are scored on a scale from zero to one, using a codified algorithm for scoring and weighting them according to expert judgements. A final country-sector score is then obtained, where a score of zero indicates complete openness to trade, while a score of one indicates complete closure to foreign services providers.

4.2.1 MFN STRI

The primary STRI from the OECD is measured of MFN restrictions and does not consider individual trade agreements or mutual recognition agreements (Grosso et al., 2015). For the most part, service trade policies apply to all trading partners. This is partially due to behind-the-border barriers connected to the local regulatory framework, which affects both domestic and all foreign service providers. In RTAs, preferential liberalisation of the applied regimes is uncommon (Lamprecht and Miroudot, 2018). The OECD MFN STRI currently provides information on the potential restrictions to services imports in services in 22 sectors across 50 countries from 2014 to 2021. The index provides a quantitative proxy for the restrictiveness of the services market in empirical analysis and encompasses over 80% of global trade in services at a level of granularity that is unmatched (*OECD,* 2022).

4.2.2 Intra-EEA STRI

In regional blocs where services trade has been liberalised, the OECD MFN STRI could be insufficient to measure trade restrictions and behind-the-border barriers. This problem is partially addressed by the intra-EEA STRI database, which also makes it possible to measure how restrictive the services trade is within the EEA. The EEA is the largest regional bloc in the world and is distinguished by the freedoms of the internal market (freedom of movement for people, goods, services, and capital) and the standardisation of regulations in areas like competition policy (Benz and Gonzales, 2019).

This paper uses both the OECD MFN STRI database and the OECD intra-EEA database, including time-varying policy changes from 2014 to 2019. I follow the recent literature and utilise the new intra-EEA STRI (Benz and Jaax, 2020; Shepherd, Décosterd, Castillo Comabella, Stivas, et al., 2022; Khachaturian and Oliver, 2021)[6].

4.3 Gravity Covariates

The chosen gravity covariates are similar to those found in Khachaturian and Oliver (2021) and Benz and Jaax (2020). Covariates are sourced from the the USITC's Dynamic Gravity Dataset (DGD) (Gurevich and Herman, 2022). I merge the DGD with the ITPD-E from 2014 to 2019, selecting a set of standard and widely used gravity variables from the literature (See Section 3). In addition, I create an EEA dummy if country pairs are in the EEA and mutate the SPTA dummy in the DGD to exclude EEA country-pair observations.

4.4 Data Compilation

An overview of how the data was compiled is provided below. The detailed methodology for data compilation can be found in the reproducible R code.

1. Filter ITPD-E to obtain trade data from 2014 to 2019 and sectors included in the analysis (provided in Table 1).
2. Extend the ITPD-E data by filling in missing domestic trade data for several countries.
3. Map the MFN STRI and the intra-EEA STRI to the ITPD-E data. Only four of the seven services sectors analysed in the ITPD-E correspond directly to the STRI sectors. I therefore follow Fraser (2021), where smaller STRI sectors that are considered sub-sectors of ITPD-E sectors are pooled and averaged together, before calculating a sector average as a whole matching the ITPD-E sector (see Table 5). For example, the STRI for road freight transport and rail freight transport are averaged together to create a 'freight composite', which is then averaged with the STRI for the logistics composite, maritime transport, air transport to create the transport STRI that maps to the transport ITPD-E sector. This method is by no means precise. As Fraser (2021) recognises, this method reflects that, in the absence of more comprehensive sub-sectoral trade data, there is no single consistent trade weighting system across countries.

[6] Intra-EEA STRI was included in their robustness check.

Table 5: ITPD-E sector and STRI sector correspondence

ITPD-E code	ITPD-E Sector	Composite STRI	STRI Sector Code	STRI sector description
156	Transport	Logistics composite	LSCAR	Logistics cargo-handling
			LSCUS	Logistics customs brokerage
			LSFGT	Logistics freight forwarding
			LSSTG	Logistics storage and warehouse
			CR	Courier services
		Maritime transport	TRMAR	Maritime transport
		Air transport	TRAIR	Air transport
		Freight composite	TRROF	Road freight transport
			TRRAI	Rail freight transport
163	Business services	Accounting	PSACC	Accounting
		Professional composite	PSARC	Architecture
			PSENG	Engineering
		Legal	PSLEG	Legal
162	Info. Services	Audio visual composite	ASMOT	Motion pictures
			ASBRD	Broadcasting
			ASSOU	Sound recording
		Telecom	TC	Telecom
		Computer	CS	Computer
169	Trade-related services	Direct correspondence	DS	Distribution
160	Finance	Direct correspondence	FSBNK	Commercial banking
159	Insurance	Direct correspondence	FSINS	Insurance
158	Construction	Direct correspondence	CO	Construction

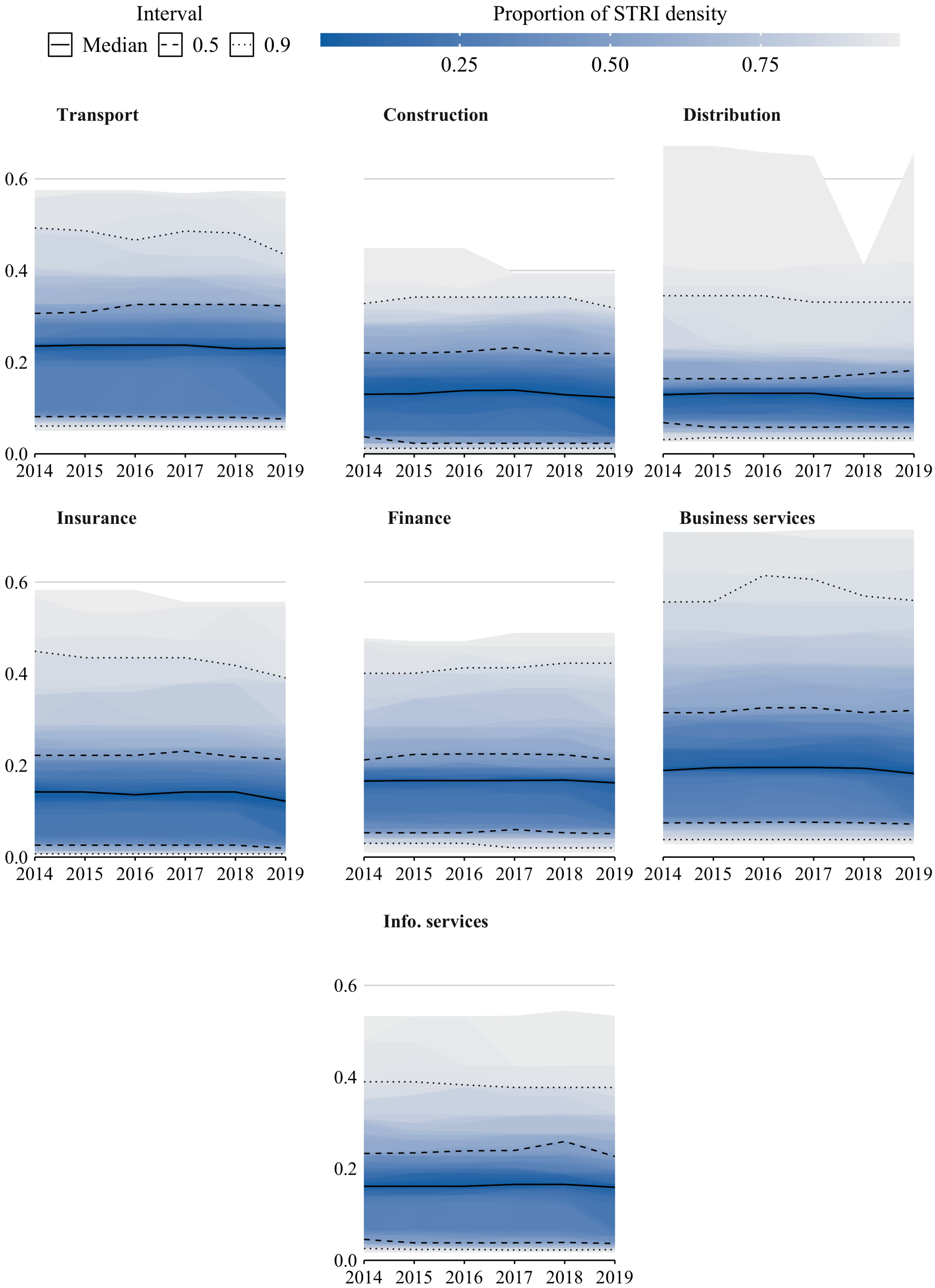
4. If both countries are in the EEA, use the intra-EEA STRI and use the MFN STRI if otherwise. All STRI observations are mapped to the importer as in equation 8 in Section 3.

Figure 2 indicates the distribution of the aggregated[7] and mapped[8] country STRI scores from 2014 to 2019. It shows there is little change over time in the median STRI scores by sector. Furthermore, the median STRI score is lower in distribution and construction and higher in transport. The median STRI score in finance, insurance, business services and information services are broadly similar over 2014 to 2019 but there is a wider dispersion of scores in distribution, business services, insurance and information services. This is similar to Benz and Jaax (2020) who found little time variation but significant cross-country variation differences in relation to import penetration and STRI scores. In Section 5, I present regression results from the main specification, which allows for identification of the relationship between the STRI and services trade (relative to domestic services consumption) controlling for other observable and unobservable factors.

[7]STRI sectors converted to ITPD-E sectors.

[8]Intra-EEA STRI if both countries in the EEA and MFN STRI for all other country-pairs.

Figure 2: Distribution of country STRI scores from 2014 to 2019, by sector



Note: Changes in colour represent intervals covering an increasing proportion of total density.
Source: OECD and own estimates

5 Empirical results

5.1 Results for Estimating the Trade Elasticity

Table 6 sets out regression results of a panel analysis from the core specification in equation 8. The coefficients can be interpreted as partial equilibrium effects on bilateral trade, and are identified from variation across countries and over time. There are two main findings from these results. First, there is a negative and significant relationship between the STRI and services trade (relative to domestic services consumption) for all sectors at a 1% level of significance, except construction, which is significant at a 5% level of significance, indicating that a more restrictive trade policy is associated with lower services trade. Second, there is significant sectoral heterogeneity in terms of the magnitude and significance of different coefficients.

Table 6: Panel results from main specification

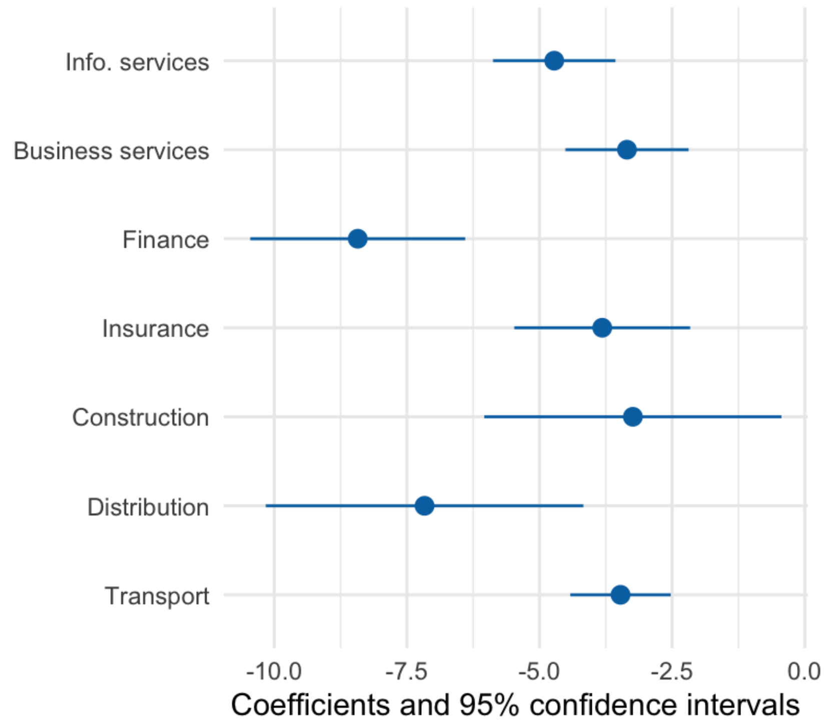
	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
Trade elasticity	−3.473***	−7.167***	−3.240**	−3.818***	−8.426***	−3.351***	−4.722***
	(0.483)	(1.527)	(1.429)	(0.846)	(1.033)	(0.592)	(0.589)
Int. Border	−4.379***	−8.138***	−7.048***	−5.258***	−3.739***	−4.555***	−4.057***
	(0.218)	(0.382)	(0.544)	(0.458)	(0.464)	(0.340)	(0.282)
Log distance	−0.007	0.256**	−0.434**	−0.326**	0.153	−0.040	−0.289***
	(0.085)	(0.122)	(0.210)	(0.144)	(0.140)	(0.096)	(0.098)
Contiguity	0.875***	1.497***	0.410	0.278	0.820**	0.730***	0.285
	(0.155)	(0.247)	(0.342)	(0.366)	(0.374)	(0.208)	(0.202)
Colony ever	0.646***	0.163	0.920***	1.089***	0.879**	0.579**	0.510**
	(0.203)	(0.328)	(0.328)	(0.329)	(0.355)	(0.268)	(0.208)
Common language	0.294**	0.244	−0.032	0.627***	0.680***	0.304	0.506***
	(0.119)	(0.189)	(0.327)	(0.234)	(0.262)	(0.202)	(0.145)
SPTA	0.167	0.284	0.663**	−0.187	−0.481*	−0.130	−0.123
	(0.123)	(0.254)	(0.296)	(0.203)	(0.272)	(0.177)	(0.187)
EEA	0.773**	1.195*	1.523**	0.252	0.266	0.045	0.429
	(0.331)	(0.617)	(0.716)	(0.537)	(0.514)	(0.492)	(0.357)
Num.Obs.	10 153	7729	7865	8479	9218	10 393	10 079
R2 Adj.	0.990	0.999	0.999	0.997	0.982	0.991	0.994
Exporter-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

The interpretation of an STRI change should be of the form "bilateral exports rise $100 * (exp(\beta_1 * \Delta STRI) - 1)$ percent before accounting for third country effects". For example, assuming a decline in the STRI by 0.01, the information services trade elasticity coefficient implies a partial trade rise of 4.85% in response, ceterus paribus.

Figure 3 compares the estimated trade elasticities across sectors, along with the associated 95% confidence interval from the structural gravity model. Financial services has the largest negative relationship (-8.4), and construction has the lowest negative relationship (-3.2). Distribution, construction and finance also have much larger confidence intervals than the other sectors.

Figure 3: Regression coefficients for the trade elasticity, by sector



These findings are broadly consistent with the findings of Benz and Jaax (2020), who evaluate the effect of the STRI on a pooled cross-section from 2014–2018 and in a panel setting. Their reported sector specific panel results indicate a negative and significant impact on trade elasticity for each sector, with coefficients ranging from -3.5 in transport services to -7.4 in financial services in their panel estimation. They do not analyse distribution or construction services.

Although similar in direction, the results vary in terms of magnitude from Fraser (2021), who captures additional variation from FTAs. Fraser (2021) found a negative and significant impact of the services trade restrictions on bilateral services trade in all sectors except finance and construction, with significant coefficients ranging from -1.2 in information services to -8.1 in distribution services. In conjunction with the wider confidence intervals for the finance and construction service sectors in Figure 3, it appears as though there is a relatively larger amount of uncertainty relating to estimates for these sectors.

Table 7: Comparison of trade elasticity coefficients with the recent literature

Paper	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
This paper, panel	-3.473***	-7.167***	-3.240**	-3.818***	-8.426***	-3.351***	-4.722***
(2014 to 2019)	(0.483)	(1.527)	(1.429)	(0.846)	(1.033)	(0.592)	(0.589)
Fraser (2021), panel	-2.611**	-8.138***	-4.656	-5.341***	-2.341	–4.398***	-1.167**
(2014 to 2016)	(1.149)	(2.955)	(2.930)	(2.014)	(1.458)	(1.217)	(0.578)
Benz and Jaaz (2020),	-3.547***	-	-	-5.010***	-7.379***	-3.946***	-4.451***
panel (2014 to 2018)	(1.021)	-	-	(0.960)	(1.612)	(1.388)	(0.961)

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

The coefficients for the international border dummy[9], are negative and strongly significant for all service sectors, indicating that domestic trade is substantially higher than services imports in all sectors. These estimates verify the existence of substantial border barriers in

[9]Equals one if the observation is for international trade flow rather than domestic trade.

services (Anderson, Borchert, et al., 2018). As expected, the international border dummy is higher for construction and distribution services relative to the other services sectors, which are highly localised and regulated services. Distance has the expected direction and is significant at a 5% level in construction and insurance and at a 1% level of significance in information services. However, bilateral geographic distance is not significant in transport, finance and business services, and the positive and significant coefficient for distribution is unexpected. But contiguity is significant in these sectors, indicating that countries trade more with their direct neighbours than with other countries, which could be a better indicator for geographic trade costs in these services sectors. Further, the distance results are consistent with Anderson, Borchert, et al. (2018), in the sense they show the association with distance varies across services sectors, with distance possibly having less of an impact in transportation and business services, in contrast with insurance and construction services, which are strongly associated with distance. Common language and colonial ties are positively associated with the exchange of services, particularly in finance and insurance, where communication is important.

Similar to Benz and Jaax (2020), I find the SPTA variable is negative in insurance, finance, business services and information services[10], which is counterintuitive. Benz and Jaax (2020) used a PTA dummy with a focus on goods and argued the coefficients are negative, as their PTA dummy did not cover specific services provisions. However, I find similar results using a trade agreement dummy specific to agreements with provisions for services. This appears to support the proposition from Fraser (2021) that these results are difficult to explain without specification error. Another explanation could be that services trade data are generally published on a cross-border basis, aggregating service Modes of Supply 1, 2, and 4 and excluding Mode of Supply 3 (that is, a supplier's commercial presence in foreign markets). It could be that firms in intangible service sectors, such as finance and business services, prefer to set up operations in other countries (Mode 3), rather than export those services from a base country. Furthermore, the STRI used in the model is a single index, which may mask heterogeneity related to different modes of supply (Khachaturian and Oliver, 2021).

The EEA dummy also provides interesting results. It is positive in all sectors, but only significant at a 5% level in transportation and construction, and at a 10% level in distribution. These results are in contrast with Benz and Jaax (2020), who found negative coefficients and mostly insignificant results for the EEA dummy, arguing the trade elasticity coefficient captures this effect with the inclusion of the intra-EEA STRI data. However, estimating the regression without an EEA dummy (as conducted in a robustness check) generally increases the trade elasticity estimate across most sectors. This, along with the positive coefficients found in Table 6, supports the inclusion of EEA dummy, suggesting that not all of the variation is captured using the intra-EEA data.

5.2 Robustness Checks

The overall pattern emerging regarding the trade elasticity from this analysis continues to hold in several robustness checks. This is encouraging in terms of their further use in the calculation of AVEs in Section 6, keeping in mind the limitation regarding identification of the effect of SPTA. The general pattern arising from this analysis continues to hold in several

[10] The equivalent sector in Benz and Jaax (2020) is communications

robustness checks. Four robustness checks were performed, including:

1. Estimating equation 8 with only OECD country data.
2. Estimating equation 8 without an EEA dummy.
3. Estimating a similar equation to equation 8 but with OLS (and hence log trade as the independent variable and excluding all zero trade observations).
4. Estimating equation 9 with country-pair fixed effects.

Regression results for robustness checks 1 to 3 are found in Appendix B. Estimating equation 8 with only data from OECD countries reveals a similar direction for most coefficients, but different magnitudes across sectors. First, the trade elasticity estimate for construction services is much higher, and the estimate of trade elasticity for finance is much lower. As highlighted before, these sectors tend to be the ones with the largest degree of uncertainty. Another possible explanation for this finding is that the OECD does not include many large Asian countries, such as India, China, Indonesia and Vietnam, where restrictiveness, especially in the finance sector, is much higher. For example, the STRI index in finance was 0.49 in India compared to 0.17 in the United Kingdom in 2019. This robustness test also indicates that distance is now significant in all sectors except finance. This could be because OECD countries have greater data coverage and collection. OECD countries are missing only 26% of observations, in contrast to the main estimation, where 39% of export observations are missing. Furthermore, these results suggest that the international border dummy estimates in the main results (Table 3) could capture some of the impact from the distance coefficients, as other sources supplemented most missing domestic trade data, while supplementing missing bilateral export or import data for many countries was not possible.

Estimating the regression without an EEA dummy generally increases the trade elasticity estimates across most sectors, suggesting that not all of the variation is captured using the intra-EEA data. Moreover, similar results were obtained estimating via OLS. However, across all these robustness checks, the SPTA dummy variable provided unexpected results as in the main estimation strategy. This is further discussed in the limitations (see Section 5.3).

5.2.1 Estimation With Country-Pair Fixed Effects

Fraser (2021), who conducted a similar analysis, but with ITPD-E data from 2014 to 2016, suggested the release of a longer panel could facilitate the use of country-pair fixed effects and improve the quality of estimates. Release 2 of the ITPD-E extended the panel to 2019, and I use the longer panel to try and identify short-run effects of services liberalisation using country-pair fixed effects as in equation 9.

$$X^k_{ij,t} = exp[\beta_1 STRI^k_{j,t} * INTER_{ij} + \beta_2 SPTA_{ij} + \gamma_{ij} + \pi^k_{i,t} + \chi^k_{j,t}] * \epsilon^k_{ij,t} \tag{9}$$

The country pair fixed effects, γ_{ij}, absorb all possible time invariant bilateral trade costs (Peter H. Egger and Tarlea, 2015) and mitigate endogeneity concerns related to the bilateral time-varying trade policy variables (Baier and Bergstrand, 2007), while exporter-year and importer-year fixed effects control for other macroeconomic factors, such as productivity shocks, exchange rate fluctuations, and terms of trade changes (Baier, Y. V. Yotov, and Zylkin, 2019). This implies that all coefficients are identified only from variation over time within country pairs, allowing for a more robust causal interpretation of the resulting coefficients on the STRI trade elasticity and on SPTAs. Because trade policy is not exogenous, this interpretation is not always justified when relying on a specification without pair fixed effects. For example, a specific historical relationship between two trading partners could simultaneously determine services regulation and bilateral exports.

The results in Table 8 suggest that a reduction of services trade barriers could lead to higher values of services exports already in the year of liberalisation. The coefficient on the trade elasticity (that is, the interaction variable between the international border variable and the STRI) is negative in every sector, except construction. The positive sign for construction could be because construction features little trade across borders. Only information services are significant at a 1% level, and distribution services at a 5% level.

Not all trade elasticity estimates are significantly different from zero, which could be due to many reasons. First, there is no effect. Second, a longer panel may be needed to identify an effect. This is because of the relatively low number of policy changes that can be exploited for the identification of the effect, as the data cover only a relatively short period of six years. In this specification, the country-pair fixed effects absorb all time-invariant bilateral trade cost determinants, which is inappropriate for estimations that aim to determine the impact of variables with little to no fluctuation over time. Third, these short-run effects indicate the effect of services trade reform in the same year that the reforms enter into force. In general, trade effects in the first year of reform can be expected to be smaller than the long-term effects estimated in Table 6. The reason is that firms do not adjust immediately to regulatory reform, and often it takes a while before they can fully exploit a liberalised trade regime.

Table 8: Short-term trade effects using country-pair fixed effects

	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
Trade elasticity	−0.331	−6.846**	3.995	−0.671	−3.775	−0.807	−4.930***
	(1.452)	(3.143)	(3.524)	(2.874)	(2.897)	(0.764)	(1.723)
SPTA	−0.036	0.181	0.335*	0.283	−0.302***	0.003	0.116
	(0.082)	(0.175)	(0.198)	(0.330)	(0.117)	(0.101)	(0.102)
Num.Obs.	10 135	7526	7493	8119	8738	10 352	10 059
R2 Adj.	0.998	1.000	1.000	0.999	0.999	0.999	0.999
Exporter-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates.
Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

The results for the coefficients on the SPTA dummy are more ambiguous. This is in contrast to results found by Benz and Jaax (2020), who found bilateral PTAs boost services trade in communication, business services, insurance services and transport services already in the year of entry into force. Similar to the results for the trade elasticity estimates, this could mean there is no effect, a longer panel is needed, or that the effect of services PTA on trade occurs over many years. This immediate non-effect could be due to RTAs taking time to negotiate and be ratified. Ciuriak, Dadkhah, and Lysenko (2020) find changing from GATS to PTA commitments result in a 4.7% rise in services trade because of reduced uncertainty. However, Benz (2017) argues that PTAs are typically used to bind already-enacted liberalisation policies, preventing countries from enacting new trade restrictions for services in the future, and that most PTAs do not liberalise services trade above the applied regime level.

5.3 Limitations

There are a number of limitations to be mindful of in relation to calculating sectoral trade elasticities. These include: the relatively short time span of the panel, utilising an interaction term along with the ability to control for services RTAs, potential omitted variable bias and the level of sector granularity available for services trade data. It is also out of this paper's scope to establish causality between services trade policy, services trade and services sector performance in general. Furthermore, the different modes of supply in services trade are outside the scope of this paper.

Limitation 1. Relatively short time span of the panel

Although this paper applies the longest panel for the empirical quantification of services trade costs, it must be acknowledged that the six-year time span covered is still relatively short. Country-pair fixed effects in panel gravity models can control for all time-invariant gravity covariates and reduce potential endogeneity from trade policy. Y. Yotov (2022) recommends using country-pair fixed effects in a panel setting but due to the limited time variation in the STRI data, country-pair fixed effects are not employed in the core specification in this paper. The STRI variation is mostly present along the dimension for which the country-pair fixed effects control. Instead, I follow the existing STRI gravity modelling literature and use standard gravity covariates as controls. However, estimations, particularly with the use of country-pair fixed effects, can be expected to become more robust once there is longer overlap between data on services trade restrictiveness and services trade flows.

Limitation 2: Interaction term and controlling for service PTAs

As discussed in the estimation strategy (see Section 3), I use an interaction term (STRI X INTER) for the trade elasticity that varies across partner countries to better identify the impact of services restrictions on services trade (Heid, Larch, and Y. Yotov, 2017). The primary disadvantage of this estimation strategy is that it applies a rigid functional relationship between the STRI and service trade flows. In particular, it implies that the impacts of importer and exporter restrictiveness are symmetrical given their relative size. Due to the unavailability of the data, this paper was unable to use a bilaterialised PTA version of the STRI used by Fraser (2021). Using a bilaterialised PTA version of the STRI would absorb the trade-promoting effects of applied liberalisation, while adding a water variable (the difference between applied and bound commitments) to the estimation specification would control the reduction in uncertainty associated with PTAs. It would also eliminate the need to use an interaction variable, and would eliminate the need for an PTA dummy. As a result, existing STRI gravity work has been required to either hard code a set of PTAs into the STRI framework or use an PTA dummy variable, which may insufficiently capture preferential effects (Fraser, 2021).

Limitation 3: Omitted variable bias

A potential source of omitted variable bias may arise if we do not account for additional determinants of services trade correlated with STRI indices. For example, demand in distribution and transport services is likely to be correlated with demand for goods. Further technological advances are likely to impact efficiency, and possibly the export potential in finance, insurance and business services. The technical ability to trade across borders might be larger than the impact of regulations in services trade H. K. Nordås and Rouzet (2017).

Limitation 4: Granularity of services sector trade data

Data limitations mean that the granularity beyond the ITPD-E coding is unrealistic from any comprehensive dataset. Reliable production data is needed to calculate domestic trade data. However, this is typically not attainable at a more disaggregated sectoral level than in the ITPD-E for most countries.

Limitation 5: Service sector performance

It is beyond the scope of this paper to establish causality between services trade policy and services trade and services sector performance in general. Further research could provide accurate estimates for alternative policies by using a suite of interactive web tools from the OECD[11], that can be used to compare regulatory regimes across countries and obtain new measures of the STRI. These counterfactual STRI scores could be used to simulate the impact of policy reforms.

Limitation 6: Mode of supply in service sectors

International trade in services has been classified into four modes of supply since the 1995 General Agreement on Trade in Services (GATS), with certain restrictions potentially affecting some modes, but not others. Khachaturian and Oliver (2021) find that firms use multiple modes of supply to provide services to foreign customers. These modes of supply are outside the purview of this paper, but they would provide further insight into potential policy changes. This is especially true as differences across service sectors are reflected in the different modes of service delivery in foreign markets and the various degrees of trade policy restrictions imposed on these modes of supply. In particular, if different modes of supply are substitutes, a restriction to one mode of supply may increase trade through another mode. For example, liberalising regulations on the establishment of foreign legal firms in a country may reduce legal service imports to that country. This is in part, because services trade data is generally published by aggregating Modes 1, 2, and 4 and excluding Mode 3 (Fraser, 2021). In addition, I use the headline STRI, which may conceal within-index differences in relation to modes of supply.

[11] See https://sim.oecd.org/

6 Ad-valorem Tariff Equivalents (AVEs)

Trade costs are typically expressed as ad-valorem tariff equivalents (AVEs). An AVE quantifies the impact of the STRI on the relative attractiveness of imported services compared to domestic services. The AVE is essentially a tax (or tariff) equivalent for regulatory barriers to services trade, as captured by the OECD's STRI. To convert STRI scores to an AVE, I follow Benz (2017) as in equation 10:

$$AVE_{ij,t}^{k} = exp\left(\frac{-STRI_{ij,t}^{k} * \beta_1^k}{(\sigma^k - 1)}\right) - 1 \tag{10}$$

Where:

- $STRI_{ij,t}^{k}$ is the STRI score for sector k in importing country j in year t
- β_1^k is the trade elasticity represented by the $STRI_{jt}^{k} * INTER_{ij}$ coefficient calculated in equation 8
- σ^k is the elasticity of substitution between varieties of traded services

Presenting results in AVE terms is relatively straightforward and provides an easy to understand number that can be compared across countries. AVEs also provide a comparable standard that shows that trade restrictions in services are typically higher than in goods (Hoekman and Shepherd, 2019). However, there are many simplifications that should be considered when converting to AVEs.

6.1 Limitations of Service Ad-valorem Tariff Equivalents (AVEs)

Converting results to AVEs assumes that the bundle of regulatory measures captured by the STRI has economic effects like a tariff, where AVEs represent an increase in the price of the imported product. For example, if the cost, insurance and freight (CIF) price of a product is £1.00, an AVE of 10% implies the tariff-inclusive import price will be £1.10.

AVEs are based on observed trade values, not prices. It is therefore wrong to claim that AVEs must be paid to provide cross-border services. This analysis does not provide information about whether services trade liberalisation contributes to a reduction in the price of imported services. To determine this, an analysis of import prices would be required. However, this is difficult for services, because it is hard to define comparable 'units' of services. As H. Nordås (2016) explains, service units are often unobservable, making it difficult to compare trade costs. This is especially true for regulatory measures that affect competitive conditions in the market or influence the fixed costs of market entry. Many service restrictions constitute fixed cost barriers to market entry, in the sense that the cost is paid once regardless of the quantity of services supplied. Because they lessen competition in the importing market, such barriers are probably more distorting than barriers based on variable costs. However, AVEs largely presume that services rules mainly affect variable trade costs.

Equation 10, which is used for estimating the AVE results presented in Table 10, Figure 4 and Figure 5 assumes that trade costs are symmetrical. Benz (2017) finds that trade costs do not increase linearly with a country's STRI score. Additionally, the AVEs must be understood as a reduction in trade costs expressed as percentage points, which equates to a reduction in the STRI from its current level to zero.

An alternative to thinking of services trade costs as transaction costs is to consider them supposed 'iceberg costs' (Samuelson, 1954). The iceberg analogy suggests that some of a product's (iceberg's) value may be lost (melt) during the transfer (when transported) from the exporter to the importer. H. Nordås (2016) applies this metaphor to services, arguing the additional cost of modifying services so that they follow foreign regulations may not add to their market value, and the resources spent on compliance are similar to what melts away in the iceberg cost metaphor.

Furthermore, these estimates might not be entirely actionable from a policy perspective. For example, Berden et al. (2009) finds that only 50% of non-tariff AVEs in products and services traded across the Atlantic are actionable. Bearing in mind these caveats, the STRI scores for 2021, trade elasticities (estimated in Table 6) and elasticities of substitution (see Table 9) are then used to calculate AVEs with results presented in Table 10.

6.2 Elasticity of Substitution

The elasticity of substitution parameter (σ^k) is not observed, and final values of AVEs are sensitive to this choice. Although considerable research has been conducted on estimating the elasticity of substitution parameter for goods, the estimation of these elasticities remains a relatively new topic in the trade literature for service sectors. To calculate AVEs for international services trade, this paper uses estimates of the elasticity of substitution across different service sectors from four recent studies. Table 9 summarises all elasticities and their respective sources, together with the simple average used in calculating AVEs in this section. As can be seen in Table 9, there is a wide variation in the estimates from the different studies. For example, the lowest estimate for finance is 1.60 and the highest is 4.18. Given the considerable variation in estimates and the inherent difficulty in assessing the reliability of any individual estimate, I follow Benz and Jaax (2020) and calculate the elasticities using the simple average of the service sector elasticities from four recent studies. This method combines the strengths of various estimation methods and data sources, while also minimising the shortcomings of any individual study.

Table 9: Elasticities of substitution for international services trade

Sectors	Rouzet, Benz, and Spinelli (2017)	Peter H Egger (2021)	Christen, Pfaffermayr, and Wolfmayr (2019)	Blank et al. (2018)	Simple Avg.
Transport	2.77	3.80	3.59	5.16	3.83
Distribution	5.40	3.17	3.00	-	3.86
Construction	2.70	3.34	4.00	6.00	4.01
Insurance	2.20	4.18	2.59	3.27	3.06
Finance	1.60	4.18	2.05	3.27	2.78
Business services	2.20	4.02	3.77	4.51	3.63
Info. services	2.23	4.27	3.95	3.92	3.59

The first column is based on firm-level data of profit margins from the United Kingdom and Finland. In the second column, elasticities are based on sectoral trade and unit labour costs from 41 countries in the WIOD database and the elasticity for distribution services is a simple average of retail (2.55) and wholesale trade (3.78). In the third column, elasticities are based on firm-level data on profit margins from Austria and the elasticity of distribution services is from only wholesale trade. In the fourth column, elasticities are based on firm-level data on profit-margins from Germany.

6.3 Ad-Valorem Tariff Equivalent (AVE) Results

Table 10 provides an overview of AVE estimates for seven sectors based on the STRI for 2021. The left panel shows the median, mean, minimum, and maximum AVE for services trade between two countries on an MFN basis. Conversely, the right panel refers to trade between two EEA countries. Detailed country level estimates for all sectors can be found in Appendix A.

Table 10: AVEs (%) for international trade in 2021 by sector

	MFN				Intra-EEA			
Sector	Median	Mean	Min	Max	Median	Mean	Min	Max
Transport	42.8	45.9	22.5	103.6	9.7	9.5	6.5	12.3
Distribution	51.2	68.6	26.9	420.1	15.5	16.3	7.0	33.7
Construction	25.4	27.9	11.4	65.7	2.5	3.2	0.0	10.2
Insurance	45.8	55.1	19.9	180.7	3.6	3.8	1.3	8.9
Finance	168.3	233.9	54.6	856.4	22.6	26.4	4.8	56.0
Business services	44.3	52.4	16.2	147.8	9.0	8.5	3.7	12.1
Info. services	49.0	56.2	27.8	146.2	6.1	7.0	3.6	13.5

Note: Intra-EEA refers to services trade between two EEA members. MFN refers to all other trading relationships.

The estimates shed light on substantial heterogeneity across sectors, with the median MFN AVE for financial services (168.3%) more than six times as high as the median AVE for construction services (25.4%) and almost four times higher for business services (44.3%). The median AVEs for transport, distribution, insurance, business services and information services are all relatively close to one another. The sectoral ranking regarding AVE levels is different when considering flows between EEA members. While financial services also display the highest median AVE (22.6%), the next highest is distribution (15.5%), followed by transport (9.7%). After construction, insurance services is the sector with the lowest AVE level for intra-EEA services trade.

Figure 4 shows a box plot in a violin plot of the MFN AVEs in 2021 across sectors. The box plot shows summary statistics, while the violin plot illustrates the distribution of AVEs. As can be seen in Figure 4, the dispersion of outcomes is largest in finance, while there are some large outliers for distribution services. For example, the AVE for Indonesia in distribution services is 420.1%. The differences across some sectors are so large that I have plotted them on a different scale on the horizontal axis. Indeed, the average AVE for finance (233.9%) is larger than the maximum AVE in all sectors except distribution. Construction has the lowest distribution of AVEs, while AVEs in information services, business services, insurance and transport tend to cluster between 25% and 75%.

The estimated AVEs are considerably lower for trade between EEA members. This is due to the lower STRI score in the intra-EEA STRI database, which reflects the profound economic integration and regulatory alignment among EEA countries. The median trade cost is at least three and a half times lower in all sectors for EEA members, and is over ten times lower in construction services between EEA members compared to the median on an MFN basis. Similarly, the minimum across the five sectors is 0% in construction services for intra-EEA trade, while the lowest level observed on an MFN basis is 11.4% in construction, followed by 16.2% in business services.

Figure 5 maps AVEs for 2021 across the EEA. The results show the difference in regulatory homogeneity across services sectors. For example, AVEs for transport services across the EEA are very similar. This is because road freight transport, air transport and maritime transport (all within the broader transport sector) are examples of sectors with homogeneous regulatory regimes across the EEA. While AVE estimates within the EEA are more heterogeneous in finance, distribution and information services. The United Kingdom left the EEA in 2021 and therefore does not have an intra-EEA AVE for 2021.

The comparison of AVE from these results with the existing literature is difficult due to methodological differences. These include: the year of STRI analysed, the choice of elasticity of substitution; the estimation strategy for the trade cost elasticity, such as what covariates are used and whether cross-sectional or panel estimation is used; and the aggregation method for STRI sectors. However, there are some emerging themes. Benz and Jaax (2020) and Fontagné (2016) find the maximum AVEs are higher for finance than transport, insurance, information services and business services. Furthermore, this paper shows that there are large differences in AVEs across service sectors, which is consistent with previous estimates. Fontagné (2016) use a different methodology, so it is difficult to pinpoint the reasons for the differences, but Benz and Jaax (2020) use a similar estimation strategy. The calculated AVEs in this paper are lower than previous AVE estimates by Fontagné (2016) and Benz and Jaax (2020). This is, at least in part, due to a decline in STRI in 2021, with service liberalisation generally outpacing new barriers across most sectors (*OECD Services Trade Restrictiveness Index* 2022). Another explanation for the lower estimates from Benz and Jaax (2020) is that the trade elasticities and elasticity of substitution estimates used in the calculation of the STRI are lower.

Figure 4: Distribution of country AVEs (%) by service sector on MFN basis in 2021

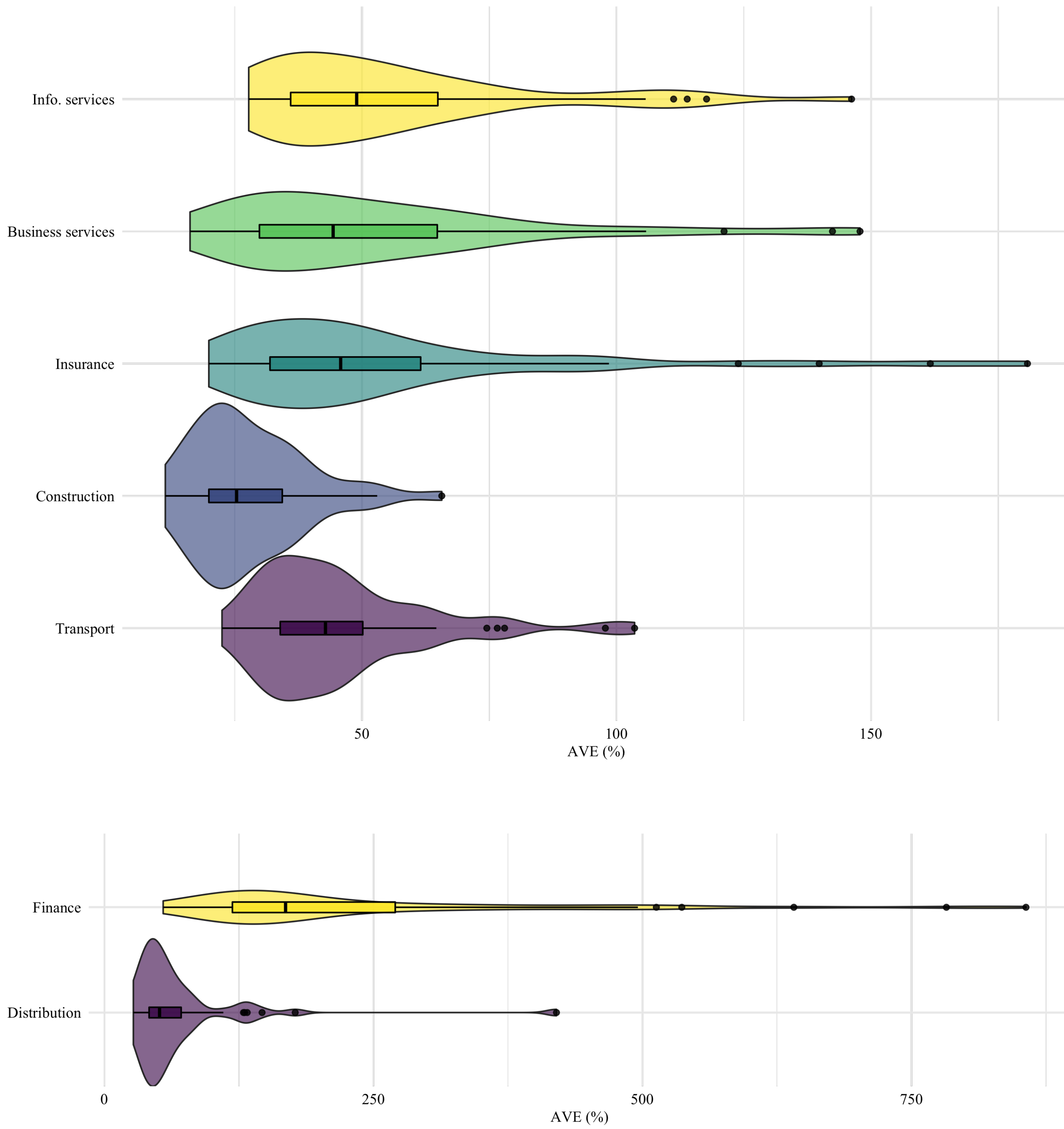
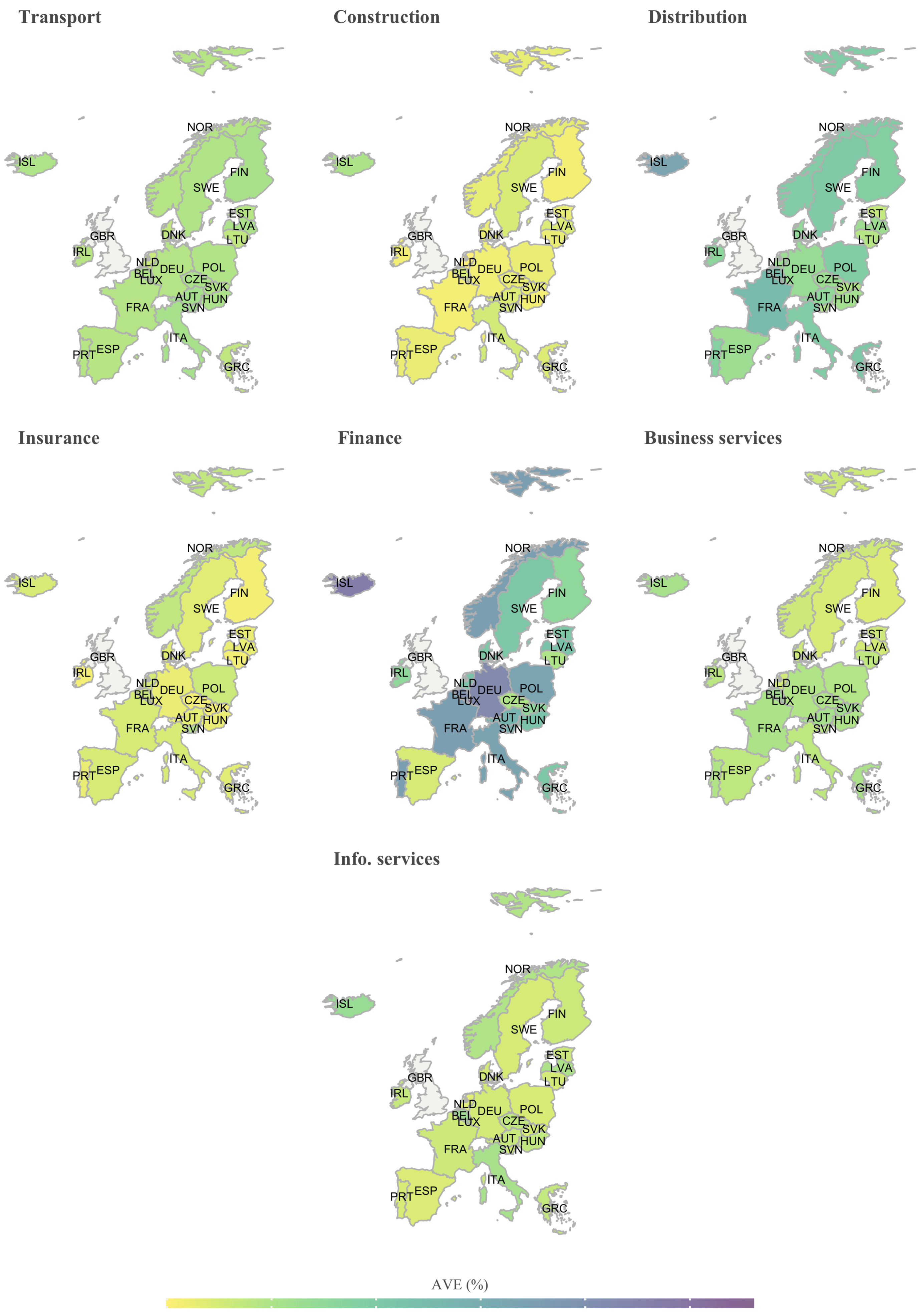


Figure 5: AVEs by service sector for intra-EEA trade in 2021



Source: Own estimates

7 Conclusion

A well specified structural gravity model provides a useful technique to quantify the impact of barriers to services trade. In accordance with best practice structural gravity modelling and the available data, I estimate a PPML structural gravity model at the sectoral level to obtain the trade elasticities in seven service sectors. I then combine these trade elasticities with estimates of elasticity of substitution from the literature to quantify the impact of trade restrictions on the relative attractiveness of imported versus domestically sourced services in the form of AVEs.

This paper makes three main contributions. First, it presents AVEs for international services trade in seven service sectors covering 50 countries. It finds a negative relationship in all sectors between the STRI and international trade (relative to domestic trade), indicating that more restrictive trade policy is associated with lower international trade. Second, estimated trade costs are considerably lower for trade between EEA members than between countries on a most-favoured nation status. Third, there is significant sectoral heterogeneity in the estimated trade costs across service sectors. Finally, the results using country-pair fixed effects are more ambiguous, possibly indicating a longer panel may be needed.

This paper utilises the latest release of the ITPD-E, which allows for estimations using a longer panel than previously conducted. Additionally, the AVE estimates could also be used as input for further analysis, such as CGE modelling.

The findings are broadly similar to the recent literature, indicating that trade costs in services are high. However, there are large differences in trade costs across services, suggesting that policymakers should be aware of different business models, competition challenges, and regulatory frameworks within sectors. In contrast with previous studies, I find mostly positive and significant results for the EEA dummy. Further, running the model without an EEA dummy generally increases the trade elasticity estimate across most sectors, providing further support for the inclusion of an EEA dummy, as not all variation is captured using the intra-EEA data.

This analysis could be expanded in many ways. First, as more data becomes available, estimations should become more robust and allow for the use of country-pair fixed effects. Second, bilateral STRIs could be created by incorporating services PTAs. This would eliminate the need for a PTA dummy in the specification, which may inadequately capture the effect of PTAs. Third, a 'water' variable could be used to quantify the effects of binding commitments in services trade. Fourth, certain modes of supply are likely to be affected differently by certain trade restrictions. Further research could investigate the impact of mode of services restrictions and their impact on services trade. Finally, counterfactual STRIs as in Shepherd, Décosterd, Castillo Comabella, and Stivas (2019) could also be created to investigate the effects of potential policy changes.

References

AiGroup (2019). *Australian Manufacturing in 2019: Local and Global Opportunities*. The Australian Industry Group (Ai Group). URL: https://cdn.aigroup.com.au/Economic_Indicators/Economic_Outlook/Australian_Manufacturing_in_2019.pdf (cit. on p. 4).

Anderson, James E. (1979). "A Theoretical Foundation for the Gravity Equation". In: *The American Economic Review* 69.1, pp. 106–116. ISSN: 0002-8282. JSTOR: 1802501 (cit. on p. 7).

Anderson, James E., Ingo Borchert, et al. (June 1, 2018). "Dark Costs, Missing Data: Shedding Some Light on Services Trade". In: *European Economic Review* 105, pp. 193–214. ISSN: 0014-2921. DOI: 10.1016/j.euroecorev.2018.03.015. URL: https://www.sciencedirect.com/science/article/pii/S001429211830059X (visited on 08/09/2022) (cit. on pp. 10, 23).

Anderson, James E. and Eric van Wincoop (Mar. 2003). "Gravity with Gravitas: A Solution to the Border Puzzle". In: *American Economic Review* 93.1, pp. 170–192. ISSN: 0002-8282. DOI: 10.1257/000282803321455214. URL: https://www.aeaweb.org/articles?id=10.1257/000282803321455214 (visited on 07/14/2022) (cit. on pp. 8, 13).

– (Sept. 2004). "Trade Costs". In: *Journal of Economic Literature* 42.3, pp. 691–751. ISSN: 0022-0515. DOI: 10.1257/0022051042177649. URL: https://www.aeaweb.org/articles?id=10.1257/0022051042177649 (visited on 07/14/2022) (cit. on pp. 8, 13).

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez-Clare (Feb. 1, 2012). "New Trade Models, Same Old Gains?" In: *American Economic Review* 102.1, pp. 94–130. ISSN: 0002-8282. DOI: 10.1257/aer.102.1.94. URL: https://pubs.aeaweb.org/doi/10.1257/aer.102.1.94 (visited on 06/16/2022) (cit. on p. 8).

Baier, Scott L. and Jeffrey H. Bergstrand (Mar. 8, 2007). "Do Free Trade Agreements Actually Increase Members' International Trade?" In: *Journal of International Economics* 71.1, pp. 72–95. ISSN: 0022-1996. DOI: 10.1016/j.jinteco.2006.02.005. URL: https://www.sciencedirect.com/science/article/pii/S0022199606000596 (visited on 07/25/2022) (cit. on pp. 9, 24).

Baier, Scott L., Yoto V. Yotov, and Thomas Zylkin (Jan. 1, 2019). "On the Widely Differing Effects of Free Trade Agreements: Lessons from Twenty Years of Trade Integration". In: *Journal of International Economics* 116, pp. 206–226. ISSN: 0022-1996. DOI: 10.1016/j.jinteco.2018.11.002. URL: https://www.sciencedirect.com/science/article/pii/S0022199618304367 (visited on 06/23/2022) (cit. on pp. 12, 25).

Baldwin, Richard and Daria Taglioni (Sept. 2006). *Gravity for Dummies and Dummies for Gravity Equations*. Working Paper. DOI: 10.3386/w12516. URL: https://www.nber.org/papers/w12516 (visited on 07/14/2022) (cit. on p. 7).

Baldwin, Richard E., ed. (1994). *Towards an Integrated Europe*. London: CEPR Centre for Economic Policy Research. 234 pp. (cit. on p. 7).

Benz, Sebastian (Apr. 21, 2017). *Services Trade Costs: Tariff Equivalents of Services Trade Restrictions Using Gravity Estimation*. Paris: OECD. DOI: 10.1787/dc607ce6-en. URL: https://www.oecd-ilibrary.org/trade/services-trade-costs_dc607ce6-en (visited on 08/10/2022) (cit. on pp. 26, 28).

Benz, Sebastian and Frédéric Gonzales (Jan. 28, 2019). *Intra-EEA STRI Database: Methodology and Results*. Paris: OECD. DOI: 10.1787/2aac6d21-en. URL: https://www.oecd-ilibrary.org/trade/intra-eea-stri-database_2aac6d21-en (visited on 07/28/2022) (cit. on pp. 11, 17).

Benz, Sebastian and Alexander Jaax (July 8, 2020). *The Costs of Regulatory Barriers to Trade in Services: New Estimates of Ad Valorem Tariff Equivalents*. OECD Trade Policy Papers 238. DOI: 10.1787/bae97f98-en. URL: https://www.oecd-ilibrary.org/trade/the-costs-of-regulatory-barriers-to-trade-in-services_bae97f98-en (visited on 07/12/2022) (cit. on pp. 6, 8, 12, 18, 19, 22, 23, 25, 29, 31).

Benz, Sebastian and Inese Rozensteine (2021). "Services Trade Restrictiveness Index (STRI): Measuring Services Liberalisation and Commitments in the GATS and RTAs". In: p. 36 (cit. on p. 12).

Berden, Dr Koen G et al. (2009). "Client: European Commission, Directorate-General for Trade". In: p. 237 (cit. on p. 29).

Blank, Sven et al. (2018). *A Structural Quantitative Analysis of Services Trade De-Liberalization*. 47/2018. Deutsche Bundesbank. URL: https://ideas.repec.org/p/zbw/bubdps/472018.html (visited on 08/03/2022) (cit. on p. 30).

Borchert, Ingo et al. (Aug. 2021). "The International Trade and Production Database for Estimation (ITPD-E)". In: *International Economics* 166, pp. 140–166. ISSN: 21107017. DOI: 10.1016/j.inteco.2020.08.001. URL: https://linkinghub.elsevier.com/retrieve/pii/S2110701720302602 (visited on 07/04/2022) (cit. on p. 15).

– (2022a). "Disaggregated Gravity: Benchmark Estimates and Stylized Facts from a New Database". In: *Review of International Economics* 30.1, pp. 113–136. ISSN: 1467-9396. DOI: 10.1111/roie.12555. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/roie.12555 (visited on 07/04/2022) (cit. on pp. 11, 16).

– (2022b). *The International Trade and Production Database for Estimation - Release 2 (ITPD-E-R02)*. USITC Working Paper 2022–07–A. URL: https://www.usitc.gov/publications/332/working_papers/itpd_e_r02_usitc_wp.pdf (visited on 07/13/2022) (cit. on pp. 1, 5, 15).

Chor, Davin (Nov. 1, 2010). "Unpacking Sources of Comparative Advantage: A Quantitative Approach". In: *Journal of International Economics* 82.2, pp. 152–167. ISSN: 0022-1996. DOI: 10.1016/j.jinteco.2010.07.004. URL: https://www.sciencedirect.com/science/article/pii/S0022199610000668 (visited on 07/14/2022) (cit. on p. 8).

Christen, Elisabeth, Michael Pfaffermayr, and Yvonne Wolfmayr (2019). *Trade Costs in Services: Firm Survival, Firm Growth and Implied Changes in Employment*. 8008. CESifo. URL: https://ideas.repec.org/p/ces/ceswps/_8008.html (visited on 08/03/2022) (cit. on p. 30).

Ciuriak, Dan, Ali Dadkhah, and Dmitry Lysenko (July 2020). "The Effect of Binding Commitments on Services Trade". In: *World Trade Review* 19.3, pp. 365–378. ISSN: 1474-7456, 1475-3138. DOI: 10.1017/S1474745618000496. URL: https://www.cambridge.org/core/journals/world-trade-review/article/effect-of-binding-commitments-on-services-trade/0F35120043766FCB49F0953F857692D3 (visited on 07/24/2022) (cit. on pp. 11, 26).

Conway, Paul and Giuseppe Nicoletti (Dec. 7, 2006). *Product Market Regulation in the Non-Manufacturing Sectors of OECD Countries: Measurement and Highlights*. Paris: OECD. DOI: 10.1787/362886816127. URL: https://www.oecd-ilibrary.org/content/paper/362886816127 (visited on 07/28/2022) (cit. on p. 10).

Costinot, A., D. Donaldson, and I. Komunjer (Apr. 1, 2012). "What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas". In: *The Review of Economic Studies* 79.2, pp. 581–608. ISSN: 0034-6527, 1467-937X. DOI: 10.1093/restud/rdr033. URL:

https://academic.oup.com/restud/article-lookup/doi/10.1093/restud/rdr033 (visited on 07/14/2022) (cit. on p. 8).

De Melo, Jaime and Ben Shepherd (Feb. 2018). *The Economics of Non-Tariff Measures: A Primer*. Working Paper P212. FERDI. URL: https://econpapers.repec.org/paper/fdiwpaper/4168.htm (visited on 07/31/2022) (cit. on p. 4).

Deardorff, Alan V. (Jan. 1, 1984). "Chapter 10 Testing Trade Theories and Predicting Trade Flows". In: *Handbook of International Economics*. Vol. 1. Elsevier, pp. 467–517. DOI: 10.1016/S1573-4404(84)01013-3. URL: https://www.sciencedirect.com/science/article/pii/S1573440484010133 (visited on 07/16/2022) (cit. on p. 7).

Eaton, Jonathan and Samuel Kortum (2002). "Technology, Geography, and Trade". In: *Econometrica* 70.5, pp. 1741–1779. ISSN: 1468-0262. DOI: 10.1111/1468-0262.00352. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1468-0262.00352 (visited on 06/25/2022) (cit. on p. 8).

Economic Indicators (Jan. 29, 2021). *Economic Indicators: Input-Output Tables*. Asian Development Bank. URL: https://www.adb.org/publications/series/economic-indicators-input-output-tables (visited on 08/12/2022) (cit. on p. 45).

Egger, Peter H (2021). "Trade Costs in the Global Economy: Measurement, Aggregation and Decomposition". In: p. 116 (cit. on p. 30).

Egger, Peter H., Mario Larch, and Yoto V. Yotov (2022). "Gravity Estimations with Interval Data: Revisiting the Impact of Free Trade Agreements". In: *Economica* 89.353, pp. 44–61. ISSN: 1468-0335. DOI: 10.1111/ecca.12394. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/ecca.12394 (visited on 07/29/2022) (cit. on p. 16).

Egger, Peter H. and Filip Tarlea (Sept. 1, 2015). "Multi-Way Clustering Estimation of Standard Errors in Gravity Models". In: *Economics Letters* 134, pp. 144–147. ISSN: 0165-1765. DOI: 10.1016/j.econlet.2015.06.023. URL: https://www.sciencedirect.com/science/article/pii/S0165176515002736 (visited on 07/25/2022) (cit. on pp. 14, 24).

Feenstra, Robert C. (2002). "Border Effects and the Gravity Equation: Consistent Methods for Estimation". In: *Scottish Journal of Political Economy* 49.5, pp. 491–506. ISSN: 1467-9485. DOI: 10.1111/1467-9485.00244. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-9485.00244 (visited on 07/29/2022) (cit. on p. 13).

Fontagne, Lionel, Amelie Guillin, and Cristina Mitaritonna (2011). "Estimations of Tariff Equivalents for the Services Sectors". In: *SSRN Electronic Journal*. ISSN: 1556-5068. DOI: 10.2139/ssrn.2004933. URL: http://www.ssrn.com/abstract=2004933 (visited on 08/09/2022) (cit. on p. 10).

Fontagné, Lionel (2016). "Estimated Tariff Equivalents of Services NTMs". In: p. 14 (cit. on pp. 10, 31).

Fraser, Benjamin (Aug. 2021). *Services Trade Modelling Working Paper*. Working Paper. Department for International Trade. URL: https://www.gov.uk/government/publications/services-trade-modelling-working-paper (visited on 07/22/2022) (cit. on pp. 11, 12, 15, 16, 18, 22–24, 26, 27).

Grosso, Massimo Geloso et al. (Jan. 23, 2015). *Services Trade Restrictiveness Index (STRI): Scoring and Weighting Methodology*. Paris: OECD. DOI: 10.1787/5js7n8wbtk9r-en. URL: https://www.oecd-ilibrary.org/trade/services-trade-restrictiveness-index-stri_5js7n8wbtk9r-en (visited on 07/24/2022) (cit. on p. 17).

Gurevich, Tamara and Peter Herman (2022). *The Dynamic Gravity Dataset: 1948-2016*. Working Paper 2018-02-A. USITC. URL: https://www.usitc.gov/data/gravity/dgd.htm (visited on 07/26/2022) (cit. on p. 18).

Head, Keith, Thierry Mayer, and John Ries (May 2009). "How Remote Is the Offshoring Threat?" In: *European Economic Review* 53.4, pp. 429–444. ISSN: 00142921. DOI: 10.1016/j.euroecorev.2008.08.001. URL: https://linkinghub.elsevier.com/retrieve/pii/S0014292108000822 (visited on 07/28/2022) (cit. on p. 10).

Heid, Benedikt, Mario Larch, and Yoto Yotov (Oct. 23, 2017). *Estimating the Effects of Non-discriminatory Trade Policies within Structural Gravity Models*. 2017-10. LeBow College of Business, Drexel University. URL: https://ideas.repec.org/p/ris/drxlwp/2017_010.html (visited on 07/24/2022) (cit. on pp. 11–13, 15, 26).

Hoekman, Bernard and Ben Shepherd (2017). "Services Productivity, Trade Policy and Manufacturing Exports". In: *The World Economy* 40.3, pp. 499–516. ISSN: 1467-9701. DOI: 10.1111/twec.12333. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/twec.12333 (visited on 07/31/2022) (cit. on p. 4).

– (Dec. 1, 2019). *Services Trade Policies and Economic Integration: New Evidence for Developing Countries*. SSRN Scholarly Paper. Rochester, NY. URL: https://papers.ssrn.com/abstract=3504610 (visited on 07/28/2022) (cit. on pp. 11, 28).

Horvát, Peter and Colin Webb (Nov. 18, 2020). *The OECD STAN Database for Industrial Analysis: Sources and Methods*. Paris: OECD. DOI: 10.1787/ece98fd3-en. URL: https://www.oecd-ilibrary.org/science-and-technology/the-oecd-stan-database-for-industrial-analysis_ece98fd3-en (visited on 08/11/2022) (cit. on p. 16).

Hummels, David L. (1999). "Toward a Geography of Trade Costs". In: *SSRN Electronic Journal*. ISSN: 1556-5068. DOI: 10.2139/ssrn.160533. URL: http://www.ssrn.com/abstract=160533 (visited on 07/25/2022) (cit. on p. 9).

Khachaturian, Tamar and Sarah Oliver (2021). "The Role of "Mode Switching" in Services Trade". In: p. 54 (cit. on pp. 5, 18, 23, 27).

Kimura, Fukunari and Hyun-Hoon Lee (2006). "The Gravity Equation in International Trade in Services". In: *Review of World Economics / Weltwirtschaftliches Archiv* 142.1, pp. 92–121. ISSN: 1610-2878. JSTOR: 40441082 (cit. on p. 10).

Lamprecht, Philipp and Sébastien Miroudot (Mar. 28, 2018). *The Value of Market Access and National Treatment Commitments in Services Trade Agreements*. Paris: OECD. DOI: 10.1787/d8bfc8d8-en. URL: https://www.oecd-ilibrary.org/trade/the-value-of-market-access-and-national-treatment-commitments-in-services-trade-agreements_d8bfc8d8-en (visited on 08/09/2022) (cit. on p. 17).

Larch, Mario et al. (2019). "Currency Unions and Trade: A PPML Re-assessment with High-dimensional Fixed Effects". In: *Oxford Bulletin of Economics and Statistics* 81.3, pp. 487–510. ISSN: 1468-0084. DOI: 10.1111/obes.12283. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/obes.12283 (visited on 08/01/2022) (cit. on p. 14).

Leamer, Edward E. and James Levinsohn (Nov. 1994). *International Trade Theory: The Evidence*. Working Paper. DOI: 10.3386/w4940. URL: https://www.nber.org/papers/w4940 (visited on 07/16/2022) (cit. on p. 7).

Miroudot, Sébastien and Charles Cadestin (Mar. 15, 2017). *Services In Global Value Chains: From Inputs to Value-Creating Activities*. Paris: OECD. DOI: 10.1787/465f0d8b-en. URL: https://www.oecd-ilibrary.org/trade/services-in-global-value-chains_465f0d8b-en (visited on 07/24/2022) (cit. on p. 4).

Nizalova, Olena and Irina Murtazashvili (Mar. 2011). *Exogenous Treatment and Endogenous Factors: Vanishing of Omitted Variable Bias on the Interaction Term*. Discussion Paper 37. Kyiv School of Economics. URL: https://econpapers.repec.org/paper/ksedpaper/37.htm (visited on 08/01/2022) (cit. on p. 14).

Nordås, Hildegunn (May 13, 2016). "Services Trade Restrictiveness Index (STRI): The Trade Effect of Regulatory Differences". In: *OECD Trade Policy Paper* 2016 (cit. on pp. 28, 29).

Nordås, Hildegunn K. and Dorothée Rouzet (2017). "The Impact of Services Trade Restrictiveness on Trade Flows". In: *The World Economy* 40.6, pp. 1155–1183. ISSN: 1467-9701. DOI: 10.1111/twec.12424. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/twec.12424 (visited on 07/22/2022) (cit. on pp. 4, 10, 11, 27).

OECD Inter-Country Input-Output (ICIO) Tables - OECD (2022). URL: https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (visited on 08/11/2022) (cit. on p. 16).

OECD Services Trade Restrictiveness Index (2022). *OECD Services Trade Restrictiveness Index: Policy Trends up to 2022 by OECD - Issuu*. URL: https://issuu.com/oecd.publishing/docs/oecd_stri_policy_trends_up_to_2022 (visited on 08/12/2022) (cit. on p. 31).

OECD, (2022). Services trade in the global economy. URL: https://www.oecd.org/trade/topics/services-trade/ (visited on 07/31/2022) (cit. on pp. 4, 17).

Olivero, María Pía and Yoto V. Yotov (2012). "Dynamic Gravity: Endogenous Country Size and Asset Accumulation". In: *Canadian Journal of Economics/Revue canadienne d'économique* 45.1, pp. 64–92. ISSN: 1540-5982. DOI: 10.1111/j.1540-5982.2011.01687.x. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-5982.2011.01687.x (visited on 07/25/2022) (cit. on p. 9).

Pöyhönen, Pentti (1963). "A Tentative Model for the Volume of Trade between Countries". In: *Weltwirtschaftliches Archiv* 90, pp. 93–100. ISSN: 0043-2636. JSTOR: 40436776 (cit. on p. 7).

Pulliainen, Kyösti (1963). "A World Trade Study : An Econometric Model of the Pattern of the Commodity Flows in International Trade in 1948-1960". In: *Ekonomiska Samfundets tidskrift*. Ekonomiska Samfundets Tidskrift. - Helsingfors : Centraltryckeriet, ISSN 0013-3183, ZDB-ID 4410075. - Vol. 16.1963, 2, p. 78-91 16.2 (cit. on p. 7).

Ravenstein, E. G. (1885). "The Laws of Migration". In: *Journal of the Statistical Society of London* 48.2, pp. 167–235. ISSN: 0959-5341. DOI: 10.2307/2979181. JSTOR: 2979181 (cit. on p. 7).

Riker, David (2014). "Estimates of the Impact of Restrictions on Cross-Border Trade in Services". In: p. 14 (cit. on p. 10).

Rouzet, Dorothée, Sebastian Benz, and Francesca Spinelli (Dec. 12, 2017). *Trading Firms and Trading Costs in Services: Firm-level Analysis*. Paris: OECD. DOI: 10.1787/b1c1a0e9-en. URL: https://www.oecd-ilibrary.org/trade/trading-firms-and-trading-costs-in-services-firm-level-analysis_b1c1a0e9-en (visited on 08/03/2022) (cit. on p. 30).

Samuelson, Paul A. (1954). "The Transfer Problem and Transport Costs, II: Analysis of Effects of Trade Impediments". In: *The Economic Journal* 64.254, pp. 264–289. ISSN: 0013-0133. DOI: 10.2307/2226834. JSTOR: 2226834 (cit. on p. 29).

Shepherd, Ben, Maura Décosterd, Claudia Castillo Comabella, and Dionysios Stivas (2019). *EU Exit and Impacts on Northern Ireland's Services Trade*. Developing Trade Consultants Report commissioned by the Northern Ireland Department for the Economy, p. 51. URL: https://www.economy-ni.gov.uk/publications/eu-exit-and-impacts-northern-irelands-services-trade (cit. on pp. 11, 12, 34).

Shepherd, Ben, Maura Décosterd, Claudia Castillo Comabella, Dionysios Stivas, et al. (2022). *Non-Tariff Measures and the United Kingdom Internal Market*. Research Report. Report by Developing Trade Consultants commissioned for the UK Department for Business, Energy & Industrial Strategy. URL: https://www.gov.uk/government/publications/analysis-of-non-tariff-measures-in-the-uk-internal-market (visited on 07/28/2022) (cit. on pp. 11, 12, 18).

Silva, J. M. C. Santos and Silvana Tenreyro (Nov. 1, 2006). "The Log of Gravity". In: *The Review of Economics and Statistics* 88.4, pp. 641–658. ISSN: 0034-6535. DOI: 10.1162/rest.88.4.641. URL: https://doi.org/10.1162/rest.88.4.641 (visited on 07/14/2022) (cit. on pp. 9, 13).

Supply and Use Tables, Database - OECD (2022). URL: https://www.oecd.org/sdd/na/supply-and-use-tables-database.htm (visited on 08/11/2022) (cit. on p. 16).

Tinbergen, Jan (Jan. 1, 1962). "Shaping the World Economy; Suggestions for an International Economic Policy". In: URL: https://repub.eur.nl/pub/16826 (visited on 07/14/2022) (cit. on p. 7).

Trade in Value Added: United Kingdom Country Note - OECD (2022). URL: https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm (visited on 07/31/2022) (cit. on p. 4).

Van der Marel, Erik and Ben Shepherd (2013). "Services Trade, Regulation and Regional Integration: Evidence from Sectoral Data". In: *The World Economy* 36.11, pp. 1393–1405. ISSN: 1467-9701. DOI: 10.1111/twec.12083. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/twec.12083 (visited on 07/22/2022) (cit. on p. 10).

Yotov, Yoto (2022). "Gravity at Sixty: The Workhorse Model of Trade". In: *SSRN Electronic Journal*. ISSN: 1556-5068. DOI: 10.2139/ssrn.4037001. URL: https://www.ssrn.com/abstract=4037001 (visited on 07/08/2022) (cit. on pp. 7, 9, 10, 26).

Yotov, Yoto V. et al. (Nov. 15, 2016). *An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model*. WTO. ISBN: 978-92-870-4368-9. DOI: 10.30875/abc0167e-en. URL: https://www.wto-ilibrary.org/content/books/9789287043689 (visited on 04/13/2022) (cit. on pp. 7, 11).

Appendix

Appendix A AVEs (%) in 2021 by Country and Sector

	Transport		Distribution		Construction	
Country	MFN	EEA	MFN	EEA	MFN	EEA
AUS	31.9		37.8		22.0	
AUT	37.2	11.3	51.6	15.1	20.2	4.1
BEL	44.3	9.8	77.1	23.7	30.9	4.3
BRA	50.3		74.9		40.8	
CAN	32.7		67.1		24.4	
CHE	47.8		61.8		31.9	
CHL	25.8		28.5		14.9	
CHN	46.5		48.2		25.8	
COL	31.6		31.7		24.6	
CRI	39.6		43.8		21.4	
CZE	30.8	10.3	31.4	12.8	14.4	2.5
DEU	29.9	9.1	39.9	13.6	16.8	1.6
DNK	35.3	7.2	45.3	14.5	22.4	2.5
ESP	34.5	8.7	41.3	12.8	22.6	2.5
EST	38.3	8.8	42.4	7.0	25.4	2.5
FIN	44.8	10.6	72.7	18.0	23.6	1.3
FRA	30.8	9.2	53.1	25.0	12.7	1.3
GBR	22.5		29.4		16.0	
GRC	44.3	7.5	78.4	20.7	34.5	4.0
HUN	43.1	10.3	57.0	11.7	30.2	1.3
IDN	76.6		420.1		51.7	
IND	78.0		177.3		37.7	
IRL	33.7	8.7	48.2	15.9	17.1	1.3
ISL	62.5	9.8	130.3	33.7	65.7	10.2
ISR	64.6		44.2		38.3	
ITA	41.7	10.9	50.8	19.2	37.2	5.4
JPN	30.1		26.9		11.4	
KAZ	74.5		146.5		48.9	
KOR	61.4		46.0		18.2	
LTU	34.9	7.5	41.0	8.9	19.8	2.5
LUX	35.6	12.3	52.3	17.7	19.6	5.6
LVA	32.1	10.3	35.8	12.5	18.5	4.2
MEX	61.7		57.8		32.9	
MYS	54.1		132.7		36.8	
NLD	27.9	6.5	36.1	12.8	14.2	0.0
NOR	49.7	9.0	82.0	19.2	34.9	2.7
NZL	36.7		42.0		19.7	
PER	43.9		47.5		23.2	
POL	40.0	9.7	59.0	18.6	30.3	2.5
PRT	30.2	9.0	42.4	17.7	21.8	2.5
RUS	103.6		88.0		44.5	
SGP	42.5		62.6		25.8	
SVK	36.4	9.6	35.4	9.7	22.3	2.5
SVN	44.1	11.6	48.6	9.7	30.5	4.2
SWE	43.5	9.7	64.2	19.8	25.6	4.3
THA	97.8		129.2		53.0	
TUR	58.4		57.0		34.0	
USA	49.2		39.9		26.6	
VNM	57.5		110.5		34.7	
ZAF	48.6		61.0		25.4	

	Insurance		Finance		Business		Info. services	
Country	MFN	EEA	MFN	EEA	MFN	EEA	MFN	EEA
AUS	38.3		137.8		23.4		40.5	
AUT	49.8	3.0	137.8	27.3	49.7	11.1	44.1	6.7
BEL	45.9	6.1	197.1	39.9	49.4	12.1	54.2	12.2
BRA	98.5		512.9		50.8		79.4	
CAN	47.0		118.4		27.1		49.8	
CHE	52.3		262.4		46.6		61.6	
CHL	33.0		138.9		16.2		40.9	
CHN	90.6		363.6		78.3		146.2	
COL	47.0		240.8		20.7		52.9	
CRI	38.1		113.3		32.6		41.7	
CZE	21.0	1.3	54.6	9.9	24.5	10.0	28.3	7.4
DEU	27.5	2.4	111.3	42.6	29.4	9.6	27.8	5.1
DNK	36.8	3.6	126.8	20.8	33.9	5.9	38.1	5.0
ESP	37.3	4.9	59.0	4.8	37.0	7.7	32.0	4.2
EST	31.6	2.4	117.4	20.8	57.3	6.0	38.3	5.8
FIN	55.7	1.3	180.7	15.3	27.3	3.7	49.4	6.3
FRA	21.9	4.9	115.3	34.7	68.8	10.2	33.7	6.0
GBR	29.4		110.3		31.2		28.4	
GRC	61.6	3.6	184.7	20.8	59.7	10.4	52.6	7.1
HUN	44.3	2.4	187.4	22.6	65.8	10.0	51.1	7.4
IDN	139.8		782.5		121.1		113.9	
IND	161.7		856.4		147.8		70.9	
IRL	25.4	1.3	94.9	15.3	28.5	8.2	35.5	6.9
ISL	88.1	4.9	361.4	46.7	59.8	11.0	101.4	13.5
ISR	57.5		198.5		49.4		69.9	
ITA	61.3	4.4	172.8	33.5	68.9	7.6	52.4	10.9
JPN	30.1		134.5		40.4		33.4	
KAZ	72.1		431.8		41.7		117.7	
KOR	19.9		129.0		100.9		48.4	
LTU	27.7	1.3	115.3	9.9	39.1	7.6	36.0	5.0
LUX	37.0	4.9	120.5	56.0	78.6	11.9	34.4	9.9
LVA	28.7	2.4	98.7	22.6	19.4	5.0	36.1	10.0
MEX	56.3		441.9		36.8		66.0	
MYS	63.1		175.4		68.7		74.7	
NLD	24.2	4.9	114.3	22.6	25.8	5.5	29.7	3.6
NOR	75.7	7.5	296.5	34.7	42.1	6.0	59.5	9.7
NZL	29.4		178.0		29.2		42.6	
PER	47.3		156.5		26.8		59.7	
POL	42.5	6.1	166.4	32.8	105.8	9.3	48.4	4.4
PRT	42.7	2.4	126.8	34.7	61.7	9.5	29.3	4.4
RUS	97.1		536.6		47.5		105.7	
SGP	47.9		240.8		41.2		60.9	
SVK	26.3	1.3	92.2	15.3	52.4	11.5	29.9	5.2
SVN	36.5	8.9	154.1	28.5	72.1	8.8	48.6	6.0
SWE	50.1	3.6	170.2	20.8	32.0	4.6	41.7	4.9
THA	180.7		640.7		142.4		91.9	
TUR	45.7		272.8		86.9		73.0	
USA	70.2		152.9		26.2		33.9	
VNM	123.9		495.8		58.1		111.2	
ZAF	39.1		317.7		39.5		60.5	

Appendix B Robustness Checks

B.1 Regression results: Robustness check with only OECD

	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
Trade elasticity	−0.401	−5.190*	−6.062**	0.046	−3.064*	−2.347**	−2.642**
	(0.928)	(2.711)	(2.790)	(1.407)	(1.600)	(1.169)	(1.241)
Int. Border	−4.025***	−6.484***	−6.319***	−4.901***	−3.905***	−3.896***	−3.651***
	(0.258)	(0.403)	(0.553)	(0.483)	(0.552)	(0.379)	(0.282)
Log distance	−0.358***	−0.674***	−0.454***	−0.579***	0.029	−0.357***	−0.585***
	(0.081)	(0.160)	(0.141)	(0.163)	(0.216)	(0.107)	(0.091)
Contiguity	0.565***	0.696***	0.321	0.071	0.728*	0.363*	0.029
	(0.163)	(0.257)	(0.351)	(0.387)	(0.424)	(0.217)	(0.196)
Colony ever	0.573***	−0.135	0.649**	0.926***	0.836**	0.397	0.390*
	(0.206)	(0.340)	(0.296)	(0.318)	(0.338)	(0.315)	(0.209)
Common language	0.297**	0.269	0.778**	0.648**	0.665**	0.444*	0.512***
	(0.134)	(0.175)	(0.337)	(0.259)	(0.267)	(0.239)	(0.156)
SPTA	−0.466***	−0.975***	−0.780**	−0.955***	−0.995***	−0.564**	−0.450**
	(0.171)	(0.355)	(0.391)	(0.256)	(0.296)	(0.231)	(0.195)
EEA	0.868*	−0.497	0.731	0.822	0.734	−0.235	0.160
	(0.457)	(0.562)	(0.885)	(0.558)	(0.522)	(0.771)	(0.423)
Num.Obs.	6907	5739	5610	5969	6409	7082	6955
R2 Adj.	0.991	0.999	0.999	0.997	0.979	0.992	0.995
Exporter-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

B.2 Regression results: Robustness check excluding EEA dummy

	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
Trade elasticity	−4.081***	−9.947***	−4.567***	−4.044***	−8.739***	−3.392***	−5.147***
	(0.442)	(1.802)	(1.462)	(0.795)	(1.190)	(0.436)	(0.563)
Int. Border	−4.207***	−7.809***	−6.657***	−5.214***	−3.691***	−4.547***	−3.963***
	(0.198)	(0.339)	(0.480)	(0.429)	(0.433)	(0.284)	(0.266)
Log distance	−0.069	0.197	−0.618***	−0.346***	0.138	−0.043	−0.328***
	(0.085)	(0.121)	(0.196)	(0.130)	(0.132)	(0.084)	(0.089)
Contiguity	0.850***	1.469***	0.320	0.271	0.824**	0.729***	0.272
	(0.158)	(0.252)	(0.353)	(0.360)	(0.374)	(0.202)	(0.199)
Colony ever	0.481**	−0.056	0.599**	1.038***	0.812**	0.568**	0.408*
	(0.195)	(0.289)	(0.295)	(0.332)	(0.369)	(0.222)	(0.210)
Common language	0.359***	0.379**	0.065	0.642***	0.703***	0.307*	0.541***
	(0.112)	(0.180)	(0.317)	(0.224)	(0.235)	(0.182)	(0.143)
SPTA	0.247*	0.375	0.770**	−0.166	−0.461*	−0.127	−0.086
	(0.132)	(0.285)	(0.318)	(0.209)	(0.276)	(0.192)	(0.185)
Num.Obs.	10 153	7729	7865	8479	9218	10 393	10 079
R2 Adj.	0.989	0.999	0.999	0.997	0.982	0.991	0.994
Exporter-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

B.3 Regression results: Robustness check with OLS

	Transport	Distribution	Construction	Insurance	Finance	Business services	Info. Services
Trade elasticity	−5.370***	−4.813***	−5.076***	−2.058**	−5.623***	−2.692***	−5.397***
	(1.147)	(1.128)	(1.361)	(0.881)	(1.575)	(0.551)	(1.156)
Int. Border	−2.755***	−7.635***	−6.826***	−6.615***	−4.796***	−4.278***	−4.555***
	(0.450)	(0.546)	(0.451)	(0.394)	(0.559)	(0.409)	(0.423)
Log distance	−0.898***	−0.666***	−0.828***	−0.671***	−0.755***	−0.848***	−0.796***
	(0.156)	(0.220)	(0.171)	(0.144)	(0.187)	(0.157)	(0.144)
Contiguity	0.299	0.703***	0.605**	0.659***	0.605**	0.294	0.387**
	(0.201)	(0.232)	(0.239)	(0.190)	(0.237)	(0.211)	(0.181)
Colony ever	0.609***	0.175	0.095	0.527***	0.113	0.228	0.452**
	(0.175)	(0.190)	(0.227)	(0.162)	(0.199)	(0.223)	(0.186)
Common language	0.667***	0.150	0.289**	0.414***	0.572***	0.437***	0.218**
	(0.108)	(0.105)	(0.147)	(0.102)	(0.127)	(0.108)	(0.096)
SPTA	0.244	0.436	0.483**	0.466***	0.253	0.379**	0.256*
	(0.155)	(0.267)	(0.244)	(0.162)	(0.165)	(0.161)	(0.144)
EEA	−0.437	0.244	−0.097	0.103	−0.086	−0.266	−0.233
	(0.382)	(0.422)	(0.496)	(0.322)	(0.366)	(0.306)	(0.323)
Num.Obs.	9898	6511	5729	7013	7599	10 139	9604
Exporter-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered by exporter, importer and year in parentheses below the parameter estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

Appendix C Additional Domestic Trade Data

I supplement the ITPD-E data by appending missing domestic trade data for a small group of countries. I follow the same procedure for calculating domestic trade as in the ITPDE, which is calculated as the difference between domestic production and exports. Export data is sourced from the ITPD-E. The supplementary production data is sourced from OECD STAN, OECD supply-use tables, and OECD input-output tables. Export data from within the ITPD-E is used. In the final estimation dataset, the only domestic trade data missing is for New Zealand in 2019.

Missing domestic trade data for Australia, Brazil, Korea, Luxembourg, Slovenia, Sweden are sourced from OECD supply-use tables. Missing domestic trade data for Canada, Iceland, Japan, Korea (only distribution and business services in 2014) and the United Kingdom are sourced from the OECD STAN database.

Missing domestic trade data from 2014 to 2018 for Malaysia, China, Indonesia, Kazakhstan, Vietnam, Singapore, Thailand, South Africa, Turkey and Russia are sourced from OECD input-output tables. Shares of sector output for 2018 are calculated and then used to infer sectoral production data for 2019. Total output for 2018 is multiplied by the growth rate for 2019 (using current prices, current exchange rates) from the OECD national accounts data for China, Indonesia, Singapore, South Africa, Turkey and Russia. Other countries (Malaysia, Kazakhstan, Vietnam and Thailand) 2019 growth rates are calculated from the Asian Development Bank's Input-Output tables (*Economic Indicators* 2021), which are in current USD million. Total output for 2019 is then multiplied by the share of sector output for 2018 to obtain production data for 2019 by sector in these countries. This assumes that output in services sectors grew at the same rate in 2019 in these countries.