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The Role of "Mode Switching" in Services Trade

Tamar Khachaturian and Sarah Oliver

Abstract

Since the 1995 General Agreement on Trade in Services (GATS), international trade in services has been categorized into four "modes of supply." This paper uses a detailed sector level cross-border services structural gravity model to shed light on the question of whether mode 3 trade (trade via foreign affiliates) is a complement or substitute for cross-border trade (modes 1, 2 and 4) in 14 services sectors. Due to data limitations, previous work on this topic has been unable to disaggregate services trade data at this level, and as a result has not found a consistent answer to this question. In this paper, we find a negative and significant impact of mode 3 barriers on cross-border trade, suggesting an inter-modal complementary relationship between cross border-trade and foreign affiliate sales. This result holds for majority of the sector-specific estimations. These results suggest that within individual services sectors, firms use multiple modes of supply to provide services to foreign customers. For example, while architecture services can in principal be provided entirely via cross-border means by email or travel abroad, architecture firms may nevertheless benefit from commercial presence in foreign markets, since this enables them to interact more effectively with clients and monitor construction progress.

U.S. international Trade Commission

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Introduction

The relationship between cross-border trade and foreign affiliate sales remains an open question for services trade. Often drawing on the manufacturing sector, theoretical literature on foreign direct investment and the proximity-concentration hypothesis suggest that cross-border trade and investment, particularly horizontal investment, are substitutes. However, a clear relationship between cross-border trade and foreign investment has not emerged in services-specific work. This ambiguity points to the need for additional analysis, with disaggregation across services sectors as data permits. Our paper contributes to the evolving services literature by providing a detailed sector-level cross-border services structural gravity estimation across multiple years with mode-specific policy barriers using the OECD Services Trade Restrictiveness Index (STRI), incorporating domestic production and controlling for multilateral resistance.

The ambiguity around the relationship between FDI and cross-border trade in services is partly related to the multiple modes of supplying services abroad, which are not perfectly analogous to exports and FDI in manufacturing. More specifically, in the WTO General Agreement on Trade in Services (GATS) mode of supply framework, services are supplied to foreign markets through four modes of delivery.[1] Additionally, relative to manufacturing, the underlying characteristics across (and within) services industries differ along several dimensions, as firms provide intangible and often differentiated products which vary in terms of the required levels of customer interaction, the degree of tradability over the internet, and the skill level needed to deliver. As a result, some services lend themselves to being supplied predominantly through one mode (as in travel), while others may be supplied through all four modes (as in certain legal services) with different modes of supply acting as compliments to one another.

The heterogeneity of services industries conducting international trade is reflected both in the differing predominant channels of services delivery in foreign markets and the varying restrictiveness of mode-specific trade policies across services industries. The heterogeneity signifies the importance of detailed sector-level research, as studying services as a whole limits the ability to fully answer fundamental questions in services trade, including assessment of the impact of prevailing trade policies and evaluation of the related inter-relationship between modes of supply.

In addition to finding that for most services sectors overall trade policy restrictions have a negative and significant impact on cross-border services trade, a key finding of this paper is that mode 3 barriers (including restrictions related to foreign ownership and operation of firms) also have a negative impact on cross-border trade. This result suggests that cross-border trade and foreign affiliate sales tend to be complementary. The result is robust across most sectors ranging from telecommunications to professional services, notwithstanding diversity in intensity of restrictiveness of mode 3 policies, the importance of mode 3 as a channel of delivery, and in the types of services supplied across modes and sectors (see table 1).

[1] As described in the next section, the four modes of services delivery are: mode 1, services supplied across borders (e.g. digitally); mode 2, travel of consumers to suppliers; mode 3, suppliers' commercial presence in foreign markets; and mode 4 travel of service suppliers to consumers.

Table 1 Summary Results: Impact of overall trade policy restrictions and mode 3 barriers on cross-border trade

The summarized effects in column 1 correspond to the regression specification presented in equation 4 and regression coefficients shown in figure 2 while the summarized effects in column 2 correspond to the regression specification presented in equation 5 and regression coefficients shown in figure 3.

n.a.= Mode specific STRI not available.

	Negative and Significant Impact of Overall Trade Policy Restrictions on Cross-Border Trade	**Negative and Significant Effect of Mode 3 Barriers on Cross-Border Trade, Suggesting Inter-Modal Complementarity**
Air transport	×	×
Legal services	✓	✓
Accounting	✓	✓
Rail freight transport	×	×
Broadcasting and Audiovisual services	✓	n.a.
Maritime transport	✓	✓
Postal and courier	×	✓
Logistics services	×	✓
Architecture and engineering	✓	✓
Computer services	✓	✓
Construction	✓	×
Insurance	✓	×
Telecom	✓	✓
Road freight transport	✓	✓

We also find that, when considered separately, mode 4 policies (which largely capture restrictions related to movement of people) have a positive and significant impact on cross-border services trade. This result potentially suggests that service providers may switch to providing services remotely when restrictions impede their travel. While this dynamic may be obvious in some industries, it is not always clear in which instances services provided via movement of people are substitutable with remote provision and in which instances mode 4 trade exists only to facilitate mode 1 cross-border trade and mode 3 foreign affiliate sales.

This paper is structured as follows. Section 2 provides an overview of modes of supply in services trade and trade restrictions across sectors. Section 3 provides an overview of relevant literature, including the relationship between trade and FDI and services trade gravity models. Section 4 presents our model framework, while Section 5 describes our trade data and sources. Section 6 presents our main results on the impact of the overall level of trade restrictiveness, and results by mode of supply with separate discussions for three groups of sectors (transportation and related services, data intensive services, and professional services). Section 7 concludes.

Modes of Supply in Services Trade and Trade Restrictions

In the WTO GATS mode of supply framework, services are supplied to foreign markets through four modes of delivery, which depend on the territorial location of the "supplier" and the "consumer." This

mode of supply framework reflects the heterogeneity of service sectors, as well as the intangible nature of services. Mode 1 is defined as services supplied across borders (e.g. digitally), mode 2 as travel of consumers to suppliers, mode 3 as suppliers' commercial presence in foreign markets, and mode 4 as travel of service suppliers to consumers.[2] These four modes of supply categories are typically used in trade negotiation and classification of types of trade barriers.

In the trade data, these modes fall into two categories: cross-border trade and foreign affiliate sales. Cross-border trade, captured in balance of payment statistics, include services provided digitally across borders or through the travel of service supplier or client (modes 1, 2, and 4). Foreign affiliate sales approximate services delivered via the establishment of a local commercial presence (mode 3), though foreign direct investment (FDI) data is also used as a proxy for mode 3 trade (as in Kox and Nordas 2009). Cross-border trade and foreign affiliate sales statistics are not generally harmonized.[3] Due to this lack of harmonization (and that cross-border trade is not disaggregated by mode), the exact share of services supplied across modes is not well known. Further, underlying sector-specific characteristics or regulations affect the way services are delivered and modal compositions of services trade vary across sectors, countries, and type of trade flow.[4]

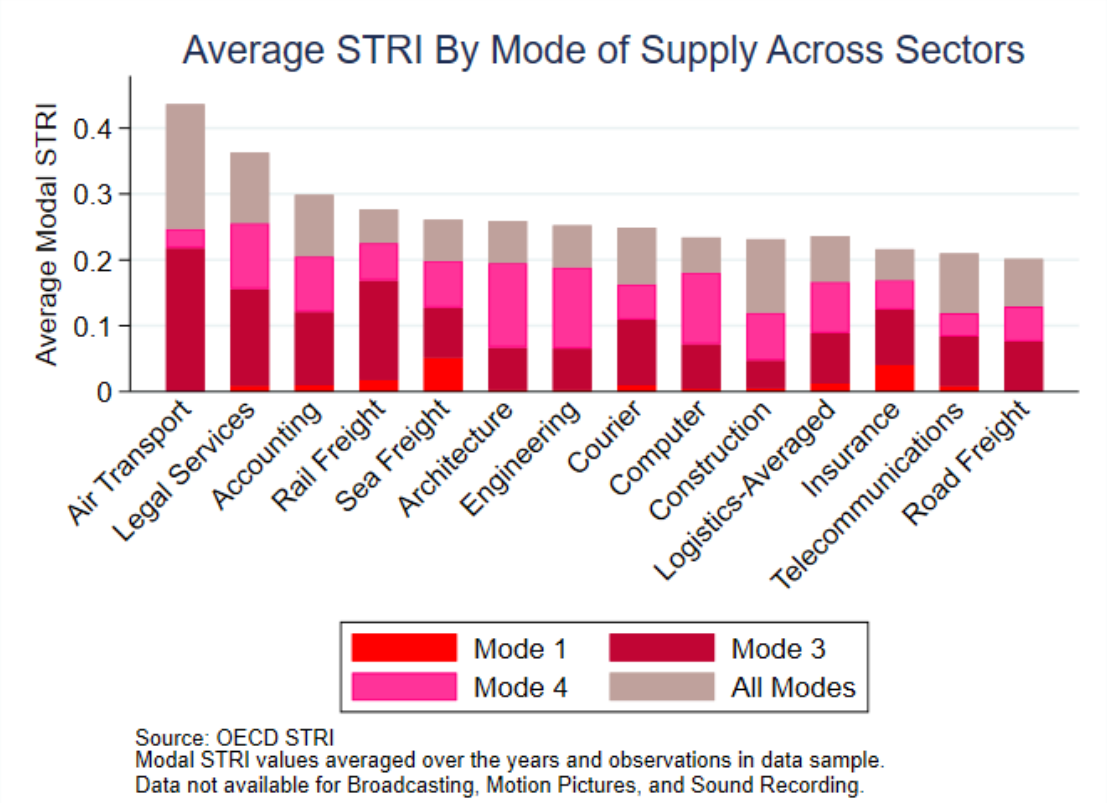
Recent work by Mann (2019) (for the United States) and Mann and Cheung (2019) (for the United States and United Kingdom) move beyond previously published estimates of modal shares based on pre-assigned allocations (see for example, Mann 2017). Instead, Mann (2019) and Mann and Cheung (2019) measure sector-specific shares of cross-border services trade by mode of supply using survey data. Their results show significant heterogeneity across sectors. For example, within the cross-border channel alone, there are UK service sectors that are reliant on one mode of supply (travel is exclusively mode 2), dominant in one mode but have a residual in a second mode (financial services are almost entirely mode 1, with some mode 4), split between two modes (construction is almost evenly split between modes 1 and 4), and employ all three cross-border modes (other business services) (Mann and Cheung 2019).

Relatedly, services trade policies can either apply to all modes of services trade or can be specific to a single mode. Over time, various indices have been developed to measure regulations affecting international trade in services at the sector level. An early example is the Trade Restrictiveness Index (TRI) developed by the Australian Productivity Commission (Findlay and Warren, 2000). More recently, the World Bank Services Trade Restrictions Index (STRI) provides a snapshot of the restrictions in place (typically as of 2008) across a number of services sectors and across modes of supply for 103 countries (Borchert et al. 2012).[5] Beginning in 2014, the OECD Services Trade Restrictiveness Index (STRI), quantifies and annually updates restrictions and regulations covering 22 sectors across 46 OECD and select non-OECD countries.[6] The STRI scores can be disaggregated across policy categories and modes of

[2] For a detailed discussion of the different modes of supply of services trade, see https://www.wto.org/english/tratop_e/serv_e/cbt_course_e/c1s3p1_e.htm.
[3] See Mann 2019 for a discussion of the differences between trade data collection across cross-border and affiliate sales and bridge between two data types.
[4] There are other complicating factors, for example that firms may use multiple modes in a single transaction (Mann 2017).
[5] For information on updates to the database, see https://www.worldbank.org/en/research/brief/services-trade-restrictions-database.
[6] See https://www.oecd.org/trade/topics/services-trade/.

supply.[7] Figure 1 shows the OECD STRI decomposed by mode across sectors. For example, within the professional services sectors included in the database, figure 1 demonstrates that mode 3 barriers are relatively dominant in accounting and legal services while mode 4 barriers appear to be the main impediments to architecture and engineering services.

Figure 1 Average STRI scores by mode of supply, 2014–2018



Related Literature

As noted in the introduction, research on services trade should account for heterogeneity of characteristics, patterns of supply, and policy barriers across sectors. However, until recently, data limitations have constrained the ability of sector specific quantitative research. The literature review that follows summarizes empirical work—focusing on gravity modes of services trade—which tends to consider broad categories of services sectors and trade policy measures and investigate the impact that non-tariff measures (NTMs) have on services trade generally. A subset of the literature considers the complement vs substitution question for specific services sectors, with findings of both substitution and complementary across channels of supply. Before summarizing the empirical services literature, the review below begins with a brief overview of theoretical literature related to manufactured goods trade that focuses on the tradeoffs between exports and foreign direct investment, which serve as a point of

[7] The mode of supply disaggregation consists of modes 1, 3, 4, and an "all modes" category, where "all modes" refers to restrictions that affect all types of services trade. In each country-sector-year, the sum of each mode-specific disaggregation equals the total STRI.

comparison for our analysis of the interaction between foreign direct investment and cross-border trade in services.

Relationship Between Trade and FDI

Literature on the relationship between exports and foreign investment has focused primarily on the manufacturing sector and tends to consider the relative costs of FDI vs exports, and firm productivity as drivers of a firm decision to export or engage in FDI (or engage in both). While the same fundamental costs and productivity decisions could also be present in services firm export decisions, previous work suggests that the relationship between export and FDI decisions is more ambiguous for services sectors.

In the model presented in Helpman, Melitz, and Yeaple (HMY, 2004), productivity at the firm level determines whether a firm will choose to serve only the domestic market, export, or engage in foreign direct investment (FDI). In this framework, the most productive firms engage in FDI, the mid-range productive firms export, and the least productive firms serve only the domestic market. This characterization of exports based on productivity considers FDI and exports to be substitutes, a characterization that is supported empirically in HMY (2004) through analysis of U.S. manufacturing sectors. Other empirical work has confirmed the findings of HMY (2004) to varying degrees. Arnold and Hussinger (2010), using data on manufacturing firms in Germany, also finds empirical support for the ordered predictions of Helpman et al (2004). Engel and Procher (2012) confirm the findings of Helpman et al (2004) for a sample of French manufacturing and services firms, for all sectors except construction. In contrast, Kimura and Kiyota (2006), using data on both manufacturing and services firms in Japan find that FDI (defined as having a foreign affiliate) is not a substitute for exports. Instead, the most productive firms in Japan are both exporters and have affiliates.

Applying HMY (2004) to professional services, Khachaturian and Riker (2016) use a partial equilibrium version of the HMY (2004) model to simulate the impact of trade liberalization in professional services industries which in principle are supplied in foreign markets through multiple modes of supply. The paper calculates hypothetical reductions in the fixed costs of exporting into the United States through cross-border trade and foreign affiliate sales and shows the degree of substitution across the two channels in response to mode-specific liberalization.[8]

The proximity-concentration hypothesis, which focuses on relative costs rather than productivity, provides additional support for a theoretical view of exports and FDI as substitutes. As outlined in Antràs and Yeaple (2014), the proximity-concentration hypothesis states that when exporters face high shipping costs or tariffs in a particular market, firms may choose to establish production facilities and affiliates in that market (horizonal FDI), rather than relying on exports.

Related research has added nuance to the proximity-concentration hypothesis by considering factors which may affect the relationship between trade and FDI, such as different types of FDI, the sequence of trade vs FDI, economic size, or other market characteristics. Tekin-Koru (2012) finds that for Swedish manufacturing firms, the relationship between foreign direct investment and exports depends on the type of foreign direct investment: FDI though new operations abroad (greenfield FDI) tends to be a substitute for exports, while FDI through mergers and acquisitions tends to complement exports. Neary

[8] Khachaturian and Riker (2019) use a modified version of the earlier PE model and the OECD STRI to calculate effects if U.S. trade restrictions were increased to international average levels.

(2009) considers the dichotomy between the proximity-concentration hypothesis, which suggests that a decrease in trade cost has a negative effect on investment, and the strong growth in FDI in the 1990s despite reductions in trade costs. Neary highlights two explanations for this trend: first that firms may engage in FDI to serve a group of countries from a central location, and that cross-border mergers and acquisitions, which tend to be positively related to trade liberalization, may also be the drivers of this trend. Relatedly, Oberhofer and Pfaffermayr (2012) find that at the firm level, the optimal vehicle for serving foreign markets can differ in different markets, and that a majority of firms in their data use FDI and exports as complements. Barattieri et al. (2016) consider the relationship between trade policy barriers in services and cross-border M&A transactions. Using the World Bank STRI, Batattieri et al. (2016) find that more restrictive trade policy decreases M&A inflows, but that this result varies with economic size, suggesting that the level of trade policy barriers is less important in markets with large manufacturing and services sectors.

Finally, Oldenski (2012) considers an alternative to the proximity-concentration tradeoff that could better explain services trade decisions. In contrast to manufacturing firms, services firms' decision to export via cross-border trade or foreign affiliate sales depends on the cost of communicating information. In particular, in sectors where there are high levels of customer interaction, firms are more likely to choose to serve foreign customers via foreign affiliates, where the customers and services providers are in the same location. On the other hand, in cases where the services provided require complicated activities like creative problem solving, within-firm communication is more important than communication with the customer, and therefore firms will choose cross-border exports, rather than foreign affiliate sales. Using U.S. data on exports and foreign affiliate sales, Oldenski (2012) finds that the degree of interaction with customers is positively related to a both U.S. manufacturing and services sector decisions to engage in trade through foreign affiliates rather than via exports. However, the relationship is a more important explanation for trade decision for services sectors than manufacturing sectors. Additionally, higher degrees of non-routine activities are associated with an increased cross-border trade.

Gravity Models with Services Trade

General Models

Development of gravity models of services trade tends to be less common than gravity models of goods trade, primarily due to limited data on trade in services and limited measures of services trade costs. Despite these limitations, gravity models of services trade have evolved over time, and incorporated new developments in the gravity modeling literature. One of the earliest instances of services gravity models, Freund and Weinhold (2002), find that the level of internet penetration in a country is positively related to trade in business, professional, and technical services. Kimura and Lee (2006) compare the gravity models using goods and services data and find that relative to goods trade, distance and common language have a stronger effect on services trade, while contiguity is less important for services relative to goods. Head et al. (2009) find that commercial services, excluding transport, are more negatively affected by distance than goods. However, over time, distance has a smaller effect on trade in services, which may reflect the increase in tradability of services over time. Mirodout et al. (2013) find that trade costs in services tend to be higher than trade costs in goods.

Anderson, Milot, and Yotov (2014) use a structural gravity model with Canadian province-level internal trade, interprovincial trade, and international trade data to measure the effect of international borders on trade in services. Since Anderson and Yotov (2010) used the same methodology and data to measure the effect of international borders on goods, Anderson, Milot, and Yotov (2014), are able to compare their results in this paper to the previous paper. Overall, the paper finds that services face impediments at the border that are 7 times higher than for goods trade on average, and that the international border between the United States and Canada reduces trade in services to 2.4 percent of the estimated trade value without any border. Using a similar structural gravity framework, with multilateral resistance and internal trade, applied to 12 services sectors, Anderson et al. (2018) find that relative to goods trade, language effects have a much stronger effect on trade in services, while colonial ties are insignificant. The paper also finds that advanced digital infrastructure tends to be associated with lower services trade costs, consistent with the earlier findings of Freund and Weinhold (2002). Consistent with Anderson et al. (2018), Gervais and Jensen (2019) estimate trade costs for U.S. goods and services sectors and find that overall, services sectors tend to face higher trade costs than goods sectors. However, at a disaggregated level, some services sectors have similar trade costs to manufacturing sectors.

STRI Effects and Complements versus Substitutes

In addition to the work described above, previous gravity literature has also considered the relationship between services trade and trade barriers. These papers can be divided into two groups: papers that consider the effect of trade restrictions on services trade generally and those that consider the question of whether cross-border trade and foreign affiliate sales in services are complements or substitutes. While previous research generally finds a negative and significant relationship between trade policy measures and trade flows, results considering the complement/substitute question tend to depend on sectoral aggregation and type of trade flow.

First, several papers focus on the effect of services trade barriers on trade generally. Riker (2014), using the World Bank STRI, finds a negative relationship between the STRI and cross-border trade in transportation, telecommunications and financial services sectors. Nordås and Rouzet (2017) use the 2014 edition of the OECD STRI to estimate its effect on both imports and export levels. The authors find that higher STRI values are negatively associated with services imports, as well as export levels, and suggest that high barriers to services trade in the home market may negatively impact overall performance in that country-sector, thus decreasing exports relative to country-sectors with few restrictions. Nordås (2016) uses the OECD STRI to construct a bilateral index of regulatory heterogeneity for country pairs. The author finds a positive relationship between trade and regulatory similarity, which is related to the overall level of trade restrictions: the effect of regulatory heterogeneity on trade is larger for countries with smaller STRI scores. Ciuriak et al. (2019) measure the difference between a country's commitments under GATS or FTAs relative to its most favored nation (MFN) services policies as measured by the OECD STRI, and find that a reduction in services trade barriers and a reduction in uncertainty about services trade barriers (as captured by trade agreements) both increase services trade. Focusing on digital trade barriers, Ferracane and van der Marel (2018) consider the effect of policies related to cross border movement of data and regulations governing domestic data use, on services exports. The authors find that, conditional on the data intensity of services sectors, there is a negative and significant relationship between more restrictive data policies and cross-border imports of

services. Additional work, including Fontagné et al (2011), Fontagné et al (2016), Benz (2017), and Benz and Jaax (2020) have used gravity frameworks to estimate ad-valorum tariff equivalent rates for services trade.

The question of whether cross-border services trade and foreign affiliate sales are complements or substitutes does not have a clear answer in the literature, with previous work finding evidence of both relationships. Grünfeld and Moxnes (2003) is the first paper to consider the question of whether cross-border trade and foreign affiliate sales in services are complements or substitutes. Using the Trade Restrictiveness Index (TRI) compiled by the Australian Productivity Commission and Australian National University, Grünfeld and Moxnes (2003) find a negative relationship between the TRI and cross-border trade as well as between the TRI and services outward FDI stock. The authors also find a positive relationship between the residuals of their cross-border trade and FDI stock model, which they cite as some evidence of a complementary relationship. Kox and Nordås (2009), using bilateral stocks of FDI as a proxy for foreign affiliate sales, find that regulatory heterogeneity between countries in services sectors is negatively related to foreign affiliate sales, and that cross-border trade and commercial presence tend to be complements. Using data on the German banking sector, Buch and Lipponer (2007) find that cross-border trade and foreign direct investment are complements, rather than substitutes. More recently, Benz (2017) decomposes estimates of ad-valorum tariff rates in services sectors by mode of supply and finds that barriers to mode 3 trade increase trade costs for cross-border trade in construction and courier services, suggesting a complementary relationship. Lamprecht and Miroudot (2020), in assessing the impact of binding existing services trade policies, find evidence of complementarity of modes of supply in professional and financial services and substitution in the telecommunications sector.

In contrast, Riker (2015) uses U.S. foreign affiliate sales data and the World Bank STRI to test the relationship between cross-border exports and FDI in services sector, and finds that higher levels of mode 3 barriers are associated with lower foreign affiliate sales, while higher mode 1 barriers increase foreign affiliate sales, suggesting that, for the services sector as a whole, cross-border trade and foreign affiliate sales are substitutes. Andrenelli et al. (2018) use a gravity model with foreign affiliate sales data to understand the relationship between foreign affiliate output and services trade restrictions, as measured by the OECD STRI. The authors find that for all services, mode 3 restrictions are negatively related to foreign affiliate output, while mode 1 restrictions are positively related to foreign affiliate output, suggesting that affiliate sales are substitutes for cross-border trade. Van Der Marel and Shephard (2013) use a gravity framework covering six aggregated services sectors to assess the relationship between cross-border services trade and Mode 1 and Mode 3 trade barriers as measured by the World Bank STRI. Van der Marel and Shephard (2013) find that across total services, higher mode 1 restrictions are associated with smaller trade flows, but mode 3 restrictions are associated with stronger trade flows. This suggests that services firms, facing restrictions to establishment and operations of foreign affiliates may be substituting away from trade through affiliates toward trade in cross-border services. However, when estimations are disaggregated across services, only transport services show evidence of substitution while results for business, finance, and insurance services suggest complementary between modes 1 and 3.

Our paper builds on the finding of potential complementarity across modes of services trade found in Van der Marel and Shephard (2013) by testing the relationship for a disaggregated group of services, across multiple years of data on services trade restrictions. Our paper also builds on the methodology in

Benz and Jaax (2020) by applying a similar structural gravity model to disaggregated services sectors and disaggregating the OECD STRI by mode-specific barriers.

Methodology

As demonstrated in Arkolakis et al (2012), structural gravity can be derived from a large class of underlying models, including notable work by Eaton and Kortum (2002) and Anderson and van Wincoop (2003). This paper follows the demand-driven approach developed in Anderson and van Wincoop (2003), incorporating importer and exporter-time fixed effects to control for multilateral resistance (Feenstra 2002), along with more recent innovations such as including both internal and external trade (Anderson and van Wincoop 2003, Heid et al 2015), and use of a poisson pseudo-maximum likelihood (PPML) estimator (Santos Silva and Tenreyro, 2006).

The structural gravity model is given by the following system of three equations:

$$X_{ij}^{s} = \frac{Y_i^s E_j^s}{Y^s}\left(\frac{t_{ij}^s}{\Pi_i^s P_j^s}\right)^{(1-\sigma_s)} \ \forall\, i,j; \quad (1)$$

Equation 1 defines the trade relationship between an exporting country (*i*) and importing country (*j*), which holds for all potential country-pairs. X_{ij}^{s} represents the value of cross-border service shipments in sector (s) from country i to county j. Y_i^s represents the total sales of service s by country i to all other destinations, while Y^s represents total world output of service s. E_j^s represents total spending on service s on country j, accounting for total demand for service s in country j. t_{ij}^s represents the country-pair specific trade cost associated with exporting service s from country i to country j. $\Pi_i^s \; and \; P_j^s$ represent outward and inward multilateral resistance, which aggregate all of exporter i and importer j specific trade costs as they export and import service s in the world market. The trade costs and multilateral resistance terms are raised to 1-σ_s, which represents the elasticity of substitution between country sources for service s. The multilateral resistance terms are further defined in equations 2 and 3:

$$(\Pi_i^s)^{(1-\sigma_s)} = \ _j\left(\frac{t_{ij}^s}{P_j^s}\right)^{(1-\sigma_s)} \frac{E_j^s}{Y^s} \ \forall\, i; \quad (2)$$

$$(P_j^s)^{(1-\sigma_s)} = \ _i\left(\frac{t_{ij}^s}{\Pi_i^s}\right)^{(1-\sigma_s)} \frac{Y_i^s}{Y^s} \ \forall\, j; \quad (3)$$

Outward multilateral resistance, as defined in equation 2, sums the total trade costs exporter i faces when exporting to all other markets, including bilateral costs (t_{ij}^s), trade costs faced by consumers in each destination market (P_j^s), total spending on service s in each destination, and total production of service s. Inward multilateral resistance, as defined in equation 3, similarly sums total trade costs faced when country j imports from all other markets, including bilateral costs, trade costs faced by exporters in each origin market (Π_i^s), production of service s in each market and total production of service s.

To move from a theoretical to empirical specification, the variables in (1-3) correspond to a relatively simple specification. Importer and Exporter multilateral resistance terms are accounted for using country-year fixed effects, which also capture the total output (Y) and expenditures (E) for each importer and exporter. Country-pair fixed effects can also capture all bilateral trade costs (t). However, since our variable of interest, the OECD STRI, is cataloged on an MFN basis rather than bilaterally, we are

unable to incorporate country-pair fixed effects into our model, due to a lack of variation. Instead, we use an approximation of country-pair trade costs common to gravity literature: distance, contiguity, common language, and colonial relationship. Since the OECD STRI does not capture bilateral trade agreements between country pairs, we also include dummy variables for services-specific trade agreements and European Economic Area (EEA) membership. Consistent with Benz and Jaax (2020), we include within-country trade to allow for unbiased estimation of multilateral policy using the OECD STRI.[9] Our baseline empirical specification, estimated separately for each sector, is given in equation 4:

$$Exports_{ijt}^{s} = exp(\beta_0 + \beta_1 Border_{ij} + \beta_2 Border_{ij} * STRI_{jt}^{s} + Z_{ijt} + \eta_{it} + \delta_{jt}) + \varepsilon_{ijt}^{s} \quad (4)$$

In equation 4, *Border* equals one if exports from country *i* to country *j* crosses an international border[10], *and Border*STRI* represents the interaction between international trade and sector-specific STRI score of the importing country *j*. Z_{ijt} is a vector of bilateral gravity covariates, and includes: *log(distance),* which captures the distance between country-pairs, *contiguity*, which equals one if country-pairs share a common border, *common language,* which equals one if country-pairs share a common language, *colony*, which equals one if country-pairs share a colonial relationship, *services PTA*, which equals one if country-pairs have a preferential trade agreement covering services in a given year, and *EEA member*, which equals one if the country pairs both belong to the EEA in a given year. η_{it} controls for exporter-year fixed effects, δ_{jt} controls for importer-year fixed effects, while ε_{ijt}^{s} represents the error term.

The Border*STRI variable represents the primary variable of interest and measures the impact of the STRI on international service sector trade relative to internal trade. In addition to this baseline specification, we also decompose the Border*STRI variable by mode of supply and category of measure. Equation 5 shows the empirical specification for STRI by mode of supply, which subdivides the STRI into four categories: barriers to all modes, mode 1 barriers, mode 3 barriers, and mode 4 barriers. In our data, barriers to all modes, mode1 barriers and mode 4 barriers should directly impact cross-border trade, as mode 1 (remote cross-border trade) and mode 4 (temporary movement of people) services trade are components of the larger cross-border category. Mode 3 barriers, which relate to foreign direct investment, could have an indirect impact on cross-border trade. If cross-border trade and foreign direct investment are substitutes, we expect β_{M3} to be positive, suggesting that cross-border trade *increases* when barriers to investment are high. If cross-border trade and foreign direct investment are complements, we expect β_{M3} to be negative, suggesting that barriers that limit foreign direct investment also limit cross-border trade.

[9] The OECD STRI includes both discriminatory policies (which affect foreign providers) and non-discriminatory policies (which affect all providers). Our conceptual framework assumes the STRI is designed to measure only the restrictiveness of international trade and does not apply to internal trade, because non-discriminatory policies likely have disproportionate impacts on foreign services providers. Additionally, we find no consistent relationship between discriminatory and non-discriminatory policies and trade.

[10] In this framework, international trade occurs when exporter i ≠ importer j, and within-country trade occurs when i=j.

$$Exports_{ijt}^{s} = exp(\beta_0 + \beta_1 Border_{ij} + \beta_{AM} Border_{ij} * STRI\_AllModes_{jt}^{s} + \beta_{M1} Border_{ij} * STRI\_Mode1_{jt}^{s} + \beta_{M3} Border_{ij} * STRI\_Mode3_{jt}^{s} + \beta_{M4} Border_{ij} * STRI\_Mode4_{jt}^{s} + Z_{ijt} + \eta_{it} + \delta_{jt} + \varepsilon_{ijt}^{s}$$

(5)

Equation 6 shows the empirical specification for STRI by category of measure, which subdivides the STRI in to five categories: restrictions on foreign entry, restrictions on movement of people, other discriminatory measures, barriers to competition, and regulatory transparency.

$$Exports_{ijt}^{s} = exp(\beta_0 + \beta_1 Border_{ij} + \beta_{CAT1} Border_{ij} * STRI\_ForeignEntry_{jt}^{s} + \beta_{CAT2} Border_{ij} * STRI\_MovtPeople_{jt}^{s} + \beta_{CAT3} Border_{ij} * STRI\_OtherDisc_{jt}^{s} + \beta_{CAT4} Border_{ij} * STRI\_BarriersCompetition_{jt}^{s} + \beta_{CAT5} Border_{ij} * STRI\_RegTransparency_{jt}^{s} + Z_{ijt} + \eta_{it} + \delta_{jt}) + \varepsilon_{ijt}^{s}$$

(6)

More details on the STRI and its mode and measure specific decompositions are presented in the next section.

Data Sources and Description: Trade, Trade Policy, and Trade Covariates

The analysis in this paper uses three principal sources for data on (i) trade, (ii) trade policy, and (iii) trade covariates. Each data source is described below.

OECD's International Trade in Services Statistics (ITSS) is the source for trade data. Specifically, the analysis uses export data over the years 2014-2018 from the ITSS by Partner Country dataset. Following Anderson et al. (2014) we prioritize export flows, but where export data is not available, we supplement it with reported import flows. The export data is available for OECD and select non-OECD countries with partner counties across the world. Data is categorized by Extended Balance of Payments Services Classification 2010 (EBOPS 2010). In order to measure within-country trade, we supplement this data using national accounts production data.[11] We exclude financial services from our analysis due to a lack of a consistent measure of total output in financial services across different data sources. Data where trade flows are negative (49 observations) are replaced with zeros, as these negative values likely represent errors in measuring or recording individual trade data flows.

OECD's Services Trade Restrictiveness Index (STRI) is the source for trade policy data. As with the export data, the analysis uses STRI data over the years 2014-2018. The data is available for 45 countries (OECD countries, as well as Colombia, Costa Rica, Brazil, China, India, Indonesia, Malaysia, Russia, South Africa) categorized by International Standard Industrial Classification (ISIC) code across 22 services industries. The STRI scores are reported per country/sector and range from 0 ("complete openness to trade and investment") to 1 ("completely closed to foreign services providers"). Additionally, selected policies in

[11] See Data Appendix for details on supplemental data sources.

the STRI are scored separately for some subsectors, for example for the fixed and wireless segments of the telecommunications industry. However, only overall STRI scores are used in the analysis.

Five separate sub-classifications of the STRI are available and included in separate gravity estimations. The sub-classifications presented in this paper include those by category of restrictions (restrictions to foreign entry, restrictions to movement of people, other discriminatory measures, barriers to competition, and regulatory transparency) and by modes of supply (mode 1, mode 3, mode 4, and all modes).

For the purposes of merging the OECD STRI and export data, STRI services categories were assigned EBOPS codes. Table 1 lists the OECD STRI services industries included in our sample and the EBOPS categories assigned to each STRI category. Table 2 shows, for example, that the air transport STRI matches to EBOPS SC2. STRIs for motion picture and sound recording were averaged and matched with EBOPS SK1 while STRIs for logistics services were averaged and matched with EBOPS SC3G. Additionally, while the STRI is available separately for telecommunications and broadcasting, the export data (EBOPS SI1) includes both services; as such the trade data was split between the two categories based on telecommunications and broadcasting sector shares in U.S. cross-border services export data.

Table 2 OECD STRI Services Categories and EBOPS 2010

SI1B and SI1T are categories created for the purposes of the regression analysis. SI1 was split into broadcasting and telecom based on the relative size of each sector's cross-border exports in U.S. trade statistics, with 11% of SI1 assigned to SI1B and 89% f of SI1 assigned to SI1T.

STRI Sector	EBOPS 2010 Item and Description
Maritime Transport	SC12 - Freight (Sea)
Air Transport	SC2 - Air transport
Rail Freight Transport	SC3B2 - Freight (Rail)
Road Freight Transport	SC3C2 - Freight (Road)
Logistics, cargo handling	SC3G - Other supporting and auxiliary transport services
Logistics, customs brokerage	SC3G - Other supporting and auxiliary transport services
Logistics, freight forwarding	SC3G - Other supporting and auxiliary transport services
Logistics, storage and warehouse	SC3G - Other supporting and auxiliary transport services
Courier	SC4 - Postal and courier services
Construction	SE - Construction
Insurance	SF - Insurance and pension services
Broadcasting	SI1B*- Telecommunications services includes telecom and broadcasting, split sector
Telecommunications	SI1T*- Telecommunications services includes telecom and broadcasting, split sector
Computer	SI2 - Computer services
Legal	SJ211 - Legal services
Accounting	SJ212 - Accounting, auditing, bookkeeping, and tax consulting services
Architecture	SJ311 - Architectural services
Engineering	SJ312 - Engineering services
Motion pictures	SK1 - Audio-visual and related services
Sound recording	SK1 - Audio-visual and related services

Finally, the Dynamic Gravity Dataset (Gurevich and Herman, 2018) is the source for geographic, cultural, and trade facilitation variables. Each variable included in the analysis is listed in table 3, below.

Table 3 Trade covariates

Colony variables are collapsed into one variable capturing all country pair colonial ties; EEA membership expands the EU membership variable in Gurevich and Herman (2018) to a variable indicating EEA membership (EU countries plus Iceland, Liechtenstein and Norway).

Variable	Description
Contiguity	Country pair shares a common border
Distance	Population weighted distance between country pair
Common Language	Residents of country pair speak at least one common language
Colony of Destination Ever	Origin country was ever a colony of the destination country
Colony of Origin Ever	Destination country was ever a colony of the origin country
Agree PTA Services	Country pair is in at least one active preferential trade agreement covering services
Member EEA	Origin/destination country is a European Economic Area (EEA)

Taken together, these three data sources allow us to estimate the effect of the STRI on trade for 14 distinct sectors across, four years of data and 45 countries, summarized in table 4. We combine broadcasting and audiovisual services, and architecture and engineering in our regressions. Overall, each sector has between 2,000 and 10,000 observations. The largest export sector, in terms of total value is construction, while the most restricted sector on average is air transport.

Table 4 Summary statistics

	Number of observations	Average export value (millions $)	Average STRI value
Air transport	5,986	360	0.44
Legal services	4,818	1,547	0.36
Accounting	4,664	416	0.30
Rail freight transport	2,087	119	0.29
Broadcasting and Audiovisual services	9,446	2,032	0.26
Maritime transport	4,042	494	0.26
Postal and courier	3,240	477	0.26
Logistics services	3,334	986	0.25
Architecture and engineering	4,789	415	0.25
Computer services	6,079	1,705	0.24
Construction	4,849	4,241	0.23
Insurance	5,752	2,309	0.22
Telecom	5,858	978	0.22
Road freight transport	4,573	731	0.20
Total	69,517	1,201	0.27

Source: Authors' calculations.

One concern with using this data to test whether cross-border trade and FDI are complements or substitutes is that if barriers to cross-border trade are correlated with barriers to trade via foreign affiliate sales (mode 3 barriers), a negative relationship between mode 3 barriers and cross-border trade may only be capturing the effect of the overall regulatory environment, rather than indicating whether cross-border trade and foreign affiliate sales are complements or substitutes. Table 5 presents correlation between different types of trade barriers classified by mode of supply. As shown in this table, for the data in our sample, there is little correlation between barriers categories by mode of supply.

Table 5 Correlations of STRI barriers by mode of supply

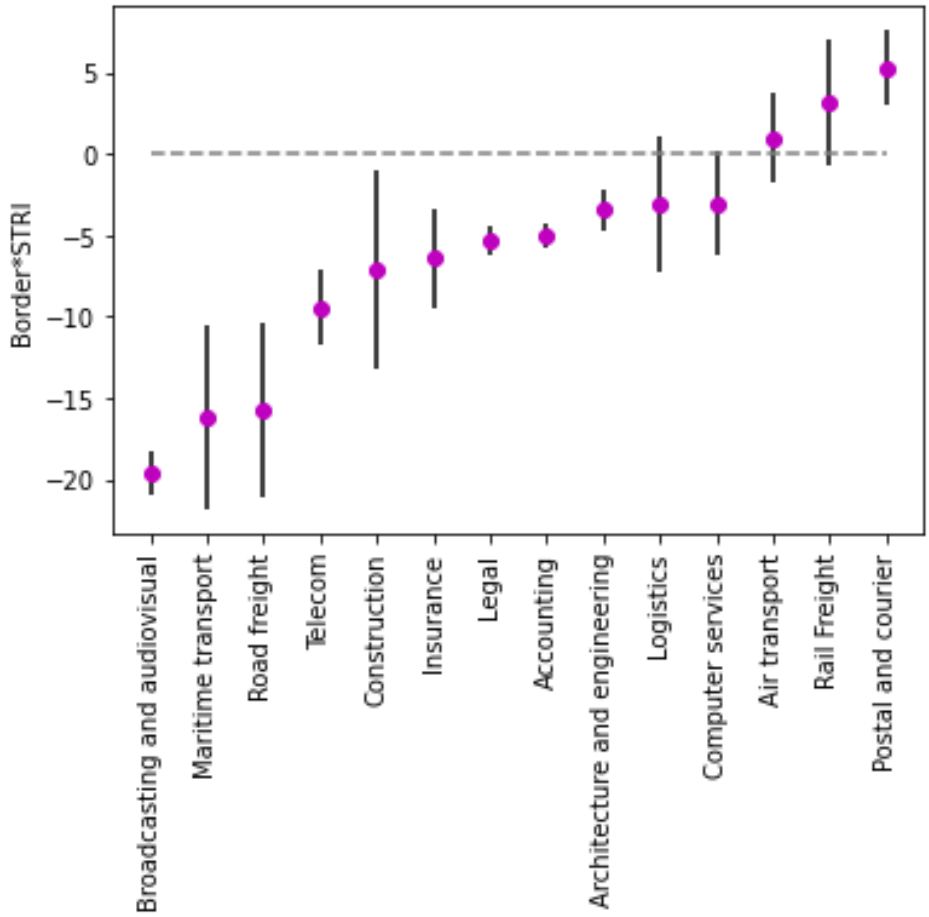
	STRI All Modes	STRI Mode 1	STRI Mode 3	STRI Mode 4
STRI All Modes	1			
STRI Mode 1	-0.034	1		
STRI Mode 3	0.66	0.15	1	
STRI Mode 4	0.043	-0.18	0.097	1

Results and Sector-Specific Discussion

There are three important takeaways in our results across all of the 14 sectors covered in our data, as summarized in figures 2–4 (full regression results by sector are presented later in this section). First, for the majority of the sectors covered, there is a negative and significant relationship between the STRI and cross-border trade, indicating that more restrictive trade policy depresses cross border trade. For three sectors (logistics, air and rail transport) there is no relationship between the overall STRI and trade, while for postal and courier services, the relationship is positive and significant. Figure 2 compares gravity model results by sector for the estimated coefficient on the Border*STRI variable in equation 4 (which captures the effect of the STRI on trade relative to internal trade), along with the associated 95 percent confidence interval for each estimate. Broadcasting and AV services sees the largest negative relationship, while legal and accounting services estimates show the most precise estimations of effects, as shown by the size of their associated confidence intervals.

These findings are in line with the findings of Benz and Jaax (2020), who consider the effect of the STRI on a pooled cross-section from 2014–2018, as well as a panel estimation. The reported sector specific results show a negative and significant impact of the services trade restrictions on bilateral services trade for each sector (relative to domestic services consumption)–with coefficients ranging from -3.5 in transport services to -7.3 in financial service in their main specification. In their panel estimation, the interaction between the border variable and the STRI, while always negative, is only significant in two of the five sectors.

Figure 2 Regression coefficients on Border*STRI value, by sector



Note: The coefficients reported in this figure correspond to the regression specification presented in equation 4.

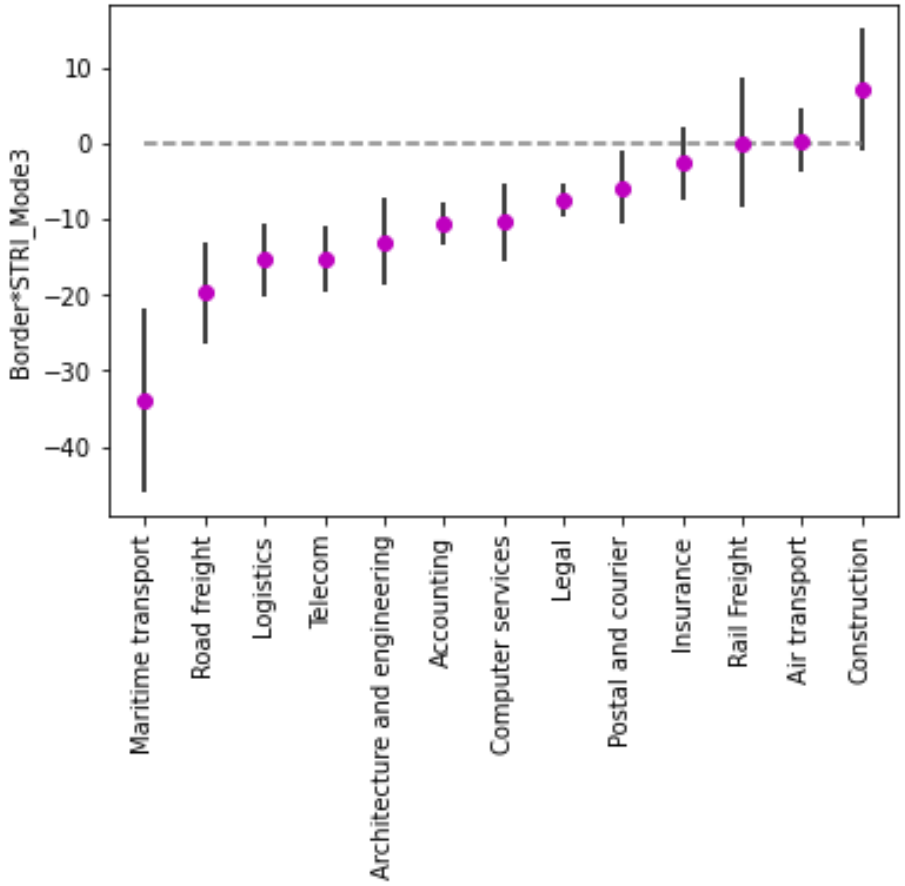
Second, figure 3 shows that for 9 of the 13 sectors where the STRI by mode of supply is available, there is a negative and significant relationship between barriers to foreign affiliate sales (the mode 3 STRI) and cross-border trade (equation 5). The remaining sectors in our data show no relationship between mode 3 barriers and cross-border trade at the 95% confidence level. This result suggests that for sectors where mode 3 barriers are a significant predictor of cross-border trade, there is a complementary relationship between cross-border trade in services and trade via foreign affiliate sales. This result suggests that for these services, the proximity-concentration hypothesis does not hold.

This diversity in the types of services provided within each services sector can help explain the trends present in figure 3. Within each sector where there is a negative relationship between restrictions on foreign affiliate sales and cross-border trade, firms provide a suite of services to their customers that are not substitutes for one another. As outlined in Oldenski (2012), services providers interact directly with customers for some of services they provide (customer service, project monitoring, installation, sales), but other services require complicated problem-solving and are more easily provided cross-border (development of new products, data analysis, design services). Typically, the central office of a services firm provides the complex problem-solving expertise for clients cross-border, while the foreign affiliates tailor this expertise for the specific market. In transportation, the physical movement of goods from one

country to another is not a substitute for a commercial presence that coordinates shipments with customers. In architecture and engineering, plans can be drafted in a central office, but still need local presence to monitor the construction of buildings. In other professional services, a central office can provide broad advice, but a foreign affiliate with local credentials, and knowledge of local language and regulations can adapt this advice to a specific market context. In computer services, a central office can develop and deploy new software products, but a local presence can help sell and provide customer service for that software.

On the other side, where we do not see a significant relationship between barriers to trade in foreign affiliate sales and cross-border trade, services sectors are limited in their need for providing cross-border services (construction, property and casualty insurance), or completely unable to provide services within a foreign country via foreign affiliate sales (air transport).

Figure 3 Regression coefficients on Border*STRI_mode3, by sector

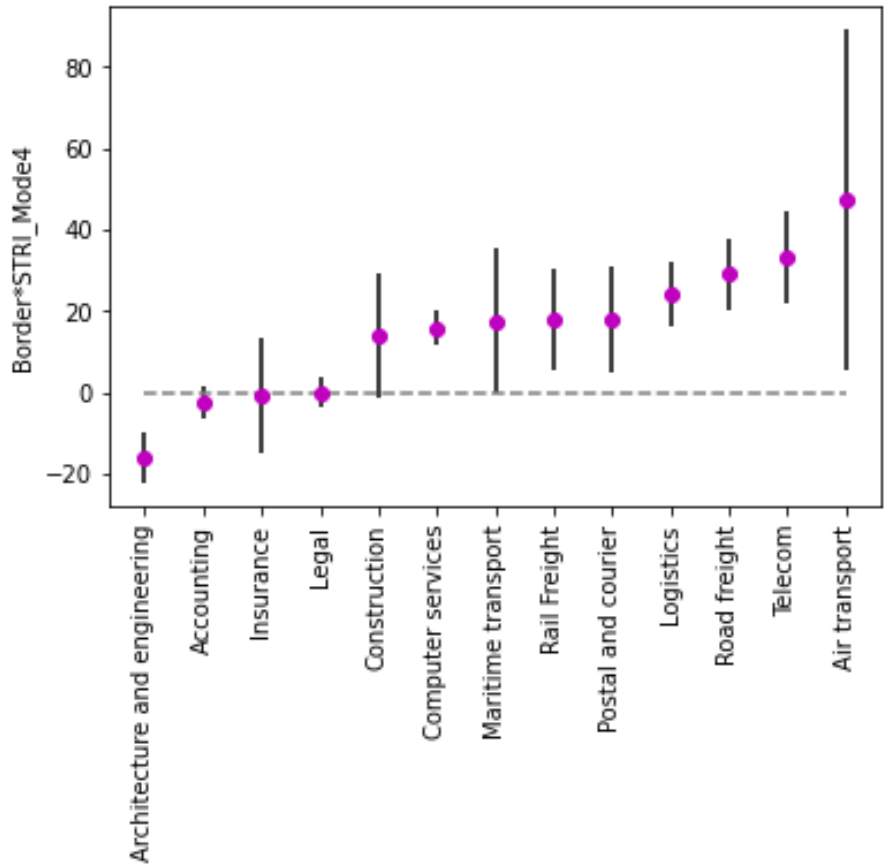


Note: Audiovisual and Broadcasting services STRI do not include breakouts by mode of supply. The coefficients presented in this figure correspond to the regression specification presented in equation 5, and includes controls for mode 1, mode 4 and all mode barriers, as well as standard gravity covariates.

A third trend in our results by mode of supply (equation 5) show a surprising relationship between mode 4 trade barriers (barriers to temporary movement of persons) and cross border trade. In a majority of sectors covered, there is a positive and significant relationship between mode 4 barriers and cross-border trade, indicating that countries with more restrictions on temporary entry of foreign nationals

tend to have more cross-border trade. This result is surprising because cross-border trade data includes trade via mode 4, and could potentially be identifying unobserved mode switching between mode 1 and 4, as firms choose to provide services remotely in countries with more restrictive mode 4 barriers where they would otherwise send individuals to the country absent mode 4 barriers. In recent months, the COVID-19 pandemic has also demonstrated the substitutability of mode 1 and mode 4 trade flows, as services providers, facing travel restrictions, have been forced to shift to an online model of services delivery. However, due to the inability to disentangle the share of mode 1 and mode 4 trade flows in existing data, this result functions more as a motivation for further study of mode 1/mode 4 dynamics than a conclusive result.

Figure 4 Regression coefficients on Border*STRI_mode4, by sector



Note: Audiovisual and Broadcasting services STRI does not include breakout by mode of supply. The underlying regression in this figure corresponds to equation 5, and includes controls for mode 1, mode 4 and all mode barriers, as well as standard gravity covariates.

The remainder of this section discusses sector-level results in detail, focusing on the relationship between the STRI and trade as a whole, by mode of supply, and by category of measure.

Telecom, Computer, and Insurance

Across all modes of supply, mode 3 trade is likely the largest mode of supply for computer, telecommunications, and insurance services. However, differences in data collection, data suppression issues, and within sector heterogeneity of services provided make definitive characterizations of total

trade difficult in these sectors. While many of the activities that fall under computer services, such as electronic delivery of software, do not require physical presence to export, other services, such as cloud infrastructure tend to benefit from local infrastructure to improve customer experience. Trade in computer services could also occur via mode 4, as programmers temporarily travel to a client to develop custom computer systems or software. The dynamic nature of this sector can make it difficult to precisely distinguish mode 3 computer services activities. For example, a company like Apple, which produces both software and electronic devices, may appear in cross-border services export data, but not in data on foreign affiliate sales of software. Despite these data limitations, Kirkegaard (2008) and Mann (2019) both find that mode 3 trade is a key avenue for trade in computer services.

Telecommunications services tend to be provided via large multinational firms, which means that while mode 3 trade is a prominent source of trade in this sector, data on foreign affiliate sales are frequently not reported to avoid disclosing confidential information on the activities of individual companies (USITC, 2017, 92). Finally, in insurance, the type of insurance traded is likely to affect the level of services supplied via cross-border. Typically, reinsurance can be traded cross-border without a corresponding local presence in a market, while a local presence is required for life and non-life insurance to be provided on a cross-border basis. As a result, the composition of cross-border trade of a particular country is likely to influence the effect of the STRI on cross-border insurance trade. For example, in 2017, 80 percent of U.S. cross-border insurance exports were reinsurance exports, while for the EU, only 28 percent of cross-border insurance exports were in reinsurance (OECD, TISS).

Telecommunications, computer and insurance services, while not necessarily similar in the type of services they provide, are all data intensive industries for which cross-border trade is likely predominantly mode 1. Table 6 presents estimates of the share of mode 1 trade captured in total cross-border trade statistics in the United Kingdom and United States for insurance and computer services, as well as a larger aggregate that includes telecommunications services. In each case, survey respondents indicated that at least 80 percent of their cross-border trade was captured in mode 1.

Table 6 Estimates of mode 1 services share in cross-border exports, insurance, telecommunications, and computer services

Sector (country source)	Share of cross-border exports attributed to mode 1 trade, %
Insurance and pension services (UK)	84
Telecom, computer, and information services (UK)	85
Computer services (U.S.)	80

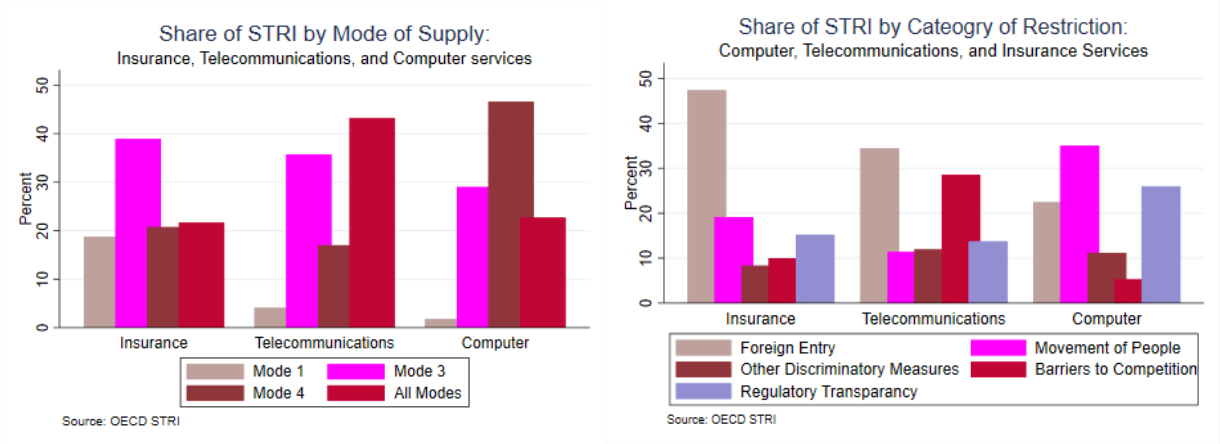
Source: Mann 2019, Mann and Cheung 2019.

STRI by Category of Restriction and by Mode

Figure 5 shows the average contribution of trade barriers in the STRI by the mode of supply, for our sample of countries with trade flows and STRI values. In insurance services, mode 3 restrictions, such as foreign equity limits, and restrictions on cross-border trade without a local presence, represent the largest share of trade barriers. In addition to trade barriers, the insurance sector overall tends to be highly regulated for prudential reasons, which despite being necessary for consumer protection and financial stability, can nevertheless potentially limit trade (Rouzet et. al, 2014).

Mode 3 restrictions are also important for telecommunications services, though policies that affect all modes of supply are most prominent in our sample of telecommunications trade. Key trade barriers in telecommunication include limits on cross-border mergers and acquisitions, foreign branch limits, and data flow restrictions. In computer services, restrictions on mode 1 trade, such as data flow restrictions, make up a relatively small share of all barriers, while mode 4 restrictions, including limitations on temporary entry are the largest category of barriers (OECD, 2018).

Figure 5 Trade barriers by mode of supply and category of restriction, computer, telecommunications and insurance services



The breakdown of the STRI by category of restriction in our sample reflects the distribution of trade barriers by mode of supply and is shown in figure 5. For insurance services, barriers to foreign entry is the most prominent type of barrier faced by exporters. For telecommunications, barriers to foreign entry and barriers to competition make up the largest shares of total trade barriers, with barriers to competition representing a combination of barriers that apply to mode 3 and all modes (Nordås et al, 2014). For computer services, restrictions on the movement of people represents the largest share of restrictions, though regulatory transparency and foreign entry restrictions are also relatively large categories.

Table 7 presents regression results for the insurance, computer services and the telecommunications services. For each sector, results include the baseline STRI specification, the STRI by mode of supply, and the STRI by category of restriction. Discussion of sector specific results are presented briefly below, with different specifications identified by column number.

Insurance Services Results

Overall, the STRI for all types of services trade has a negative and significant effect on trade in insurance, suggesting that non-tariff measures generally decrease trade in insurance services (column 1). However, as seen in column 2, barriers by mode of supply do not significantly affect trade in insurance services, aside from the barriers that affect all modes, which means we cannot definitively determine whether cross-border trade and foreign affiliate sales in insurance are complements or substitutes. This result could reflect the bifurcated nature of insurance services, which tends to have different barriers based on the type of insurance provided. Reinsurance services, which pool and distribute risk globally tend to face

few barriers to cross-border trade. On the other hand, property and casualty and life insurance tend to be prohibited from conducting cross border trade without also establishing a commercial presence in a country. Column 3 shows that restrictions on foreign entry, movement of people and barriers to competition all have a negative and significant effect on trade, despite the lack of mode-specific effects. Distance has a negative and significant effect on insurance trade, while common language is positively related to trade.

Computer Services Results

Columns 4-6 in table 7 present results for the computer services sector. Overall, the STRI has a negative and significant effect on trade in computer services (column 4). Considering the results by mode of supply (column 5), increased levels of mode 3 trade barriers are associated with a significant decrease in cross-border trade. This suggests that in the computer services sector, cross-border trade may complement mode 3 trade. Interestingly, there is a large negative effect of mode 1 restrictions on trade, while an increase in mode 4 barriers in computer services increases cross-border trade in the computer services sector. Since our data includes both mode 1 and mode 4 trade, it is difficult to give a definitive reason for these diverging signs. However, the difference in signs across these two coefficients could suggest that when barriers to mode 4 trade increase, computer services exporters shift to providing services via mode 1. This conjecture is further supported by the results of column 6, which show that restrictions on movement of people (which are primarily mode 4 restrictions) are the only type of restrictions that tend to increase trade in computer services. Across all three regressions, distance has a negative and significant effect on trade, while contiguity and EEA membership have a positive relationship to trade.

Telecommunication Services Results

The STRI has a negative and significant effect on trade in telecommunications (table 7, column 7). Considering the results by mode of supply (column 8), for telecommunications increased levels of mode 3 trade barriers are associated with a significant decrease in cross-border trade. This suggests that in the telecom services sector, cross-border trade may complement mode 3 trade. As in computer services, mode 1 restrictions have a large negative effect on trade, while mode 4 restrictions are positively related to cross-border trade. While it is difficult to give a definitive reason for these diverging signs, this result could suggest that higher barriers to mode 4 trade lead telecom exporters to shift to providing more services via mode 1. This conjecture is further supported by the results of column 9, which show that restrictions on movement of people tend to increase trade in telecom services. As expected, distance has a negative effect across specifications, while common language and colonial ties are positively related to trade. This is not surprising given the infrastructure-heavy nature of telecommunications services.

Table 7 Regression results, insurance, computer and telecommunications services

	Insurance			Computer Services			Telecommunications Services		
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Trade value	Baseline	By mode	By category	Baseline	By mode	By category	Baseline	By mode	By category
Border	-3.265***	-3.368***	-3.307***	-3.038***	-3.433***	-3.071***	-2.624***	-4.955***	-3.975***

	Insurance			Computer Services			Telecommunications Services		
	[0.702]	[0.669]	[0.822]	[0.498]	[0.426]	[0.482]	[0.354]	[0.332]	[0.431]
Border*STRI	-6.409***			-3.011*			-9.442***		
	[1.554]			[1.639]			[1.163]		
Border*STRI_All Modes		-20.27***			-13.93***			9.886***	
		[6.290]			[3.184]			[1.868]	
Border*STRI_Mode 1		3.514			-120.6***			-73.49***	
		[5.840]			[13.51]			[5.913]	
Border*STRI_Mode3		-2.590			-10.45***			-15.30***	
		[2.433]			[2.587]			[2.218]	
Border*STRI_Mode4		-0.802			15.84***			33.11***	
		[7.175]			[2.214]			[5.750]	
Border*Foreign entry			-7.856***			-4.805			-25.67***
			[2.518]			[3.013]			[2.826]
Border*Movement of People			-32.93***			20.69***			34.86***
			[8.352]			[2.760]			[6.964]
Border*Other discriminatory			43.41***			-24.32***			-1.428
			[12.66]			[4.015]			[9.676]
Border*Barriers to competition			-35.52***			-37.17***			10.62***
			[7.146]			[8.355]			[2.698]
Border*Regulatory transparency			21.08***			-10.86***			-12.95**
			[6.684]			[3.363]			[5.899]
Log(distance)	-0.801***	-0.804***	-0.769***	-0.783***	-0.793***	-0.857***	-1.126***	-1.139***	-1.170***
	[0.137]	[0.138]	[0.144]	[0.0907]	[0.0753]	[0.0810]	[0.0789]	[0.0633]	[0.0672]
Contiguity	-0.109	-0.0840	-0.106	0.321*	0.399***	0.220	-0.0619	0.0705	-0.0388
	[0.304]	[0.286]	[0.285]	[0.189]	[0.144]	[0.157]	[0.200]	[0.144]	[0.151]
Common language	0.829***	0.768***	0.634***	-0.202	-0.247*	-0.0175	0.205	0.422***	0.436***
	[0.261]	[0.258]	[0.245]	[0.155]	[0.138]	[0.141]	[0.136]	[0.104]	[0.116]
Colony	0.0733	-0.0979	0.0151	0.158	-0.136	0.133	0.740***	0.966***	1.503***
	[0.528]	[0.535]	[0.563]	[0.288]	[0.284]	[0.264]	[0.191]	[0.221]	[0.269]
Services PTA	-0.239	-0.448	-0.470	-0.244	-0.721***	-0.392**	0.0766	0.118	0.400**
	[0.285]	[0.332]	[0.289]	[0.186]	[0.188]	[0.196]	[0.133]	[0.155]	[0.164]
EEA member	0.592	0.814	1.036*	0.791**	1.461***	0.880***	-0.191	-0.411	-0.689**
	[0.705]	[0.661]	[0.560]	[0.370]	[0.332]	[0.335]	[0.249]	[0.275]	[0.278]
Number of Observations	5734	5734	5734	6079	6079	6079	5754	5806	5806
AIC	988.2	992.2	992.2	974.2	972.2	976.2	1056.1	1070.1	1074.1

Standard errors, clustered at the country-pair level, in brackets
*** p<0.01, ** p<0.05, * p<0.1
Intercept, importer-year and exporter-year fixed effects not reported.

Transportation and Related Services

Mann (2019) estimates that about 66 percent of all trade in U.S. transportation services is conducted via mode 1. While Mann's estimates assume 100 percent of all cross-border trade is mode 1, survey data from the UK ONS suggests that 65% of cross-border trade in UK transportation services is mode 1 (Mann and Cheung 2019). While this still represents the majority of cross-border trade, the share of

transportation services trade that is delivered via mode 1 is smaller than the share of more data intensive industries, such as computer services and insurance. Whether due to characteristics of the industry or because of specific restrictions, other modes likely support mode 1 trade. For example, as cabotage (domestic point-to-point transport services) are typically closed to foreign firms, modes 3 and 4 trade in air transport services is likely to consist of support services, such as sales and marketing offices (USITC, 2017, 104–106).

Logistics, and postal and courier services trade by mode of supply do not have estimates for trade by mode of supply in either Mann (2019) or Mann and Cheung (2019). However, in the WTO's recent data release of trade in services by mode of supply, industry experts indicated that mode 1 is the primary mode of cross-border supply for both sectors. Since postal services in particular historically include public sector entities (such as the USPS), that may limit the ability of firms to conduct trade via foreign affiliates (Sugie, et al. 2015).

STRI by category of restriction and by mode

The STRI for air and road transport do not cover mode 1 barriers to trade, although these services are primarily traded via cross-border means, as discussed above. While the STRI for air transport includes passenger and freight transport, the other transport sectors refer only to freight. The level of restrictiveness across transport sectors varies, with air transport the most heavily restricted of all services captured in the OECD STRI and in our sample and road freight the most liberal across countries in our sample, while sea and rail freight services falling in the upper mid-range in terms of restrictiveness.[12]

The most prevalent category of restrictions for air transport are the OECD STRI categories "foreign entry of firms" and "barriers to competition"—and by mode involve mode 3 and restrictions affecting all modes (figure 6). While the foreign entry category includes mode 3 restrictions such as foreign equity participation, barriers to competition includes mode 3 restrictions such as public ownership in aviation as well as restrictions affecting all modes of trade. Foreign entry and movement of people are the most restricted categories for sea freight—with foreign entry including a variety of restrictions (for example, on cabotage) affecting multiple modes which likely results in the even share of mode specific barriers for this sector. Foreign entry is also prevalent in rail freight—the restrictions in this category are largely related to mode 3 provision (which is likely related to mode 3's highest share of the STRI by mode in this sector). However, barriers to competition and regulatory transparency figure prominently in rail freight as well and include sector-specific regulations and competition policy. Finally, foreign entry and movement of people are the most heavily weighted categories in road freight and relatively equal shares are accounted by modes 3, 4, and all modes; overall, the restrictions included in the STRI (excluding mode 1 trade) are relatively open in this sector (Grosso et al. 2014, 6–7, 75–81).

The STRI for logistics services is reported separately and varies across the four categories: cargo-handling, storage and warehousing, freight transport agency services, and customs brokerage services (see OECD 2020, figure 3). However, in order to match the trade data, STRI values are averaged across these sectors. Foreign entry and barriers to competition appear to be significant categories for the averaged logistics services as reported below (see figure 7)—these categories include public control of

[12] However, the positions of air and road transport services would be altered if mode 1 provision were included. Also see OECD (2020) (Figure 3) for slight differences across broader sector grouping and countries in the OECD STRI database.

companies and provisions preventing foreign participation in publicly controlled companies (most prevalent at certain facilities in cargo-handling services and storage and warehouse services). Restrictions scored under regulatory transparency (such as customs procedures and visa processes) are common to all four areas of logistics services. Nationality and residency requirements included in the category restrictions on the movement of people are required by some countries (e.g. in customs brokerage). By mode of supply, foreign equity restrictions or certain screening requirements, among others, account for mode 3 provisions, while provisions categorized under barriers to competition and regulatory transparency (including some of those discussed above) affect all modes of trade (Sugie, K. et al. 2015).

Finally, policies in the STRI categories foreign entry and barriers to competition are prominent in postal and courier services, given restrictions on foreign investment in and statutory monopoly requirements for some segments of service delivery. These and related policies also contribute to the prevalence of mode 3 restrictions while domestic regulation (including those on logistics services) affect all modes of trade (Grosso et al. 2014).

Figure 6 Trade barriers by mode of supply and category of restriction, transportation

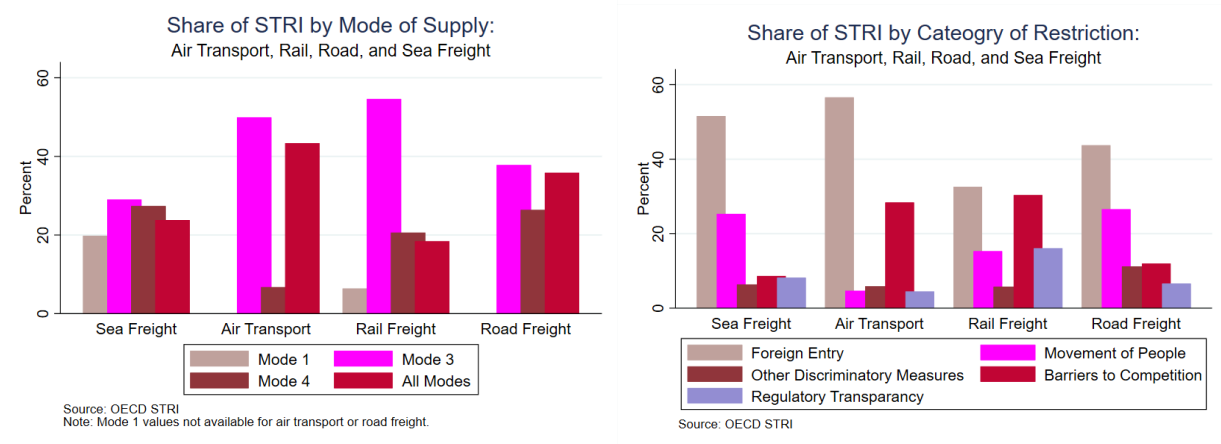
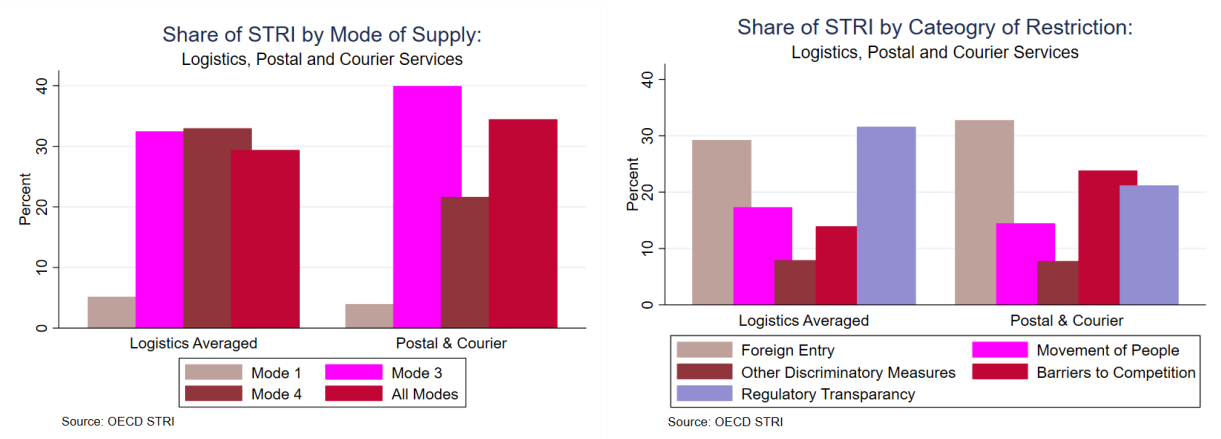


Figure 7 Trade barriers by mode of supply and category of restriction, logistics, and postal and courier services



Maritime, Rail, Road, and Air Transport Services Results

Table 8 reports regression results for maritime, rail and road transportation, while air transport results are presented in table 9. Across all four categories of trade in transportation services, there is a positive and significant relationship between mode 4 barriers and cross-border trade, and this is consistent with results by type of barrier, which also shows a positive and significant relationship between barriers to movement of people and cross-border trade. Given the supporting role that mode 4 activities likely play in transport services (as discussed above for air transport), it is more difficult to interpret the positive effects stemming from mode 4 barriers. Some services embedded in transportation services, such as sales and marketing, could potentially move from an in-person to online provision in response to mode 4 trade barriers, while others, such as shipping goods from one country to another clearly can only happen via mode 1.

For maritime transportation services, the STRI overall has a negative and significant effect on cross-border trade, as shown in table 8, column 1. Separating the STRI by mode of supply indicates there is a negative and significant effect of mode 3 barriers on cross-border trade in maritime transport services, suggesting that the two types of trade are complements, rather than substitutes. Overall, as shown in column (4), there is no significant relationship between rail transportation and the STRI. Of the sector-level results in our sample, rail transportation is also the sector with the poorest coverage, so this lack of relationship could also reflect a limited variation in the STRI. Not surprisingly, contiguity is a strong predictor of cross-border trade in rail services.

Road and Air transport are unique among sectors in our sample because the STRI does not cover mode 1 trade barriers. Road transport results, presented in table 8 columns 7-9, show a negative and significant relationship between the STRI and cross-border trade overall, as well as negative and significant relationship between mode 3 barriers and cross-border trade, suggesting a complementary relationship between cross-border trade and foreign affiliate sales. Road transport shows a positive and significant relationship between contiguity and trade, consistent with findings in rail transport, and intuitive given that cross-border trade is largely intra-regional (Grosso et al. 2014). Results for air transport, presented in table 9 columns 1-3, show that the STRI is not related to cross-border trade, nor do mode 3 barriers have a significant effect. Among the standard trade covariates, common language is positively related to trade in air transportation services.

Logistics, Postal and Courier Services Results

Overall, the STRI for logistics services does not have a significant impact on trade (table 9, column 4). This is not surprising given the STRI is averaged over four areas of logistics services which exhibit varying restrictiveness levels.[13] Although mode 1 restrictions are the least prevalent, their dampening impact on logistics services is significant and likely linked to the predominance of mode 1 delivery in this sector. Given the incidence of modes 3 and 4 at certain facilities such as airports in foreign markets (Sugie, K. et al. 2015), the negative and significant impact of mode 3 restrictions and positive and significant effect of mode 4 provisions are interesting (table 9, column 5 presents all mode-specific results). The former indicates complementarity between cross-border trade and commercial presence while the latter suggests potential substitution within the cross-border trade channel. Moreover, the effect of mode 4 is mirrored by the positive and significant impact from the movement of people category (which covers a

[13] Notably, freight forwarding is among the most restricted sectors in the database, see OECD (2020), Figure 3.

similar subset of non-tariff barriers). While the category foreign entry does not have a significant impact, the barriers to competition category's negative and significant impacts are likely due to measures related to public control of companies (table 9, column 6).

In postal and courier services, the STRI has a positive and significant impact on cross-border trade (table 9, column 7). Every subcategory except barriers to competition has a positive and significant impact (table 9, column 9); interestingly, barriers to competition consist of measures on public control and related domestic regulations impacting mode 3 and all modes of trade. Disaggregated by mode, restrictions across all modes (which are scattered across categories and include barriers to logistics services such as storage and warehousing), and mode 4 restrictions (which do not appear to be sector specific) exhibit a positive and significant impact while mode 1 (which is difficult to isolate) has a negative and significant effect (table 9, column 8).

Table 8 Regression results, maritime, rail, and road transport

	Maritime transport			**Rail transport**			**Road transport**		
Dependent Variable: Trade value	(1) Baseline	(2) By mode	(3) By category	(4) Baseline	(5) By mode	(6) By category	(7) Baseline	(8) By mode	(9) By category
Border	0.311	-3.432***	0.755	-6.177***	-6.968***	-9.681***	-2.481***	-3.682***	-4.496***
	[0.767]	[0.844]	[0.884]	[0.572]	[1.019]	[1.052]	[0.730]	[0.700]	[0.613]
Border*STRI	-16.18***			3.196			-15.73***		
	[2.896]			[1.993]			[2.725]		
Border*STRI_All Modes		15.18			4.612			-25.93***	
		[19.89]			[9.126]			[7.240]	
Border*STRI_Mode 1		6.532			49.50***				
		[7.888]			[12.62]				
Border*STRI_Mode3		-34.03***			0.0898			-19.74***	
		[6.184]			[4.418]			[3.352]	
Border*STRI_Mode4		17.60*			17.88***			29.03***	
		[9.166]			[6.384]			[4.533]	
Border*Foreign entry			-7.328***			-11.24**			-15.48***
			[2.567]			[5.302]			[3.518]
Border*Movement of People			43.41***			36.89***			26.55***
			[8.014]			[9.200]			[4.344]
Border*Other discriminatory			-186.2***			-24.29**			-31.96***
			[19.06]			[9.913]			[6.890]
Border*Barriers to competition			-46.66***			39.39***			-30.22***
			[16.55]			[7.114]			[8.808]
Border*Regulatory transparency			-79.66***			9.393			61.24***
			[19.40]			[6.026]			[13.67]
Log(distance)	-0.638***	-0.470***	-0.736***	-0.0384	-0.0537	-0.126	-0.445***	-0.652***	-0.641***
	[0.113]	[0.0976]	[0.122]	[0.115]	[0.119]	[0.119]	[0.103]	[0.0933]	[0.0962]
Contiguity	-0.0055	0.323**	-0.0954	1.154***	1.085***	0.893***	0.645***	0.555***	0.527***
	[0.166]	[0.156]	[0.162]	[0.211]	[0.210]	[0.220]	[0.167]	[0.149]	[0.154]
Common language	0.280**	0.174	0.165	0.693***	0.749***	0.728***	0.646***	0.621***	0.564***

	Maritime transport			Rail transport			Road transport		
	[0.138]	[0.136]	[0.115]	[0.175]	[0.170]	[0.171]	[0.158]	[0.138]	[0.124]
Colony	-0.593**	-0.644***	-0.607**				-0.947*	-1.048**	-1.000**
	[0.266]	[0.250]	[0.282]				[0.506]	[0.498]	[0.496]
Services PTA	0.171	-0.275	-0.535	-0.142	-0.139	0.851*	1.676***	1.828***	1.377***
	[0.363]	[0.424]	[0.395]	[0.445]	[0.467]	[0.453]	[0.314]	[0.291]	[0.299]
EEA member	-0.715**	-0.0925	-0.0693	-0.166	-0.128	-0.893	-0.348	-1.184**	-0.546
	[0.344]	[0.456]	[0.376]	[0.625]	[0.647]	[0.633]	[0.559]	[0.540]	[0.547]
Number of Observations	4042	4042	4042	2087	2087	2087	4573	4573	4573
AIC	854.0	856.0	856.0	746.0	754.0	756.0	874.1	878.1	882.1

Standard errors, clustered at the country-pair level, in brackets
*** p<0.01, ** p<0.05, * p<0.1
Intercept, importer-year and exporter-year fixed effects not reported.

Table 9 Results, Air transport, logistics, and postal and courier services

	Air Transport			Logistics services			Postal and courier service		
Dependent Variable: Trade value	(1) Baseline	(2) By mode	(3) By category	(4) Baseline	(5) By mode	(6) By category	(7) Baseline	(8) By mode	(9) By category
Border	-2.166***	-2.603*	1.923*	-4.500***	-5.603***	-4.541***	-8.117***	-8.145***	-7.967***
	[0.826]	[1.376]	[1.040]	[0.741]	[0.651]	[0.497]	[0.517]	[0.541]	[0.546]
Border*STRI	1.005			-3.118			5.307***		
	[1.423]			[2.123]			[1.162]		
Border*STRI_All Modes		-2.406			2.946			18.06***	
		[7.571]			[4.766]			[3.147]	
Border*STRI_Mode 1					-58.40***			-86.90***	
					[7.970]			[11.80]	
Border*STRI_Mode3		0.343			-15.35***			-5.824**	
		[2.128]			[2.466]			[2.428]	
Border*STRI_Mode4		47.59**			24.38***			17.98***	
		[21.37]			[4.090]			[6.524]	
Border*Foreign entry			2.693			4.935			25.59***
			[2.536]			[4.221]			[3.144]
Border*Movement of People			40.21*			27.71***			71.83***
			[21.98]			[4.773]			[7.648]
Border*Other discriminatory			-10.69			51.89***			69.24***
			[7.423]			[7.925]			[12.79]
Border*Barriers to competition			-37.27***			-120.4***			-83.64***
			[8.099]			[10.86]			[5.585]
Border*Regulatory transparency			-37.68**			-0.629			32.94***
			[15.45]			[3.192]			[5.303]
Log(distance)	-0.614***	-0.669***	-0.516***	-0.908***	-0.908***	-0.968***	-0.372***	-0.610***	-2.578***
	[0.111]	[0.117]	[0.108]	[0.100]	[0.0865]	[0.0742]	[0.103]	[0.106]	[0.134]
Contiguity	-0.132	-0.159	-0.136	0.517***	0.553***	0.557***	0.987***	1.041***	0.332
	[0.198]	[0.194]	[0.193]	[0.184]	[0.153]	[0.153]	[0.189]	[0.181]	[0.230]

	Air Transport			Logistics services			Postal and courier service		
Common language	0.403**	0.428**	0.370*	0.335**	0.359**	0.0134	0.0559	0.0411	0.354**
	[0.196]	[0.200]	[0.206]	[0.160]	[0.140]	[0.146]	[0.133]	[0.124]	[0.161]
Colony	0.463	0.424	0.645				0.0440	-0.567	-2.353***
	[0.419]	[0.427]	[0.410]				[0.491]	[0.493]	[0.497]
Services PTA	-0.414*	-0.409*	-0.361*	-0.516	-0.275	-0.202	1.053***	1.146***	0.817***
	[0.221]	[0.230]	[0.203]	[0.429]	[0.407]	[0.348]	[0.235]	[0.218]	[0.270]
EEA member	0.575	0.479	0.721*	-0.370	-0.573	-0.594	-1.035***	-1.731***	-5.244***
	[0.460]	[0.468]	[0.415]	[0.653]	[0.669]	[0.663]	[0.368]	[0.352]	[0.444]
Number of Observations	5986	5986	5986	3334	3334	3334	3240	3240	3240
AIC	1026.1	1034.1	1032.1	870.1	876.1	880.1	820.0	826.0	828.0

Standard errors, clustered at the country-pair level, in brackets
*** p<0.01, ** p<0.05, * p<0.1
Intercept, importer-year and exporter-year fixed effects not reported.

Legal; Accounting, Auditing, and Bookkeeping Services; Architectural, Engineering, and Construction Services

According to Mann (2019), in legal services, mode 1 accounts for about half of service supplied across modes of trade, while mode 3 accounts for about a third of services supplied (with modes 2 and 4 equally accounting for the remainder).[14] In particular, multi-jurisdictional legal advisory services associated with mode 3 delivery is an increasingly important aspect of legal services trade (Grosso, M., et al 2014).

While similar estimates across all modes are not available for accounting, auditing, and bookkeeping services or for architectural and engineering services, U.S. trade and foreign affiliate data show that foreign affiliate sales are the predominant mode of supply across all sets of services (USDOC BEA 2019). However, cross-border exports and foreign affiliate sales are collected differently in U.S. data and therefore cannot necessarily be directly compared.[15]

According to Mann (2019), a majority (97 percent) of U.S. construction services are provided via mode 3 with the remainder accounted for by mode 4. According to Mann and Cheung (2019), U.K. cross-border construction exports are almost equally divided into mode 1 (47 percent) and mode 4 (53 percent). The prevalence of mode 4 may depend on the nature of commercial presence (permanent versus short-term) with permanent commercial presence sourcing staff locally and depending less on mode 4 while short-term presence requiring the movement of professionals (Grosso, M., et al 2014).

Mann's estimates show that the share of mode 1 in cross-border trade (including modes 1, 2, and 4) is higher in legal services than in accounting, auditing, and bookkeeping services, as well as architectural

[14] All estimates shown refer to exports. Hook (n.d.) discusses the potentially important role of mode 2 trade in legal services (for example certain jurisdictions act as centers for arbitration, and clients that are resident countries with particularly high trade barriers sometimes travel abroad to seek legal advice.)
[15] See tables 2.1 "U.S. Trade in Services, by Type of Service" and 4.1 "Services Supplied to Foreign Persons by U.S. MNEs Through Their MOFAs, by Industry of Affiliate and by Country of Affiliate."

and engineering services (see table 10). The lower relative share of mode 1 in the latter two services is likely because of greater foreign provision via mode 4.

Table 10 Estimates of mode 1 services share in cross-border exports, legal, accounting, architectural and construction services

Sector (Country source)	Share of cross-border exports attributed to mode 1 trade
Legal services (U.S.)	80%
Accounting, auditing, and bookkeeping services (U.S.)	51%
Architectural and engineering services (U.S)	61%
Construction (UK)	47%

Source: Mann 2019, Mann and Cheung 2019.

STRI by Category of Restriction and by Mode

Legal and accounting services tend to be among most restrictive relative to other services sectors across countries in our sample, while architecture, engineering, and construction services fall in the mid-range in terms of restrictiveness.[16] The most prevalent restrictions for these services across countries in our sample involve the OECD STRI categories "foreign entry of firms" (which typically refer to mode 3 restrictions) and "movement of people" (restrictions affecting either all modes of trade or specifically mode 4 trade) (see figures 8 and 9 below).

The policies in the STRI categories can also be isolated by mode (modes 1, 2, and 4, and all modes). Figures 8 and 9 below show that mode 1 policies tend to be relatively open all sectors. Mode 3 policies such as foreign equity limits contributed most to the overall legal services and accounting index, followed by restrictions across all modes (these include for example nationality requirements to practice and restrictions on recognition of foreign qualifications). On the other hand, mode 4 policies accounted for the highest share in the architecture and engineering services index where the temporary movement of people is imperative for trade and prevalent restrictions include labor market tests and quotas (Grosso, M., et al 2014). Finally, restrictions across all modes accounted for the highest share of the construction services STRI. These restrictions which affect all modes of trade in construction services include requirements for construction engineers ranging from nationality requirements to recognition of foreign qualifications (captured in the category Movement of People) and time, costs, and procedures related to construction permits (captured in the category Regulatory Transparency).

[16] Based on our sample, also see OECD (2020), Figure 3 for complete coverage of sectors by mode of supply and category.

Figure 8 Trade barriers by mode of supply and category of restriction, accounting and legal services

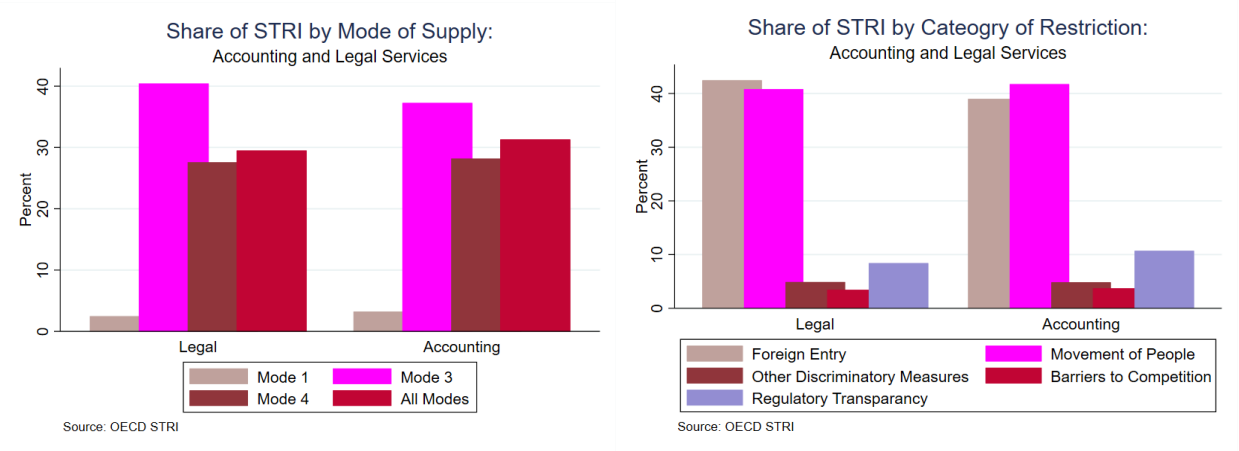
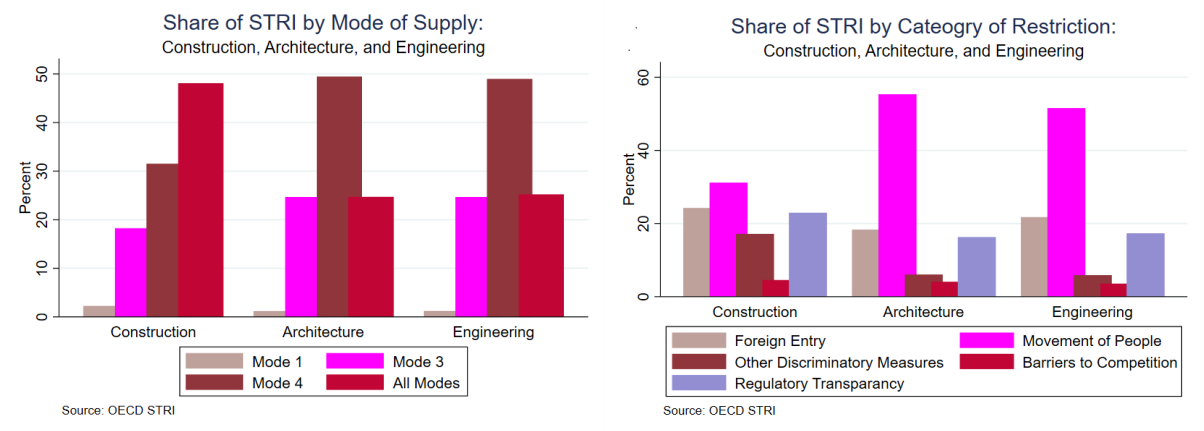


Figure 9 Trade barriers by mode of supply and category of restriction, construction, architecture and engineering services



Across all services in this section, the overall STRI has a negative and significant impact on cross-border trade, as expected. However, as results differ when the STRI is decomposed by mode, each subsection below focuses on sectoral modal results. Results for legal and accounting services are presented in table 11, while results for construction and architecture and engineering services are presented in table 12.

Legal services results

Mode-specific results are shown in table 11 (column 2) and indicate that mode 3 restrictions and restrictions across all modes have a negative and significant impact. The result on mode 3 suggests that cross-border trade and foreign affiliate sales are complementary as mode 3 restrictions dampen trade via the other modes. Additionally, the category of restrictions foreign entry capture most of the mode 3 restrictions in the sector and the coefficient is negative and significant (table 11, column 3). Restrictions across all modes also have a negative and significant impact on legal services trade, which is not surprising given they capture core impediments in the sector including those related to licensing and recognition of foreign qualifications. Though mode 4 restrictions account for about a quarter of the STRI, the effect on trade is not significant—similar to the non-statistically significant effect of the category of restrictions on movement of people which captures both mode 4 and restrictions across all modes.

These results may be related to the relatively low share of mode 4 estimated in cross-border trade for legal services. Finally, contrary to expectation, mode 1 policies appear to have a positive and significant impact, which may be related to the fact that mode 1 policies are relatively liberal for legal services.

Accounting services results

Mode 1 and mode 3 policies have a negative and significant impact in the accounting services industry (table 11, column 5). Relative to other modes, mode 3 policies are the most restrictive and the negative effect suggests complementary between cross-border and mode 3 delivery. Additionally, the restrictions on foreign entry category largely captures most of the mode 3 restrictions in the sector and the coefficient is negative and significant (table 11, column 6). As is the case with architecture and engineering services below, the largest effects from mode 1 policies are surprising. Additionally, though the effect of mode 4 STRI is negative, it is not significant, which is unexpected given the relative importance of mode 4 delivery. Finally, restrictions across all modes appear to have a positive and significant impact; these restrictions appear across a variety of categories including movement of people, other discriminatory measure, barriers to competition, and regulatory transparency which appear to have a variety of effects.

Architecture and engineering services results

Mode 1, mode 3, and mode 4 policies have a negative and significant impact in the combined architecture and engineering services industries (table 12, column 2). As with other services, the result on mode 3 suggests that cross-border trade and foreign affiliate sales are complementary. The relative importance of mode 4 delivery discussed above, coupled with the level of restrictiveness of mode 4 specific policies, helps explain its negative and significant effect. Additionally, the coefficient on the movement of people category is negative and significant (the category largely captures mode 4 restrictions as well as restrictions across all modes such as licensing requirements) (table 12, column 3). Mode 1 effects are surprising, as the largest impacts stem from mode 1 policies and there is a relative lower prevalence of mode 1 supply as share of cross-border trade (as in accounting services). Finally, all categories of restrictions have significant impacts, but with varying direction of effects.

Construction services results

Mode 1, mode 3, and mode 4 policies have a positive and significant impact in construction services while restrictions across all modes have a negative and significant relationship (table 12, column 5). Construction services are primarily provided via foreign affiliates and there may be a relative dominance of mode 4 provision via cross-border trade. Given the nature of the sector, the positive impact of mode 3 barriers likely does not indicate substitution between mode 3 and cross-border channels, but could instead indicate a greater reliance on movement of people (and perhaps the associated short-term commercial presence as discussed above) with increased mode 3 barriers. Restrictions in the category "Other discriminatory barriers" include government procurement measures important for construction services due to the role of government demand in the sector (Grosso, M., et al 2014) and have a negative and significant effect (table 12, column 6).

Table 11 Regression results, Legal and Accounting services

	Legal services			Accounting services		
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
Trade value	Baseline	By mode	By category	Baseline	By mode	By category
Border	-1.839***	-2.818***	-3.507***	-3.496***	-3.891***	-2.810***
	[0.362]	[0.315]	[0.461]	[0.284]	[0.244]	[0.320]
Border*STRI	-5.313***			-4.953***		
	[0.455]			[0.378]		
Border*All Modes		-13.67***			7.901***	
		[2.310]			[2.554]	
Border*Mode 1		133.4***			-160.4***	
		[15.23]			[8.847]	
Border* Mode3		-7.484***			-10.60***	
		[1.082]			[1.352]	
Border*Mode4		0.0720			-2.385	
		[1.865]			[1.952]	
Border*Foreign entry			-7.546***			-12.35***
			[1.047]			[1.601]
Border*Movement of People			1.985			-0.611
			[1.398]			[1.274]
Border*Other discriminatory			33.14***			4.183
			[11.12]			[7.930]
Border*Barriers to competition			-25.60			17.75
			[21.26]			[12.71]
Border*Regulatory transparency			-30.03***			-21.22***
			[9.095]			[4.153]
Log(distance)	-0.994***	-0.910***	-0.706***	-0.657***	-0.559***	-0.831***
	[0.0892]	[0.0708]	[0.0855]	[0.0739]	[0.0758]	[0.0745]
Contiguity	0.484**	0.768***	0.689***	0.0505	0.391**	0.0251
	[0.240]	[0.201]	[0.240]	[0.170]	[0.152]	[0.180]
Common language	-0.0975	-0.156	-0.220	0.301***	0.220***	0.281**
	[0.212]	[0.167]	[0.199]	[0.112]	[0.0825]	[0.115]
Colony	0.895**	1.094**	0.628	-0.709**	-0.551*	-0.739**
	[0.443]	[0.431]	[0.437]	[0.329]	[0.328]	[0.336]
Services PTA	-1.990***	-1.755***	-1.353***	0.0865	0.447***	-0.00338
	[0.212]	[0.213]	[0.219]	[0.114]	[0.140]	[0.131]
EEA member	1.390***	1.313***	1.120***	0.746***	0.834***	0.972***
	[0.392]	[0.361]	[0.394]	[0.201]	[0.229]	[0.209]
Number of Observations	4818	4818	4818	4664	4664	4664
AIC	978.1	984.1	988.1	942.0	946.0	948.0

Standard errors, clustered at the country-pair level, in brackets
*** p<0.01, ** p<0.05, * p<0.1
Intercept, importer-year and exporter-year fixed effects not reported.

Table 12 Regression results, architecture and engineering, and construction

	Architecture and engineering			Construction		
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
Trade value	Baseline	By mode	By category	Baseline	By mode	By category
Border	-4.477***	-3.990***	-4.546***	-4.839***	-6.113***	-4.526***
	[0.344]	[0.415]	[0.365]	[0.807]	[0.882]	[0.838]
Border*STRI	-3.453***			-7.105**		
	[0.658]			[3.129]		
Border*All Modes		11.20***			-14.39***	
		[3.735]			[3.610]	
Border*Mode 1		-412.4***			47.65**	
		[39.55]			[19.45]	
Border* Mode3		-12.95***			7.210*	
		[2.967]			[4.103]	
Border*Mode4		-16.20***			14.05*	
		[3.191]			[7.802]	
Border*Foreign entry			5.197*			-2.668
			[2.717]			[3.949]
Border*Movement of People			-6.400***			-2.789
			[0.948]			[3.789]
Border*Other discriminatory			-70.77***			-20.12***
			[7.221]			[3.631]
Border*Barriers to competition			-31.39***			32.34***
			[12.11]			[9.840]
Border*Regulatory transparency			24.29***			-11.65
			[2.589]			[12.88]
Log(distance)	-0.868***	-1.933***	-1.545***	-0.922***	-0.932***	-1.034***
	[0.0833]	[0.115]	[0.0549]	[0.137]	[0.108]	[0.135]
Contiguity	0.177	0.0561	-0.290**	0.0250	0.00131	-0.0263
	[0.165]	[0.199]	[0.124]	[0.287]	[0.289]	[0.276]
Common language	0.353***	-0.0472	0.505***	0.190	0.320	0.360
	[0.116]	[0.179]	[0.0978]	[0.296]	[0.262]	[0.281]
Colony	-0.392	-8.044***	-0.118	0.525	0.637*	0.527
	[0.494]	[0.527]	[0.491]	[0.373]	[0.367]	[0.339]
Services PTA	1.016***	2.797***	1.983***	0.447	0.325	0.287
	[0.298]	[0.411]	[0.277]	[0.332]	[0.353]	[0.408]
EEA member	-2.311***	-8.820***	-5.269***	0.215	0.497	0.106
	[0.562]	[0.734]	[0.529]	[0.684]	[0.720]	[0.763]
Number of Observations	4789	4789	4789	4846	4846	4846
AIC	810.0	816.0	818.0	984.3	990.3	992.3

Standard errors, clustered at the country-pair level, in brackets
*** p<0.01, ** p<0.05, * p<0.1
Intercept, importer-year and exporter-year fixed effects not reported.

Robustness Checks

As a first robustness check, we estimate the baseline relationship shown in equation (4) using OLS in place of the PPML estimator, separately for each sector as well as pooled across sectors. As with the PPML estimations, we supplement this baseline specification by decomposing the Border*STRI variable by mode of supply and category of measure. All OLS estimations use logged values of exports as the dependent variable. Below is a summary of the OLS estimation results of the three main findings outlined in the beginning of this section: the results show similarity with the PPML results in the direction of the effects in the relationship between the Border*STRI variable and cross-border trade, however there is disparity in the significance of some the relationships.

The first main findings outlined in the beginning of this section was a negative and significant relationship between the STRI and cross-border trade. In the OLS estimations, across all 14 sectors, there is a negative relationship between the STRI and cross-border trade; however, the relationship is only significant in less than half of the sectors. Additionally, regressions run on the pooled sample show a positive but insignificant effect of the STRI on cross-border trade. This lack of relationship between the STRI and cross-border trade in the pooled regression may be due to heterogeneity across services sectors. Since firms in different sectors face different types of measures and trade via different modes of supply, there is no unifying aggregate marginal effect of the STRI on trade.

The second main finding discussed above was the negative relationship between the mode 3 STRI and cross-border trade. In the OLS estimations, across all but 1 of 13 sectors where the STRI by mode of supply is available, there is a negative relationship between the mode 3 STRI and cross-border trade, with half of the relationships significant at the 95% confidence level. Estimation results on the pooled sample show a negative and significant effect of mode 3 barriers.

The third main finding was a positive and significant relationship between the mode 4 STRI and cross-border trade. In the OLS estimations, all but 2 of the 13 sectors where the STRI by mode of supply is available, there is a positive relationship between the mode 4 STRI and cross-border trade; however, the relationships are not significant at the 95% confidence level. Nevertheless, estimation results on the pooled sample show a positive and significant effect of mode 4 barriers.

As a second robustness check we incorporate the OECD EEA STRI, which catalogues trade policy measures that apply to inter-EEA trade, into our STRI variable. In these regressions, the EEA STRI values replace the main STRI values for country-pairs that are both EEA members and we eliminate the EEA member dummy variable. While the inclusion of the EEA STRI tends to change the magnitude of the effect of the STRI on cross-border trade, the signs and ordering of sectors by coefficient size remain consistent with our baseline specifications.

Conclusion

With greater availability of data across an expanded set of countries and over time, it is increasingly possible to analyze questions that are fundamental to services trade. This paper seeks to answer whether modes of services trade complement each other or may be substituted, depending on the services trade policy environment, as measured by the OECD Services Trade Restrictiveness Index (STRI). The main contribution of this paper is a detailed sector level cross-border services structural gravity

estimation, incorporating domestic production and controlling for multilateral resistance, in line with best practices established in the economics gravity literature.

In addition to showing a negative and significant impact for most sectors of the overall trade policy index on cross-border services trade, the principal finding of this paper is that that mode 3 restrictions (which largely capture barriers related to foreign ownership and operation of firms) also have a negative impact on cross-border trade. The latter result is robust across most sectors and points to a complementary inter-modal relationship, such that an increase in mode-specific trade restrictions would tend to depress all trade and conversely, a reduction in policy barriers in one mode would increase overall trade. It will be interesting to see how this relationship evolves over time with shifting business practices due to technological changes and disruptive events such as COVID-19.

We also find evidence of potential intra-modal substitution, as mode 4 policies (which largely capture restrictions related to movement of people) tend to have a positive and significant impact on cross-border trade. This result potentially suggests service providers may switch to providing services remotely when restrictions hinder travel and this is an area where the effects of coronavirus may be particularly relevant. However, as indicated earlier, this type of substitution may not be viable across all industries and in certain cases mode 4 trade may exist in association with and only to facilitate trade via other modes. Consequently, a rich area of future research could focus on gaining a better understanding of what constitutes mode 4 across services sectors as well as the dynamics of movement of people vis a vis other modes of supply.

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Appendix A-Constructing Internal Trade Data

In order to construct internal trade data, we first gathered data on total domestic production by sector and country, then subtracted total exports by sector and country from total output. This appendix provides details on the information used to construct data on total output by sector and country. Tables A.1 and A.2 provides a summary of the production data available in our final sample, by services type (A.1) and by country (A.2).

European Union

For countries within the EU, Eurostat’s annual detailed enterprise statistics for services and construction is the source for internal sales data. The indicator used refers to values of turnover or gross premiums written in million euros, which was converted to U.S. dollars using IMF exchange rate data. For most sectors, the turnover data classified by the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2) corresponded with trade data used in the analysis, available by Extended Balance of Payments Services Classification 2010 (EBOPS 2010). Turnover data for “Computer programming, consultancy and related activities” was added to “Data processing, hosting and related activities; web portals” in order to correspond with trade data on “Computer Services.”

United States

For the United States, the source for internal sales data is from the Industry Economic Accounts of the Bureau of Economic Analysis (BEA). Estimates refer to gross output by industry in billions of U.S. dollars and are structured according to the 2012 North American Industry Classification System (NAICS). In some cases, NAICS categories were not as detailed as EBOPS categories (e.g. architectural and engineering services) and were therefore not included in the dataset; in other instances, NAICS categories were added in order to correspond to EBOPS classifications (e.g. for computer services). Full details of data construction are available upon request.

Rest of the Sample

For countries outside the EU and United States, comprehensive services production data is not available at the level of disaggregation presented in this analysis. However, using a combination of data from national statistics offices and industry reports published by MarketLine we are able to add production data for an additional 108 country-sectors, adding 387 additional observations across the four years of the sample. National accounts, when available, where prioritized over MarketLine reports, as they tended to be reported using ISIC codes and tended to report more precise estimates. These production data reported either total output, total revenue, or total sales. Once the data was aggregated, we

converted all values to U.S. dollars, using exchange rate data from the IMF.[17] For Canada and South Africa, exchange rate data came from the Federal Reserve Bank of St. Louis.[18]

Table A.1 Internal trade observations by EBOPS code

EBOPS code	EBOPS description	Number of observations
SC12	Sea freight	93
SC2	Air transport	142
SC3B2	Rail freight	72
SC3C2	Road freight	132
SC3G	Other supporting and auxiliary transport services	142
SC4	Postal and courier services	139
SE	Construction	178
SF	Insurance and pension services	202
SI1B	Broadcasting	174
SI1T	Telecommunications	169
SI2	Computer services	187
SJ211	Legal services	158
SJ212	Accounting services	162
SJ311	Architecture services	105
SJ312	Engineering services	111
SK1	Audio-visual and related services	152
Total		**2318**

Table A.2 Internal trade observations, by country and data source

Country	Number of observations	Source
Australia	40	Australian Bureau of Statistics, MarketLine
Austria	66	Eurostat
Belgium	56	Eurostat
Bosnia and Herzegovina	26	Eurostat
Brazil	39	Institutio Brasilerio de Geografia e Estatistica (IBGE), MarketLine
Bulgaria	60	Eurostat
Canada	37	Statistics Canada, MarketLine
Chile	43	Insituto Nacional de Estadisticas Chile (INE), MarketLine
China	23	National Bureau of Statistics of China, MarketLine
Columbia	30	Departamento Administrativo Nacional de Estadística (DANE) Columbia, MarketLine
Croatia	59	Eurostat
Cyprus	50	Eurostat
Czechia	52	Eurostat
Denmark	57	Eurostat
Estonia	49	Eurostat
Finland	57	Eurostat
France	64	Eurostat

[17] Available from the World Bank at: World Bank. "Official exchange rate (LCU per US$, period average)", *World Bank World Development Indicators.* (Accessed November 22, 2019).
[18] FRED, "Canada/U.S. Foreign Exchange Rate (AEXCAUS)," February 6, 2019. FRED, "South Africa/U.S. Foreign Exchange Rate (DEXSFUS), December 2, 2019.

Country	Number of observations	Source
Germany	64	Eurostat
Greece	58	Eurostat
Hungary	67	Eurostat
Iceland	43	Eurostat
India	26	Ministry of Statistics and Programme Implementation (India), MarketLine
Indonesia	20	Statistics Indonesia. MarketLine
Ireland	38	Eurostat
Israel	21	Central Bureau of Statistics (CBS), Israel
Italy	63	Eurostat
Japan	43	Statistics of Japan, MarketLine
Latvia	66	Eurostat
Lithuania	64	Eurostat
Luxembourg	28	Eurostat
Malta	16	Eurostat
Mexico	8	MarketLine
Netherlands	64	Eurostat
North Macedonia	26	Eurostat
Norway	61	Eurostat
Poland	60	Eurostat
Portugal	64	Eurostat
Romania	61	Eurostat
Russia	18	Federal State Statistics Service (Russia), MarketLine
Serbia	13	Eurostat
Slovakia	57	Eurostat
Slovenia	59	Eurostat
South Africa	52	Stats SA, MarketLine
South Korea	28	Statistics Korea, MarketLine
Spain	60	Eurostat
Sweden	62	Eurostat
Switzerland	29	Eurostat
Turkey	64	Turkish Statistical Institute
United Kingdom	63	Eurostat
United States	44	U.S. Department of Commerce, Bureau of Economic Analysis.
Total	**2318**	