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In Goods We Trust
Trade Barriers in Services – Should We Care?

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Abstract

This thesis examines the impact of regulatory barriers to trade in services on trade in goods. For this purpose, I use the gravity model and the Poisson pseudo-maximum-likelihood estimator. As a measure of restrictions on trade in services, I use the OECD sectoral Services Trade Restrictiveness Index (STRI). The results reveal that there is a significant negative association between regulatory barriers to trade in telecommunications, distribution, road transport, legal, computer, and accounting services and goods imports. Furthermore, the findings suggest that trade performance in the service-intensive high- and medium-high-technology manufacturing industries (e.g., pharmaceuticals and motor vehicles) is more likely to benefit from liberalisation of trade in services in both the exporting and importing country. The findings have important implications from a trade policy perspective. The results suggest that liberalisation of trade in services – in both trading partners – may have a sizable positive effect on trade in goods, and the impact is larger for trade in skill- and service-intensive industries.

Keywords: trade policy, trade in services, barriers to trade in services, trade in goods, intermediate inputs, services trade restrictions, STRI, gravity equation, PPML.

1 Introduction

Services account for more than 70 per cent of global GDP but their share in world trade in balance of payments terms is only about 20 per cent.[1] Despite the dramatic development of information technologies in the past 30 years, the share of services in world trade has been almost unchanged, fluctuating between 20 and 24 per cent. Decomposing world gross trade in value-added (VA) terms uncovers a different picture. In VA terms, the share of services is nearly half of world gross exports, and it was almost unchanged, increasing by less than one percentage point, between 1995 and 2011 (Lanz and Maurer 2015; Miroudot and Cadestin 2017). That is, services contribute to world trade not only in their own right but account for about 35 per cent of the value of gross exports of manufactured goods.[2]

Services play an important role as intermediate inputs in production of goods. For instance, competitive transport and logistics sectors are critical for global value chains (GVCs): goods and their parts are transported during the production process and from producers to consumers. Telecommunications are a key part in any commercial transaction. Well-functioning financial and insurance markets have a direct impact on trade costs: export credits are essential for trade, and insurance is a significant part of trade costs by itself (Deardorff 2001; Mattoo et al. 2008; Hoekman and Shepherd 2017; Nordås and Rouzet 2017). GVCs are characterized by complex sourcing patterns where the right quality of intermediate inputs must arrive in the right place at the right time at each stage of the production cycle. As the share of global trade in manufactured goods organized as global supply chains increases, access to cost-effective services is required.

Whether embodied in products or facilitating transactions, competitive services sectors are critical for performance in manufacturing. It is, therefore, likely that goods trade directly benefits from liberalisation of trade in services. This hypothesis is the topic of my thesis. Liberalisation of trade in services could be an important boost to future trade since, compared to the manufacturing sectors, where tariff and non-tariff barriers to trade have decreased significantly over the past four decades, services suppliers are still highly protected (Miroudot et al. 2013; Ariu et al. 2017).

Services links in manufacturing production and trade have been incorporated in trade theory by

[1] World Bank's World Development Indicators.
[2] OECD TiVA database, 2011

Antras and Helpman (2004) and Grossman and Rossi-Hansberg (2008) who developed a theoretical framework on outsourcing and offshoring. The predictions of these theoretical models have been tested empirically in a number of recent studies. Arnold et al. (2011), Duggan et al. (2013), Bas (2014), Arbache et al. (2016), Beverelli et al. (2017), Barone and Cingano (2011), Hoekman and Shepherd (2017) studied the impact of services trade barriers on productivity in manufacturing. Blyde and Sinyavskaya (2007), Nordås and Rouzet (2015, 2017), Hoekman and Shepherd (2017) analysed the impact of services trade barriers on trade flows. A clear message unites the studies: competitiveness in the services that are highly involved in production of goods also affect industries.

The paper by Hoekman and Shepherd (2017) is of particular interest: it examines the impact of regulatory barriers to trade in services on trade in goods. I build on this study and employ a similar approach – the gravity model. But the thesis aims to extend the previous results 1) by examining the effects of services trade restrictions on both exporters and importers of goods and 2) by studying which industries may benefit the most from services trade liberalisation. As a measure of services trade restrictiveness, I rely on the Organisation for Economic Co-operation and Development Services Trade Restrictiveness Index (OECD STRI) from Nordås and Rouzet (2017). It allows including a broad range of services and makes it possible to distinguish restrictions in which services affect trade in goods the most.

The results indicate that there is a strong negative association between services trade restrictions and trade in goods. Regulatory barriers to trade in telecommunications, accounting, legal, computer, road transport, and distribution services are the most important for goods imports. The findings also suggest that a higher STRI score, i.e., a higher level of restrictiveness, is more strongly related to lower exports and imports in the service-intensive high- and medium-high-technology industries such as pharmaceuticals and motor vehicles. On the contrary, in the low-tech apparel industry, a higher STRI index is related to lower imports and higher exports.

The thesis is organised as follows. Section 2 reviews related studies. Section 3 describes the analytical and theoretical framework and introduces a descriptive analysis of how the sectoral STRI is associated with performance in the services sectors in question. Section 4 describes the structural gravity approach and estimation technique applied in the thesis. It also provides the data description and model specification. Section 5 presents the results of the analysis, discussion, and robustness checks. Section 6 concludes.

2 Literature

Trade in intermediate services inputs, or to put it more specific – outsourcing and offshoring of services, – could not easily be explained by the existing models of trade based on comparative advantage. Arguing that standard Ricardian theory was not able to explain the increasing trade between similar countries, Krugman (1979, 1981) developed a model where identical firms engage in monopolistic competition. Consumers love variety, which together with internal economies of scale, i.e. lower average costs the higher the volume, drives trade. In Krugman's framework, countries produce a limited range of differentiated products and engage in intra-industry trade, so that firms can exploit economies of scale and consumers still can choose between a large number of varieties. The findings were further developed in models of offshoring and outsourcing (Antras and Helpman 2004; Grossman and Rossi-Hansberg 2008), demonstrating how services, being purchased as intermediate inputs, are included in the production cycle of goods. The offshoring models make the same point about economies of scale and diversity as Krugman's love of variety idea: with intermediate inputs, downstream producers benefit from a broader variety of inputs, which allows them to find inputs that better match firms' production processes, which, in turn, improves productivity. Head and Mayer (2015) showed how these new theoretical foundations can be incorporated in the gravity equation of trade.[3]

In recent years, there has been a number of studies focused on the link between trade in services, used as intermediate inputs, and trade in goods. The reason behind it is that new data sources, which help to uncover the link between goods and services in the production process, have become available – e.g., the OECD-WTO Trade in Value Added (TiVA) database and firm-level data. Below, I review empirical literature on the relationship between barriers to trade in services and performance in downstream manufacturing sectors as well as some papers that both develop the new models and test them empirically.

While all studies reviewed in this section use the workhorse model of the empirical trade literature – the gravity equation – in one way or another, they focus on different aspects of a link between services and goods production. One group of papers investigates how services trade barriers affect productivity in manufacturing, mainly using country-specific firm-level data. Arnold et al. (2011)

[3]See Sections 3.2 and 4.1 for a specification of the gravity equation.

examine firm-level data for the period 1998-2009 for the Czech Republic and find that lower trade barriers in the service sectors have a positive impact on the productivity of manufacturing firms; Duggan et al. (2013) and Bas (2014) analyse firm-level data for Indonesia and India, respectively, and establish similar results; Arbache et al. (2016) examine the linkage between services trade restrictiveness and productivity in downstream manufacturing sectors in Brazil during the period 1996-2012; Hoekman and Shepherd (2017) employ firm-level data from the World Bank Enterprise Surveys for the period 2006-2011 and study the indirect impact of services productivity on exports of manufactured goods; Barone and Cingano (2011), using sector-level data for 17 OECD members for the period 1996-2002, find that lower services regulation increases value added, productivity, and export growth in downstream service-intensive industries; Beverelli et al. (2017), employing a large country sample but for a shorter period of time (mid 2000's), find that lower regulatory barriers to trade in services have a positive impact on productivity in those manufacturing sectors that use services as intermediate inputs more intensively. The main conclusion from these studies is that there is strong evidence for a positive association between open and well-regulated services markets and manufacturing productivity, and that the linkage is stronger for the manufacturing sectors that use services inputs more intensively.

Another group of papers investigates the connections between services and goods trade with a focus on servitization, or servification, of manufacturing, i.e., a transformation from products to integrated solutions where goods and services are combined in one system (Neely 2008). Neely (2008) finds that firms offering services have a higher profit than pure manufacturers; Eggert et al. (2011), looking at firms from the engineering industries, find that product innovation, when it is combined with offering services, leads to higher profitability; Crozet and Milet (2017), exploring firm-level data for France, establish results in a similar manner – firms that start selling services have higher profitability, employment, and sales. An important insight from the studies on servitization: evidence suggests that the distinction between goods and services has become blurred, and goods and services become two parts of one whole.

Finally, there are studies that examine the effects of services trade restrictions on goods trade performance. Blyde and Sinyavskaya (2007) study the relationship between bilateral trade in goods and services trade liberalisation, using data at the country-sector level for years 1980-1999. The authors model services trade openness as a ratio between trade in services and GDP and

find a strong positive association between this ratio and trade in goods. The main drawback of this approach is the problem of endogeneity that can occur because goods and services trade is to some extent complementary and driven by the same forces. Moreover, since trade data does not include data on commercial establishment, this approach omits an important channel through which restrictive regimes in services may affect trade in goods. Nordås and Rouzet (2015, 2017) investigate the association between regulatory trade barriers in services measured by the OECD STRI and international trade in goods (2015) and services (2015, 2017). In both cases, they find that stronger restrictive regimes in services in both the importing and exporting country are related to lower trade. Hoekman and Shepherd (2017), examining data on services trade restrictions from the World Bank for year 2012, establish a strong negative association between regulatory barriers to trade in services and goods trade. A 10 per cent increase in the overall restrictiveness of services trade policies is related to a 5 per cent decrease in bilateral trade in manufactured goods. At the sectoral level, the strongest association is found for restrictions in the retail and transport sectors – an 8 and 3 per cent, respectively, decrease in trade in goods. One of the latest studies is a paper by Ariu et al. (2017) who explore firm-level data for Belgium for the period 1995-2005 and construct a theoretical model of goods and services input sourcing. The model uses a final good sector and two (goods and services) intermediate sectors, where each of them can source either domestically, or from abroad. Ariu et al. (2017) estimate that an increase by one standard deviation in trade barriers in services implies a 13 per cent decrease of goods imports and a 5 per cent decrease of services imports for Belgian firms.

The works closest to mine in terms of research question, data and methodology are Nordås and Rouzet (2015, 2017) and Hoekman and Shepherd (2017). I build on Hoekman and Shepherd (2017), using a similar empirical strategy – the gravity approach. But as a measure of services trade restrictiveness, I apply the sectoral STRI indices from Nordås and Rouzet (2015, 2017). Hoekman and Shepherd (2017) only study restrictive services trade regimes in the importing country. Furthermore, they only look at the impact of restrictions in five services sectors on aggregated trade in manufactured goods. The former limits the possibility to separate effects between the impacts of restrictive regimes in services in both trading partners. The latter prevents from distinguishing which industries may benefit the most from services trade liberalisation and restrictions in which services affect trade in goods the most. The thesis aims to fill these gaps.

I extend the previous literature by 1) using a newly developed index of services trade restrictions and including a wide range of services sectors in the analysis; 2) by simultaneously including a measure of regulatory trade barriers in services in both the importer and exporter. The latter proves to be very fruitful and adds important results to the previous literature from a policy perspective, since the previous findings might underestimate the size of the effect that restrictions may have on trade in goods; 3) by using data at the sectoral level and looking at the effect of services trade restrictions on trade performance in service-intensive industries.

3 Some Stylised Facts and Theoretical Background

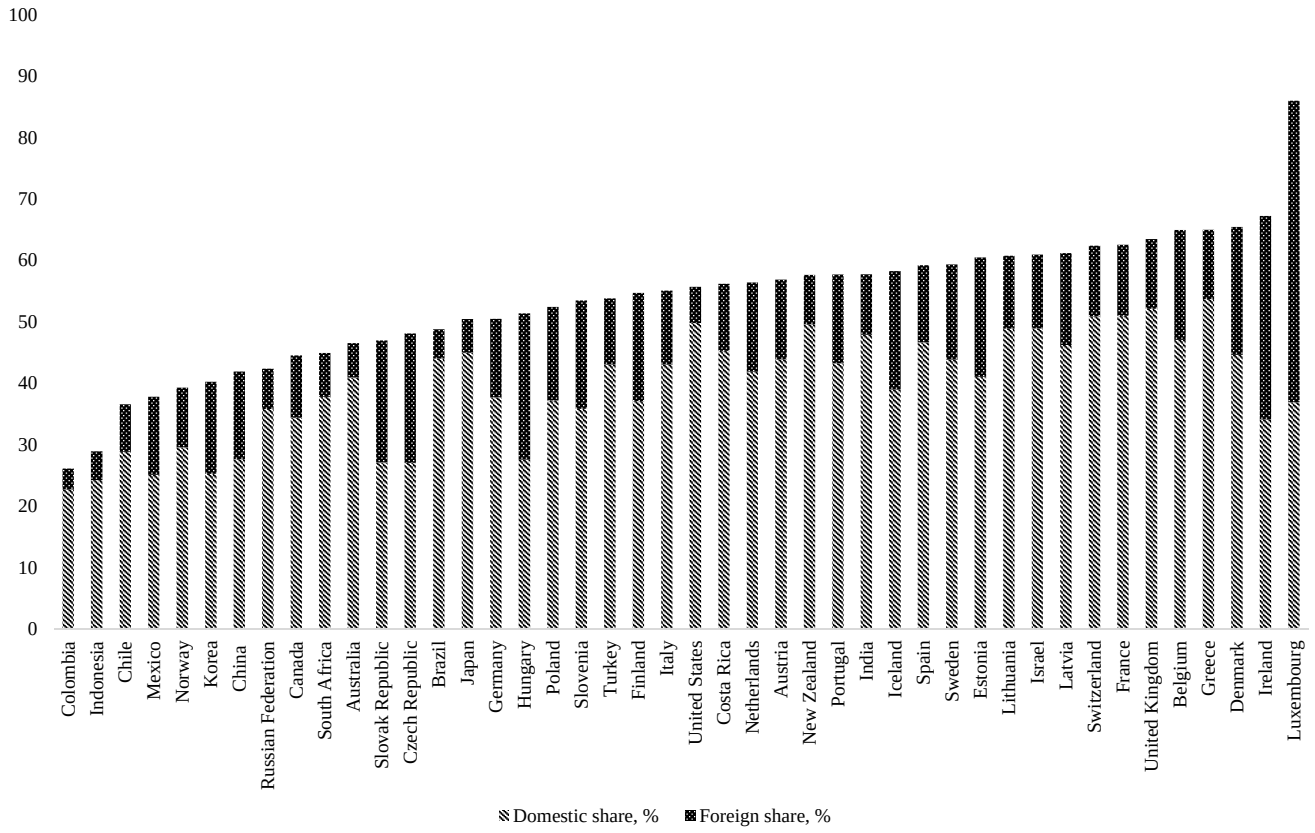
3.1 Role of Services in International Trade

Services are often seen as invisible, perishable and requiring simultaneous production and consumption. While some services demand physical interaction between the provider and the consumer, many services can be supplied without physical proximity. Telecommunication, entertainment and some financial services, for instance, can be transmitted online from the supplier to the consumer. On the contrary, construction and transport require physical proximity. That is, services are not only traded through services and goods – directly or indirectly – but also through the movement of people and capital. The General Agreement on Trade in Services (GATS) identifies four different modes of supply of services: 1) cross-border trade: from the territory of one country into the territory of any other country; 2) consumption abroad: in the territory of one country to the service consumer of any other country; 3) commercial presence: by a service supplier of one country, through commercial presence in the territory of any other country; 4) movement of natural persons: by a service supplier of one country, through presence of natural persons in the territory of any other country.[4]

As mentioned in Section 1, the "disembodied" trade in services accounts for approximately 20 per cent of gross world trade. Note that this figure includes only GATS modes 1, 2 and 4, while mode 3 is not considered as trade in balance of payment statistics. Several channels, through which goods and services are linked to each other, can be distinguished: 1) services as intermediate inputs embodied in goods (e.g., engineering and design), 2) intermediate inputs that facilitate trade in

[4]See `https://www.wto.org/english/docs_e/legal_e/26-gats_01_e.htm`

Figure 1. Services value-added content in total gross exports, 2011

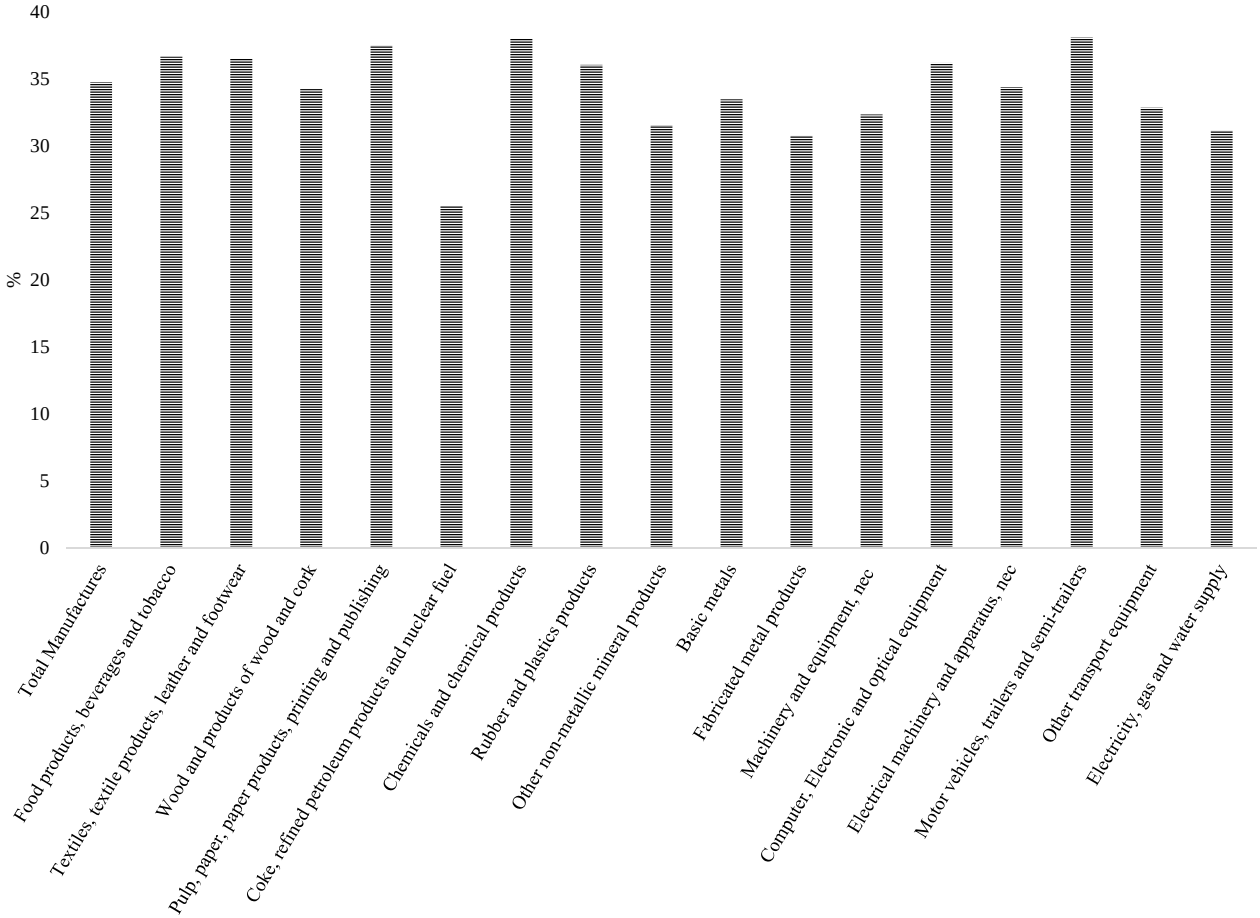


Note: Domestic services VA share of gross exports is the share of value-added originating from all domestic service industries in total gross exports. Foreign services VA share of gross exports is the share of value-added originating from all foreign service industries in total gross exports. Service industries include construction, wholesale and retail, hotels and restaurants, transport and communications, finance, real estate and business services as well as public services, i.e., ISIC Rev.3 Divisions 45 to 95.
Source: TiVA database, own elaborations.

goods (e.g., transport, logistics, finance, and insurance), and 3) services bundled with goods (e.g., repair, installation or other after-sales services, user communities on social media). As depicted in Figure 1, the share of services in gross exports increases dramatically when services value-added is taken into account. Even though the share (domestic and foreign) of services VA varies between countries, it is significantly larger than 20 per cent for all presented countries, highlighting the "intermediate" role of services in world trade.

Industries differ by intensity with which services are used in production of goods, as illustrated in Figure 2. On average, the share of services in VA in gross exports of manufactured goods is around 35 per cent. The highest share is in food, textiles and apparel, paper, print and publishing, chemicals, motor vehicles, and electronics. Exploring data from the TiVA database, Miroudot and Cadestin (2017) find that distribution and business services (telecommunication, computer

Figure 2. Services value-added content in manufactured goods exports, 2011



Note: Share of services VA in manufactured goods exports is the sum of domestic and foreign services VA shares. Service industries include construction, wholesale and retail, hotels and restaurants, transport and communications, finance, real estate and business services as well as public services, i.e., 45 to 95. The definition of manufacturing sectors corresponds to ISIC Rev.3 definitions, 15 to 37.
Source: TiVA database, own elaborations.

services, professional services, R&D, consulting, advertising and marketing, technical testing, and environmental services) are used the most in the manufacturing industries. Two other important sectors are transport and financial services.

Exploring data from the TiVA database, Miroudot and Cadestin (2017) also find that there is a shift towards foreign services in manufacturing industries. During the period 1995-2011, the share of foreign services VA increased by four percentage points, while the share of domestic services VA decreased by approximately three percentage points, highlighting that services inputs become more tradable within global value chains (Miroudot and Cadestin 2017).

Trade policy in services differs from policy for goods trade in the sense that most trade barriers in the service sectors are non-tariff measures (NTMs). Furthermore, many trade barriers in services stem from domestics regulations that aim to protect local providers of services (Mattoo et al.

2008). For example, a domestic regulation can require that accountants must have a degree from a local university to provide services in the country. The reason for this requirement might be a need to assure that all accountants in the country meet the same quality standards, but, as a consequence, market access for qualified accountants with a foreign degree will be limited. That is, such domestic protective regulations might restrict significantly trade in services. Due to the nature of regulatory barriers to trade in services, to measure them is a much more complex task than to measure tariffs and NTMs to trade in goods. Fontagné et al. (2010) and Miroudot et al. (2013) estimate the tariff equivalents of trade costs for services and find that restrictions in services are high and exceed significantly barriers to trade in goods. I return to the problem of measurements of regulatory trade barriers in services in Section 3.3.

To understand why liberalisation of trade in services might affect trade in goods, it is worth to glance at the example provided by Deardorff (2001). Imagine that truckers from one country are not allowed to operate within the borders of another country, and vice versa. In this case, a good would be shipped by truck to the border, unloaded, reloaded to the other country's truck, and shipped to the final destination in another country. This arrangement would generate additional costs. Allowing cross-border provision of trade in services, i.e., a truck from one country is permitted to ship a good to the final destination in another country, will bring down the real cost of trade and reduce time in transit. Hummels and Schaur (2013) estimated that each day in transit is equivalent to an ad valorem tariff of 0.6 to 2.1 per cent.

Clearly, transport services play an important role in production of almost any kind of goods. Together with logistics services, transport physically connects different markets and providers of goods. The telecommunication sector is responsible for virtual connections between suppliers and markets. An efficient financial sector allows placing capital in assets with the highest returns and, what is more important for trade costs, provides export credits, which are essential for trade. The potential gain from trade in insurance services might be the possibility to open market for lower-cost providers from a foreign insurer. Moreover, insurance services have a direct impact on trade costs: it shapes the volume and geography of international trade and is reported in imports statistics as a part of the c.i.f. term (cost, insurance, and freight). Professional services such as accounting and legal services can also contribute to lower trade costs. While lawyers are needed for the establishment of contracts between both domestic and foreign suppliers and

consumers, accountants are responsible for keeping the books in accordance with international standards (Deardorff 2001; Hoekman and Shepherd 2017; Benz et al. 2017).

3.2 Theoretical Background

The theoretical framework in the thesis is primarily based on the theories of intra-industry trade, i.e., trade with similar goods between countries, and trade in intermediate goods, which arises through outsourcing/offshoring and as a result of fragmentation of global production chains.[5] Krugman (1979, 1981), assuming monopolistic competition and that consumers love variety, showed that trade is determined by increasing returns to scale. In the monopolistic competition model, trade occurs because firms produce differentiated products, consumers value variety and there is a limit for how many varieties of one product that can be produced in one country. That is, Krugman's models (1979, 1981) explain how horizontal intra-industry trade arises.

International fragmentation of production, however, signifies vertical intra-industry trade. This feature of trade has been captured in models of outsourcing and offshoring. While Krugman (1979, 1981) assumed that all firms are identical, models of trade in intermediate goods often incorporate heterogeneous firms as in the model developed by Melitz (2003).

Building on the monopolistic competition framework of Krugman (1979, 1981) and the firm heterogeneity of Melitz (2003), Antras and Helpman (2004) developed a North-South model of trade in which final-good producers decide whether to integrate into the production of intermediate inputs or outsource them. In the model, final-good producers control the supply of headquarter services, whereas suppliers of intermediate inputs control the quality and quantity of the intermediates. Antras and Helpman (2004) showed that firms, being different in the level of productivity, choose between: 1) to produce in-house or to outsource, and 2) to produce at home in the high-wage North or abroad in the low-wage South. Choosing between producing in-house and outside the firm, a final-good producer faces a trade-off – the benefits of ownership advantage against the benefits of better incentives for the independent supplier of intermediate inputs. Choosing between a local and a foreign supplier, a final-good producer faces another trade-off – between the benefits of lower

[5]Note that many studies on the linkage between trade barriers in services and manufacturing industries are based on the empirical evidence from available firm-level data, input-output tables or data on services value-added and the intuition behind this relationship (e.g., see Arnold et al. 2011, Beverelli et al. 2017, Blyde and Sinyavskaya 2007, Bas 2014, Hoekman and Shepherd 2017), which also triggered new theory development.

variable costs in the South and the benefits of lower fixed costs in the North.

Considering the link between fragmentation of the production chain and intermediate services inputs, one influential theoretical framework is the Grossman and Rossi-Hansberg (2008) paper that develops a model for offshoring of *tradable tasks* performed by high- or low-skilled labour. By offshoring means outsourcing of a task to a foreign country. Offshored tradable tasks can be interpreted as services used as intermediate inputs in production of final goods. Grossman and Rossi-Hansberg (2008) showed that technological improvements (e.g., improvements in communication or transportation) reduce the cost of offshoring. It generates, in turn, benefits for goods producers, which outsource tasks, or import services inputs. The benefits occur due to specialisation and a cost reduction.

While the models developed by Antras and Helpman (2004) and Grossman and Rossi-Hansberg (2008) provide insights into the determinants of outsourcing/offshoring and trade in intermediate inputs and impacts on factor prices and specialisation, the effects on trade volume are not explicitly considered. Ariu et al. (2017) made a step in this direction. They constructed a model of services and goods trade and production at the level of individual firms. More specifically, the model assumes that there is a final sector (goods) and two intermediate sectors (goods and services). Final producers source intermediate goods and services either domestically, or abroad. By modeling a discrete choice of goods and services input sourcing, Ariu et al. (2017) captured the linkage between regulatory trade barriers in services and trade in goods. They showed that the value of imports of sourced goods and services depends on, inter alia, trade barriers in both intermediate sectors.

The theoretical framework, outlined in this section, can be summarized as follows. Because services, being outsourced as tasks, or intermediate inputs, are a part of the production process of goods, the models predict that regulatory trade barriers in services would not only have a negative impact on services sectors competitiveness but on performance in the production of final goods. Performance in services sectors would affect goods producers' productivity and, through this link, affect trade in final goods.

In the monopolistic competition model, countries would be specialized in different product varieties and trade with each other in these product varieties rather than in dissimilar products, as Krugman (1979, 1981) showed. It turned out that intra-industry trade patterns can be described by a simple

equation – the gravity equation of trade. The equation, first formulated by Tinbergen (1962), has become a workhorse for studying the determinants of bilateral trade and has been widely used in the empirical trade literature. In its general formulation, the gravity equation describes how bilateral trade flows are determined by the size of trading partners and the distance between them. The equation proposed by Tinbergen (1962) is similar to Newton's law of gravity and reads as follows:

$$X_{ij} = A\frac{Y_i Y_j}{d^\rho} \tag{1}$$

where X_{ij} is the amount of trade between countries i and j (imports, exports, or the sum of them), Y_i and Y_j are countries' i and j, respectively, GDP, d is the distance between countries i and j, ρ is the exponent on distance indicating the economic relationship between distance and trade, and A is a constant (Feenstra 2015).

Equation (1) states that bilateral trade is directly proportional to the product of partners' GDPs and inversely proportional to the distance between them. That is, the equation predicts that economies that are more similar in their relative economic sizes tend to trade more with each other. The distance between the trading partners affects trade in the opposite way (Shepherd 2013; Feenstra 2015; Head and Mayer 2015).

The theoretical models, described in this section, have been tested empirically using the gravity equation. Head and Mayer (2015) summarize how the gravity equation derived from these models can be applied in the empirical analysis.[6] The application of the gravity equation in theory-consistent estimations is discussed in detail in Section 4.1.

3.3 Measurements of Regulatory Trade Barriers in Services

To examine the hypothesis that open services markets improve trade in goods, it is important to apply a proper measure of restrictions on trade in services. As mentioned in Section 3.1, due to the nature of restrictions on trade in services, to measure and quantify them is a much more complex task than to measure tariffs and NTMs in goods trade.

One alternative is to use the OECD Product Market Regulation (PMR) indicator (e.g., Barone and Cingano 2011, Ariu et al. 2017) or the World Bank's services trade restrictions index (e.g.,

[6]See also Feenstra (2015) for a discussion of the gravity equation and the monopolistic competition framework.

Beverelli et al. 2017, Hoekman and Shepherd 2017) as direct measures of protection for trade in services. Both indicators have been used lately in the studies on restrictions on trade in services. The former covers a smaller range of services sectors and focuses on general market regulations (van der Marel and Shepherd 2013). For trade policy applications, it is, however, important to capture discriminatory measures. The World Bank's services trade restrictions indicators quantify policies targeting foreign providers of services for a broad set of countries, but it covers only five services sectors. Furthermore, the database, launched in 2012, contains data from 2008 and has been updated for only a few countries.

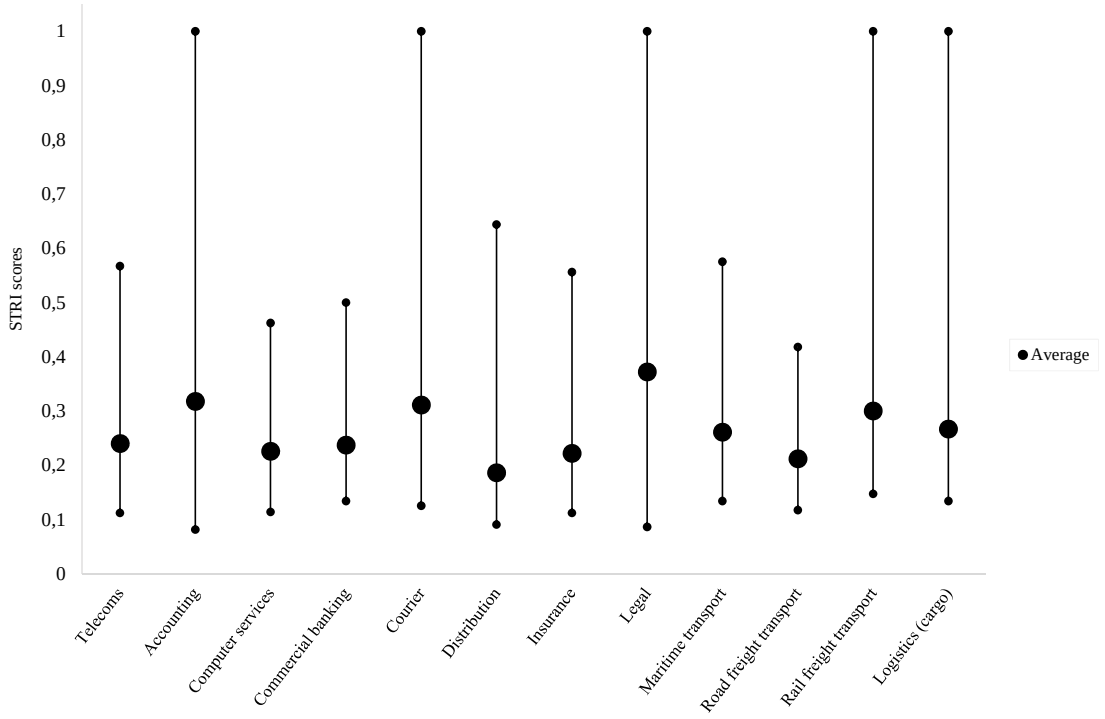
Another solution is to use the OECD Services Trade Restrictiveness Index (STRI), which was first released in 2014 and has been updated annually ever since. A limitation of this index is that it only covers 44 countries – the OECD members and the large emerging markets.[7] These economies, however, account for more than 80 per cent of world goods exports.[8] The STRI database provides information on regulatory regimes in 22 services sectors, which is significantly more than the alternative databases can provide. In addition, the PMR indicator covers mainly non-discriminatory measures, World Bank's services trade restrictions database does not cover non-discriminatory measures, while the STRI covers both. Using the OECD STRI allows employing a more precise measure of services trade restrictions in a larger number of services, thus improving the previous findings on the linkage between trade in services and trade in goods. With these points in mind, I choose to use the STRI in the thesis.

In the OECD STRI database, the composite indices for all 22 sectors are presented as a continuous number between 0 and 1, where 0 corresponds to the absence of any restrictions in a sector, and 1 indicates a fully closed sector. A reduction in the STRI, thus, indicates lower regulatory barriers to trade in services in a particular sector. The data is quantified based on the qualitative information taken from each country's relevant laws and regulation. For each sector, the database provides information on five policy areas: restrictions on foreign entry and the movement of people, barriers to competition, regulatory transparency and other discriminatory measures. The qualitative information is peer-reviewed by government officials from the countries concerned.[9]

Figure 3 shows the average, minimum and maximum scores of 12 selected sectors included in the

[7] See Table A.3 for a country coverage.
[8] WITS Comtrade, 2014.
[9] See OECD (2017) and Nordås and Rouzet (2017) for a thorough description of the OECD STRI database.

Figure 3. STRI average, minimum and maximum scores, 2014-2015



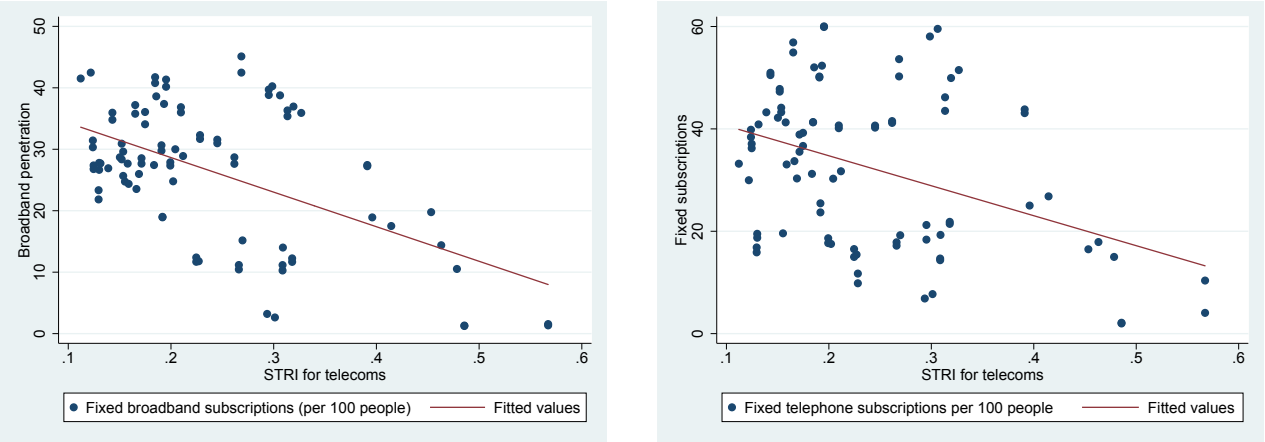
Note: The higher the score, the more restrictive a sector; scores range from 0 to 1. For the geographic coverage, see Table A.3.
Source: OECD STRI database, own elaborations.

analysis. The services of interest are those used the most intensively by manufacturing firms. Based on evidence from the TiVA database and findings made by Miroudot and Cadestin (2017) and Hoekman (2017), these sectors are transport and logistics, telecoms and business services. It is clear that services regulatory restrictiveness varies significantly both within and across sectors, although comparability across sectors is not perfect. The average STRI varies between 0.19 for "distribution" and 0.37 for "legal services". For 5 out of 12 selected sectors, the maximum value of STRI is 1: accounting, courier, legal, rail transport, and logistics services are completely closed in at least one of 44 countries. See also Table A.4 for summary statistics for the sectoral STRIs.

3.4 Services Sector Trade Performance

The STRI database quantifies regulatory trade barriers that affect local and foreign services providers. The index covers all four modes of supply identified by GATS, including mode 3 (commercial presence), which is not taken into account in balance of payments trade statistics. While restrictive regimes aim to protect local producers from competition with foreign suppliers, they might also distort domestic supply – with more entry barriers, less competition and fewer

Figure 4. STRI in telecoms and performance in the sector



Note: The higher the score on the STRI for telecoms, the more restrictive a sector; scores range from 0 to 1. Slope coefficients from left to right: -0.53, -0.40.
Source: OECD STRI and World Bank's WDI.

incentives to innovate. It is reasonable, therefore, to expect that the higher STRI scores should correlate with the symptoms of weak competition in services. To explore this correlation, I follow Nordås and Rouzet (2017) and relate the STRI indices to the corresponding indicators of services sector performance, updating to more recent years. As a measure of sector performance, I use the World Bank's World Development Indicators (WDI). These indicators are internationally comparable and available for longer time periods. From a range of the WDIs, there are suitable indicators for two sectors covered by the STRI: telecommunications and logistics.[10]

For telecommunication services, there are several relevant indicators of competition: the number of mobile, fixed or broadband subscribers per hundred inhabitants and the number of secure internet servers per million inhabitants. I find the strongest negative correlation between the STRI in telecoms and broadband penetration (Figure 4).[11] The estimated correlation suggests that a reduction in the STRI in telecoms from the mean value of 0.24 by 0.05 corresponds to three additional internet subscribers per 100 inhabitants. It is possible, however, that the correlation between the sectoral STRIs and performance indicators might be spurious if GDP per capita is an important determinant of the level of services performance indicators and countries with higher income per capita tend to have a lower score on the STRI (Nordås and Rouzet 2017). Applying the same approach as Nordås and Rouzet (2017), I regress the STRIs for telecommunications on the log

[10]There is also a suitable indicator for financial services – domestic credit to private sector (% of GDP). A statistically significant correlation between this indicator and the STRI for commercial banking could not be identified.

[11]The correlation between the STRI for telecommunications and the number of mobile subscribers and secure internet servers is -0.19 and -0.27, respectively. For the sake of brevity, the results of the regression analysis for mobile cellular subscriptions are not shown.

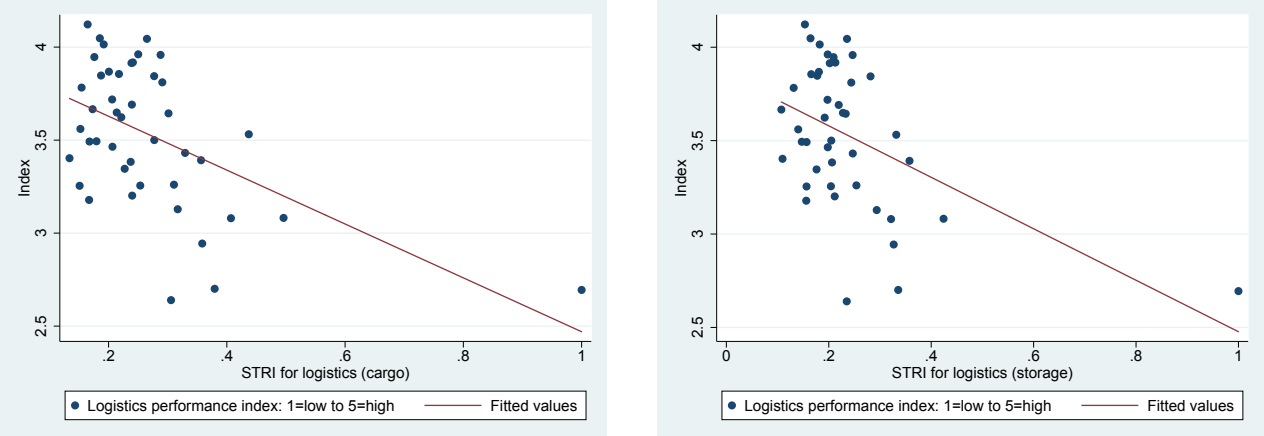
of relevant WDI and find that the negative relationship between the number of internet subscribers as well as the number of secure servers per million inhabitants is robust to controlling for the log of GDP per capita (columns 1 and 5 in Table 1). Including the interaction term between the log of GDP and the STRI reveals the negative association between the number of fixed subscribers as well (column 4). Furthermore, controlling for interaction between GDP per capita and the STRI shows that the marginal impact of the STRI is lower in the countries with high GDP per capita (columns 2, 4 and 6) where the telecoms market seems to be saturated.

Table 1. Telecommunications performance indicators and STRI for telecoms

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Broadband**	**Broadband**	**Fixed**	**Fixed**	**Servers**	**Servers**
Log GDP per capita	0.63***	0.01	0.55***	0.17*	1.42***	1.08***
	(0.06)	(0.10)	(0.08)	(0.10)	(0.09)	(0.18)
STRI telecoms	-1.83***	-22.09***	-0.80	-12.90***	-3.18***	-14.26**
	(0.57)	(2.34)	(0.53)	(3.56)	(0.89)	(5.72)
Interaction term		2.14***		1.26***		1.17*
		(0.24)		(0.37)		(0.61)
Constant	-2.85***	3.22***	-1.99**	1.63	-7.54***	-4.22**
	(0.64)	(1.06)	(0.83)	(1.06)	(1.04)	(1.82)
Observations	88	88	88	88	88	88
R-squared	0.77	0.85	0.63	0.67	0.83	0.84

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Figure 5. STRI in logistics and performance in the sector



Note: The higher the score on the STRI the more restrictive a sector; scores range from 0 to 1.
Slope coefficients from left to right: -0.53, -0.49.
Source: OECD STRI and World Bank WDI.

Similarly, performance in the logistics sectors is negatively correlated to the STRI indices in a range of logistics services: the highest association is found for cargo-handling and storage services (Figure

Table 2. Logistics performance and STRI for logistics

Variables	(1) Cargo	(2) Cargo	(3) Storage	(4) Storage
Log GDP per capita	0.08***	0.20***	0.08***	0.20***
	(0.02)	(0.05)	(0.02)	(0.04)
STRI	-0.26***	3.57***	-0.28***	4.10***
	(0.05)	(1.24)	(0.04)	(1.39)
Interaction term		-0.40***		-0.45***
		(0.13)		(0.14)
Constant	0.56***	-0.63	0.52***	-0.65
	(0.17)	(0.46)	(0.16)	(0.44)
Observations	44	44	44	44
R-squared	0.61	0.69	0.63	0.69

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

5).[12,13] The correlations deliver a clear message: countries, which are less restrictive according to the STRI for logistics services, tend to have more efficient and more competitive logistic sectors. The relationship in two of the four logistics sectors is robust to controlling for the log of GDP per capita (columns 1 and 3 in Table 2). However, interacting the STRIs with the GDP per capita leads to the change of the sign (columns 2 and 4), which indicates a presence of a non-linear relationship. The marginal impact of the STRI in logistics (cargo-handling and storage and warehouse) is negative in high-income countries, but is positive below a certain level of GDP per capita.

Higher barriers to trade in services reduce the competitiveness of the services sectors, acting as a tax on exporters (Mattoo et al. 2008). Through the mechanisms described by Deardorff (2001), services determine manufacturing firms' competitiveness as well. The reason for the exercise described above was to explore whether the STRIs, which translate laws and regulations into a number between 0 and 1, do, in fact, relate to the internationally comparable indicators of performance in the services sectors and reflect a negative association between services restrictions and the level of competitiveness. The descriptive evidence presented in this subsection supports a presence of such a correlation. In the next three sections, I empirically explore the link between the STRI indices and exports of goods to analyse whether restrictive policy measures in trade in services negatively

[12]The correlation between the logistics performance index and the STRI for customs brokerage and the STRI for freight forwarding is -0.34 and -0.36, respectively.

[13]When the possible outliers are dropped from the sample, the estimated correlations are negative with slightly different slope coefficients: -0.46 and -0.42 for the STRI for cargo-handling and the STRI for storage, respectively.

affect trade in goods.

4 Methodology and Data

4.1 General Notes on Estimating the Gravity Equation of Trade

To investigate the effect of services restrictiveness on trade in goods, I rely on the gravity approach. As mentioned in Section 3.2, the gravity equation of trade, pioneered by Tinbergen (1962), represents a relationship between bilateral trade flows, countries' economic size and distance between trading partners. The gravity equation, given in (1), has proven to produce robust results for trade in goods and to fit trade data very well.

After the equation was introduced in empirical work, its theoretical foundation has been further developed as summarized by Head and Mayer (2015). The monopolistic competition framework, briefly described in Section 3.2, has proven to suite well as a theoretical foundation to derive the gravity equation (Feenstra 2015). One of the most important contributions is Anderson & van Wincoop's (2003) paper. The authors derive the theory-consistent, or so-called structural, gravity model, which predicts that trade between two countries is determined by *relative* trade costs. The more resistant to trade with all other possible partners (other than country j) country i is, the more it will trade with a given partner – country j.

Anderson and van Wincoop (2003) show that trade between two partners depends on the trade barriers between them relative to GDP-weighted average trade costs anywhere in the world. Thus, failing to control for relative trade costs would result in biased estimates. In particular, Anderson and van Wincoop (2003) define the structural gravity model as the following system of equations:

$$X_{ij} = \frac{Y_i Y_j}{Y^W} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \tag{2}$$

where

$$\Pi_i = \left(\sum_{j=1}^{N} \left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} \theta_j \right)^{1/(1-\sigma)} \tag{3}$$

$$P_j = \left(\sum_{i=1}^{N} \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} \theta_i \right)^{1/(1-\sigma)} \tag{4}$$

where X_{ij} is the monetary value of exports from country i to country j, Y_i and Y_j denote the GDP of countries i and j, respectively, Y^W is nominal world income (total world GDP), t_{ij} is the bilateral trade cost term between countries i and j, σ is the elasticity of substitution between varieties from different countries, θ_i and θ_j stand for each country's share in global output, Π_i is defined as outward multilateral resistances, and P_j is defined as inward multilateral resistance.

The term t_{ij}, bilateral trade cost, is usually approximated by geographic and trade policy variables, such as bilateral distance or the presence of regional trade agreements (RTAs).

The terms Π_i and P_j in equations $(2-4)$ are of special interest. These are so-called multilateral trade-resistance (MTR) terms. The inward MTR term, P_j, captures the dependence of country j's imports on trade costs across all suppliers in the world. Similarly, the outward MRT term, Π_i, captures the dependence of country i's exports on trade costs across all destination markets. The terms represent exporter and importer ease of market access (Anderson and van Wincoop 2003; van der Marel and Shepherd 2013; Yotov et al. 2016).

While the intuition behind the gravity equation is rather simple, theory-consistent estimation of the model requires a structural approach. The difficulty occurs because the MTR terms are not directly observable thus making it difficult to include them directly into regression. Anderson and van Wincoop (2003) solved the problem by applying iterative custom nonlinear least squares programming. They used the trade costs parameters, t_{ij} in (3) and (4), which were estimated without controlling for the MTR terms, to obtain a set of multilateral resistances. Next, the authors re-estimated the gravity equation using the set of multilateral resistances to obtain a new estimate of trade costs, and so on. The procedure is repeated until the gravity estimates obtained using the set of the MTR terms do not change anymore (Yotov et al. 2016). The estimation technique used by Anderson and van Wincoop (2003) is rather cumbersome. Alternative and easily implemented strategies to account for inward and outward multilateral resistance have been introduced over the last years.

One approach, advocated by Feenstra (2004), is to use a full set of importer and exporter fixed effects to take account of the unobserved MTR terms, which correspond to price indices in the structural gravity equation derived by Anderson and van Wincoop (2003). The method can be easily implemented in STATA or similar softwares and has been used widely since its introduction.

The method allows estimating the gravity equation using OLS without calculating the MTR terms, given in (3) and (4). The fixed-effect approach implies that the MTR terms are estimated as part of the regression. However, the technique has a serious limitation. It cannot be applied if there are variables that vary only in the same dimension as the country fixed effects. For example, many policy indicators such as the STRI are country-specific and constant across all exporters for a given importer, and vice versa. To put them in an equation with country fixed effects would induce a perfect collinearity. Country fixed effects would simply absorb the effects of the STRI, or other similar country-specific variables (Shepherd 2013).

Proposing the country-fixed effect approach, Feenstra (2004) did not address two problems that often appear when working with trade data – zero trade flows and heteroscedasticity. The presence of zero values in trade between two countries is prevalent in the reported trade data. The zero trade issue persists more frequently in disaggregated data, since it is more common that two countries do not trade in a particular commodity than they do not trade with each other at all (Bacchetta et al. 2012). A similar reasoning applies to the use of firm-level data. The question how to handle zero trade in the gravity estimations is much-discussed in the trade literature. Whether zero observations in trade really reflect zero trade or it is a reporting error, is not always clear. The problem with the zero trade flows occurs when the gravity model is estimated in its log-linear version:

$$logX_{ij} = \beta_0 + \beta_1 logd_{ij} + \delta Z_{ij} + \beta_3 \eta_i + \beta_4 \eta_j + \epsilon_{ij} \tag{5}$$

where X_{ij} is the amount of trade between country i and country j; Z_{ij} is a vector of bilateral control variables such as RTAs or common language; η_i and η_j is country i and j, respectively, fixed effect; and ϵ_{ij} is the error term.

Since the log of zero is undefined, all the observations containing zero trade flows must be excluded (or will be automatically dropped by the software) from the sample. Because dropping the observations with zero values would result in sample selection bias, to estimate the gravity equation in the log-linear form under OLS would yield biased results (Shepherd 2013; Head and Mayer 2015). In order to include the zeros in the estimation and avoid the bias, Santos Silva and Tenreyro (2006) propose to use the Poisson pseudo-maximum likelihood (PPML) estimator instead of OLS. The PPML estimator belongs to generalized linear models and relies on using the

quasi-poisson distribution and a log-link.[14] Since the PPML estimator can be applied to the levels of trade, zero flows can be included and the model can be estimated in the nonlinear form. The method has been proven to be robust in the presence of a large number of zeros.

Another important issue that often occurs in the trade data is heteroscedasticity. In a case of log-linear models like the gravity equation, the estimates would be biased and inconsistent under OLS. The problem of heteroscedasticity cannot be solved by applying a robust covariance matrix estimator because heteroscedasticity would also affect the parameter estimates (Shepherd 2013). Santos Silva and Tenreyro (2006) show that under weak assumptions – the gravity equation contains a correct set of explanatory variables – the PPML estimator is consistent (Yotov et al. 2016). Consequently, the parameter estimates under PPML are consistent estimates of the original nonlinear model. Since the estimator is a *pseudo*-maximum likelihood estimator, there are no requirements that the data should be distributed according to the Poisson distribution. The estimator is consistent in the presence of fixed effects as well (Shepherd 2013). With these points in mind, I employ the PPML estimator in the empirical analysis.

Applying the PPML estimator does not solve the problem of collinearity between country-fixed effects and country-specific variables of interest. Baier and Bergstrand (2009) provide an alternative solution that does not require the inclusion of fixed effects but allows for an approximation of the MTR terms. The method is based on a first-order Taylor series expansion of the two nonlinear MTR terms. A first-order Taylor-series expansion of a function $f(x)$, centered around the point where $x = a$, is given by $f(x) \approx f(a) + f'(a)(x - a)$. Each trade cost variable in the gravity equation, e.g., distance or common language, should be modified using the Taylor series approximation and included in regression in the transformed form (Shepherd 2013). The methodology allows including in the gravity model the variables that do not vary bilaterally without causing omitted variable bias. However, the approach has been criticized for being inconsistent with the theoretical basis for multilateral resistance. Furthermore, Head and Mayer (2015) run Monte Carlo simulations, using the structural gravity model, to compare alternative estimators and find that the approach proposed by Baier and Bergstrand (2009) is not robust to missing data. I apply the Baier and Bergstrand (2009) transformation as one of the of robustness tests.

[14] See Santos Silva and Tenreyro (2006) and Feenstra (2015) for more technical details.

4.2 Data

To test the main hypothesis, the variable of interest is total exports of manufactured goods from country i to country j, measured in nominal terms. The data on bilateral trade is taken from the World Integrated Trade Solution (WITS) database, which originally comes from the UN Commodity Trade (UN Comtrade) database. To match it with the data on the STRI indices, which are used as a measure of regulatory barriers to trade in services, the sample in the thesis includes international trade data for the period 2014-2015 for 44 countries covered by the OECD STRI database.[15]

Several bilateral control variables are included in the data set to account for natural trade costs as well. In line with the gravity literature, I control for bilateral distance for each country pair and include dummy variables for countries that share a common border, common official language, have colonial links or participate in a regional trade agreement (RTA). I also include the reporter and partner country's GDP (in nominal terms). Data on these variables are taken from the CEPII gravity data set.

Given that the thesis studies effects on trade in manufactured goods, it is also important to control for barriers, which directly affect trade in goods. However, information on bilateral tariffs could not be found for a sufficient number of observations. An alternative would be to use the World Bank Overall Trade Restrictiveness Index as a proxy for tariff and non-tariff measures from Hoekman and Shepherd (2017). The index, however, has not been updated since 2012 and, therefore, is not compatible with the data set used in the thesis.[16]

Table 3 shows summary statistics for the data set. The list of the countries covered by the sample and detailed description of all variables and their sources are set out in the Appendix.

[15] One may argue that longitudinal data over regulatory trade barriers in services would be preferable in order to establish a causality between services trade restrictions and trade in goods. Often such data is more informative, with more variability and efficiency, and less collinearity among variables (Gujarati and Porter 2003). However, since the OECD STRI is only available for a shorter period of time, a researcher, wishing to work with a new instrument, faces a trade-off – to postpone the work until more data will be available and other studies will be published or to use available data but being cautious about inferring causalities from the obtained results. Note that the related empirical studies such as Beverelli et al. (2017), Barone and Cingano (2011), Nordås and Rouzet (2017), Hoekman and Shepherd (2017) and the theoretical papers by Anderson and van Wincoop (2003) and Santos Silva and Tenreyro (2006) use data for shorter periods of time.

[16] In fact, it is a common practice to omit tariffs and other policy-induced barriers to trade in goods in the gravity literature. The accumulated effect of tariffs on trade is captured by country-time fixed effects and dummies for RTAs.

Table 3. Summary Statistics

Variables	(1) N	(2) mean	(3) sd	(4) min	(5) max
Exports value (thousand $), only manufacturing sectors	3 784	3 950 986	16 211 358	0	398 768 864
Contiguity	3 784	0.05	0.22	0	1
Common official language	3 784	0.07	0.26	0	1
Weighted distance	3 784	6 454	5 000	160.90	19 539
GDP (million US$)	3 784	1 493 497	3 049 831	16 598.50	18 036 648.05
Colonial relationship	3 784	0.03	0.18	0	1
RTA	3 784	0.60	0.49	0	1

4.3 Model Specification and Estimation Methodology

I draw on the gravity framework developed by Anderson and van Wincoop (2003) and, taking into account the issue of zeros and heteroscedasticity in the trade data, employ the PPML estimator. Given that the STRI is a country-specific variable, the standard approach of including country fixed effects to control for multilateral resistance is not suitable. The baseline regression equation is defined as:

$$X_{ijt} = exp[\beta_0 + \beta_1 STRI_{ikt} + \beta_2 STRI_{jkt} + \theta_1 ln(GDP_{it}) + \theta_2 ln(GDP_{jt}) + \delta Z_{ijt} + \eta_t + \epsilon_{ijt}] \quad (6)$$

where X_{ijt} is the value of exports of manufactured goods from country i to country j in year t; $STRI_{ikt}$ and $STRI_{jkt}$ are the sectoral OECD STRI indices, measured on a scale from 0 to 1, in the exporter and importer, respectively, in year t in a service sector k; Z_{ijt} is a vector of bilateral control variables, described in the previous subsection; η_t is a year fixed effect; and ϵ_{ijt} is the error term.

The coefficients of interest – β_1 and β_2 – capture the association between international trade in goods and the level of restrictiveness in trade in services. In accordance with the previous discussion, the alternate hypothesis tested in the thesis is that both coefficients are significantly different from zero and are expected to have a negative sign. Hence, the null hypothesis is that

the coefficients on both STRI variables are not significant determinants of bilateral trade, i.e.:

$$H_0 : \beta_i = 0$$
$$H_1 : \beta_i < 0 \qquad \text{where } i\text{=1, 2}$$

As opposed to Hoekman and Shepherd (2017), I take into account regulatory barriers to trade in services in both the importer and exporter in the model. As shown in Section 3.3, higher STRI scores are related to weaker performance in the services sectors. Services trade barriers, being of a "behind the border" nature, impose costs on both domestic and foreign providers. Imported intermediate services can benefit domestic exporters of goods. Furthermore, services trade liberalisation would not only open the home market for foreign producers, but it could create incentives for local services firms to become more efficient and innovative. Finally, countries with less restrictive investment regimes are more attractive for multinational producers of services as a place for commercial establishment, further adding to the services supplier base local manufacturers can source from (Nordås and Rouzet 2017). In fact, the STRI captures foreign direct investment, which falls under mode 3, using the definition by GATS. Hence, to examine effects of regulatory barriers to trade in services requires considering restrictive regimes in both countries – the exporter and importer of goods.

Observe that since the STRI does not vary bilaterally, the MTR terms, Π_i and P_j, are omitted from equation (6). To check whether the results are affected by the multilateral issue and by the choice of the estimation methodology, I conduct several robustness tests. The checks are described in detail in Section 5.3.

5 Results and Discussion

Recall from Section 3.1, the data from the TiVA database makes it possible to identify which manufacturing sectors are most service-intensive and which services are used the most. Based on the evidence provided by Miroudot and Cadestin (2017), I select 12 services sectors for the empirical analysis – those with the highest share in VA terms in gross exports. These sectors are distribution, courier, telecommunications, transport, logistics (cargo-handling), finance, and business services. Transport services cover rail, road, and maritime transport; financial services

include commercial banking and insurance; business services consist of computer services and professional services such as legal services and accounting. Next, I select for the analysis the most service-intensive manufacturing industries (see Figure 2): inorganic chemicals, organic chemicals, pharmaceutical products, apparel and clothing (knitted or crocheted and not knitted or crocheted), electrical machinery, and motor vehicles and their parts.[17]

5.1 Results by Type of Services and Discussion

Equation (6) is estimated separately for each sectoral STRI. The dependent variable is bilateral manufacturing exports. The results appear in Table 4 where the heading row indicates which STRI sector is included.

To begin with, it is important to check whether the coefficients on the standard gravity variables reported in Table 4 are in line with the existing literature. For this purpose, I use the results of the meta-analysis conducted by Head and Mayer (2015) as a benchmark. The coefficients on the exporter's and importer's GDP are highly significant and close to unitary as expected. The distance variable has a negative sign as predicted by theory and significant at the 1 per cent level. The coefficients on contiguity are highly significant and their sign and magnitude are in line with the coefficients reported by Head and Mayer (2015). Having a common official language or colonial links appears to be insignificant in almost all cases, while being a member in an RTA raises trade between two countries.

The coefficients on the STRI for the importer are negative for most services sectors but not all of them are significantly different from zero. The strongest association between the STRI and imports of goods is found for the road transport sector. Restrictive regimes in telecommunications, distribution, computer and professional services are related to significantly lower trade as well. Although causalities should be inferred with caution from the coefficients in Table 4, these results are in line with the expectations and the previous studies. Recall from Section 3.1, transport and retail services play a key role in the production and movement of goods – building a global supply chain is not possible without efficient distribution of goods, within and across borders. Similarly, telecommunications and computer services and professional services such as legal and

[17]The full description of sectors included in the analysis and their codes in the HS 2002 Classification are presented in Table A.5.

Table 4. Cross-border exports of goods and STRI: PPML estimations

	(1) Telecoms	(2) Accounting	(3) Legal	(4) Computer	(5) Banking	(6) Insurance	(7) Logistics	(8) Maritime	(9) Rail	(10) Road	(11) Distribution	(12) Courier
lgdp_o	0.95***	0.94***	0.94***	0.93***	0.93***	0.92***	0.93***	0.96***	0.94***	0.92***	0.93***	0.89***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.03)
lgdp_d	0.92***	0.93***	0.92***	0.92***	0.94***	0.95***	0.93***	0.95***	0.93***	0.92***	0.93***	0.94***
	(0.04)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)
ldistw	-0.75***	-0.75***	-0.75***	-0.75***	-0.75***	-0.75***	-0.73***	-0.79***	-0.75***	-0.75***	-0.74***	-0.78***
	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)
contig	0.50***	0.50***	0.51***	0.52***	0.49***	0.50***	0.54***	0.41***	0.50***	0.54***	0.52***	0.46***
	(0.14)	(0.15)	(0.16)	(0.15)	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.13)
comlang_off	-0.04	-0.05	-0.05	-0.03	-0.04	-0.04	-0.05	0.06	-0.04	-0.07	-0.03	-0.06
	(0.12)	(0.12)	(0.13)	(0.12)	(0.11)	(0.12)	(0.12)	(0.13)	(0.12)	(0.12)	(0.12)	(0.12)
fta_wto	0.33***	0.30**	0.30**	0.24*	0.35**	0.32**	0.22	0.40***	0.31**	0.26**	0.29**	0.45***
	(0.12)	(0.12)	(0.12)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.12)	(0.13)	(0.13)	(0.13)
colony	-0.16	-0.18	-0.18	-0.25*	-0.16	-0.18	-0.25	-0.16	-0.18	-0.24*	-0.22	-0.04
	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.17)	(0.15)	(0.14)	(0.15)	(0.15)
STRI_o	1.07**	0.25	0.25	0.43	1.06	0.44	-0.38	0.94	0.13	0.12	0.27	0.97***
	(0.45)	(0.25)	(0.26)	(1.13)	(0.66)	(0.69)	(0.41)	(0.74)	(0.22)	(1.29)	(0.66)	(0.34)
STRI_d	-1.07*	-0.54**	-0.49**	-2.17***	-0.80	-0.42	-0.48	0.87*	-0.22	-3.23***	-1.14*	-0.01
	(0.56)	(0.27)	(0.22)	(0.60)	(0.56)	(0.44)	(0.32)	(0.49)	(0.18)	(0.92)	(0.60)	(0.28)
Constant	-30.79***	-30.62***	-30.54***	-29.76***	-30.99***	-30.91***	-30.42***	-32.25***	-30.76***	-29.45***	-30.71***	-29.93***
	(2.09)	(2.39)	(2.58)	(2.93)	(2.42)	(2.48)	(2.69)	(2.81)	(2.51)	(2.84)	(2.57)	(2.06)
Observations	3,784	3,784	3,784	3,784	3,784	3,784	3,784	2,812	3,610	3,784	3,784	3,784
R-squared	0.74	0.70	0.70	0.71	0.72	0.70	0.68	0.71	0.69	0.70	0.70	0.75
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by country pair in parentheses.
The dependent variable is total exports of manufactured goods.
*** p<0.01, ** p<0.05, * p<0.1.
Maritime (8) and rail transport (9) have fewer observations since 1) landlocked countries are not included,
2) Iceland does not have a railroad.

accounting are used in production of almost any good (Deardorff 2001; Hoekman and Shepherd 2017). The sector with an unexpected positive coefficient is maritime transport, which may be due to the structure of world maritime business. While the biggest shipowning economies are Greece, Japan, China, Germany and Singapore, the top five economies by flag of registration are Panama, Liberia, the Marshall Islands, Hong Kong (China) and Singapore.[18] Thus, the STRI may not properly capture the impact of trade barriers in maritime transport on bilateral trade in goods.

For illustrative purpose, I compute the marginal effect of a reduction in the STRI indices for the importer for the road transport sector and legal services on trade in goods, which can provide an approximation of the magnitude of the estimated effect. These two coefficients on the STRI indicate the strongest and the weakest, respectively, negative association with imports. If interpreted as a causal relation, lowering the STRI for road transport from the mean value of 0.21 to 0.16 would result in an increase in imports of goods by 17 per cent, while a corresponding reduction in the STRI for legal services (from the average index 0.37 to 0.32) would have a smaller impact on imports of goods – an increase by approximately 2 per cent.[19] The predicted increase in trade volume by 17 per cent should be interpreted with caution. To compare, Hoekman and Shepherd (2017) estimated that a corresponding percentage decrease in the restrictiveness of services trade policies in transport is associated with approximately a 6 per cent increase in bilateral trade in manufactured goods. Hoekman and Shepherd (2017) did not, however, distinguish between different types of transport services. Furthermore, the estimated coefficients indicate a change in bilateral trade that is related to a change in the level of services restrictiveness that can occur in the long – rather than in the short – run. It is possible to open the services markets in a short period of time, but it may take time to adjust to a more open trade regime. With only a few years of observations, it is not possible to say how long a country has been open (or not). Thus, based on the results, it is only possible to conclude that countries with open services markets trade more than countries with more restricted services markets. Furthermore, from the results it cannot be interfered how long it takes for an economy that liberalizes trade in services today to increase trade in goods to the predicted level.

Unexpectedly, I do not find the same pattern for the coefficients on the STRI for the exporter. In

[18] UNCTAD, 2016.

[19] The percentage change in imports from a 0.05 points reduction in the STRI in road transport services is computed as follows: $[exp(-0.05 \times (-3.23)) - 1] \times 100$.

fact, there are only significant coefficients in 2 out of 12 sectors, and both of them are positive. The results for the baseline estimation with total manufacturing exports as the dependent variable, reported in Table 4, are rather ambiguous. As mentioned in Section 3.3, the intensity, with which services are used as inputs in the production of goods, varies across the manufacturing sectors. Thus, policies affecting trade in services may have a different effect on trade in manufactured goods in different industries. If this is the case, it might explain the absence of the meaningful results for the exporting country. I investigate how the association between the sectoral STRIs and trade varies across industries in the next subsection.

5.2 Results by Type of Goods and Discussion

To explore the relationship between the STRIs and trade in service-intensive industries, I estimate equation (6) using bilateral exports, broken down by sectors, instead of the aggregated trade data. The results for the pharmaceutical and motor vehicles industries are presented in Tables 5 and 6. The results for the apparel industry are set out in the Appendix.[20]

Due to heterogeneity across manufacturing industries, it is likely that trade performance in the high-tech industries with complex and differentiated products would be more affected by regulatory trade barriers in services than trade in the labour-intensive industries with differentiated but less advanced products. Among sectors included in the analysis, sectors such as production of pharmaceuticals and motor vehicles are classified as high- and medium-high-technology industries, respectively, in the technology classification of manufacturing industries.[21] The results, presented in Tables 5 and 6, are striking. For a majority of services sectors included in the analysis, the coefficients on the STRI both for the exporter and importer are negative and highly significant thus supporting the hypothesis that services trade restrictions indeed are important for trade in goods.

Comparing the results for these two industries, there are several characteristics that deserve to be mentioned and further investigated in future work. Firstly, the magnitude of the coefficients on

[20]For the sake of brevity, the results for inorganic chemicals, organic chemicals, and electrical machinery are not shown. The analysis does not reveal any clear pattern for these sectors. With only a few statistically significant coefficients on the STRI indices, their magnitude and variations of the sign cannot be evaluated appropriately. The absence of meaningful results for these industries can be interpreted as supporting the hypothesis investigated in the subsection: trade in less service-intensive industries is less affected by services regulations.

[21]See "Glossary: High-tech classification of manufacturing industries" at `http://ec.europa.eu/eurostat`.

Table 5. Cross-border exports of goods (pharmaceuticals only) and STRI: PPML estimations

	(1) Telecoms	(2) Accounting	(3) Legal	(4) Computer	(5) Banking	(6) Insurance	(7) Logistics	(8) Maritime	(9) Rail	(10) Road	(11) Distribution	(12) Courier
lgdp_o	0.69***	0.68***	0.64***	0.71***	0.68***	0.73***	0.69***	0.74***	0.66***	0.68***	0.68***	0.74***
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.07)	(0.05)	(0.05)	(0.05)	(0.05)
lgdp_d	0.86***	0.86***	0.83***	0.88***	0.86***	0.89***	0.86***	0.86***	0.85***	0.87***	0.86***	0.91***
	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
ldistw	-0.90***	-0.99***	-0.97***	-0.92***	-0.91***	-0.85***	-0.87***	-0.93***	-0.94***	-0.95***	-0.91***	-0.81***
	(0.08)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)
contig	-0.40**	-0.55***	-0.41**	-0.49**	-0.40**	-0.40**	-0.40**	-0.39*	-0.48**	-0.47**	-0.42**	-0.43**
	(0.18)	(0.19)	(0.20)	(0.19)	(0.20)	(0.19)	(0.19)	(0.22)	(0.20)	(0.20)	(0.19)	(0.18)
comlang_off	0.97***	0.96***	0.90***	0.93***	1.04***	1.10***	1.03***	1.06***	0.99***	0.97***	1.09***	1.14***
	(0.17)	(0.18)	(0.19)	(0.19)	(0.18)	(0.17)	(0.18)	(0.21)	(0.19)	(0.18)	(0.18)	(0.17)
fta_wto	-0.19	0.02	-0.04	0.26	-0.23	-0.21	-0.17	-0.04	-0.06	0.14	-0.01	-0.12
	(0.22)	(0.21)	(0.20)	(0.22)	(0.22)	(0.21)	(0.23)	(0.20)	(0.24)	(0.20)	(0.20)	(0.19)
colony	-0.49**	-0.17	-0.26	-0.04	-0.51**	-0.56**	-0.48**	-0.23	-0.24	-0.20	-0.39	-0.52**
	(0.21)	(0.21)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.25)	(0.22)	(0.24)	(0.24)	(0.21)
STRI_o	-4.36***	-1.30***	-1.06***	2.43*	-3.71***	-4.02***	-4.35***	-3.56***	-1.11***	0.96	-2.39**	-2.45***
	(0.76)	(0.39)	(0.31)	(1.32)	(1.04)	(0.94)	(0.92)	(1.21)	(0.43)	(1.16)	(1.01)	(0.51)
STRI_d	-3.18***	-1.32***	-1.28***	-0.25	-2.89***	-2.61***	-1.13*	-1.31	-0.93***	-3.33**	-2.67***	-1.32***
	(0.76)	(0.41)	(0.32)	(1.16)	(0.85)	(0.67)	(0.63)	(0.98)	(0.32)	(1.55)	(0.96)	(0.38)
Constant	-21.51***	-21.67***	-19.80***	-24.93***	-21.36***	-24.25***	-21.90***	-23.07***	-21.45***	-22.49***	-22.17***	-25.74***
	(1.72)	(1.83)	(2.11)	(2.10)	(1.91)	(1.98)	(1.84)	(2.93)	(1.99)	(1.92)	(1.78)	(1.99)
Observations	3,784	3,784	3,784	3,784	3,784	3,784	3,784	2,812	3,612	3,784	3,784	3,784
R-squared	0.47	0.39	0.38	0.37	0.42	0.43	0.42	0.41	0.38	0.36	0.40	0.47
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by country pair in parentheses.
The dependent variable is exports, sector HS 30 only.
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Cross-border exports of goods (motor vehicles and their parts) and STRI: PPML estimations

	(1) Telecoms	(2) Accounting	(3) Legal	(4) Computer	(5) Banking	(6) Insurance	(7) Logistics	(8) Maritime	(9) Rail	(10) Road	(11) Distribution	(12) Courier
lgdp_o	0.90***	0.91***	0.88***	0.85***	0.90***	0.98***	0.91***	1.11***	0.90***	0.87***	0.89***	0.96***
	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.06)	(0.05)	(0.09)	(0.05)	(0.04)	(0.04)	(0.06)
lgdp_d	1.07***	1.05***	1.03***	1.02***	1.07***	1.06***	1.07***	1.10***	1.05***	1.02***	1.09***	1.09***
	(0.07)	(0.06)	(0.06)	(0.06)	(0.08)	(0.07)	(0.08)	(0.09)	(0.07)	(0.07)	(0.07)	(0.08)
ldistw	-0.48***	-0.57***	-0.57***	-0.65***	-0.46***	-0.43***	-0.43***	-0.42***	-0.52***	-0.65***	-0.49***	-0.43***
	(0.09)	(0.09)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.08)	(0.09)
contig	0.77***	0.62***	0.72***	0.66***	0.83***	0.84***	0.83***	0.77***	0.70***	0.75***	0.87***	0.76***
	(0.24)	(0.21)	(0.21)	(0.24)	(0.26)	(0.27)	(0.27)	(0.26)	(0.24)	(0.24)	(0.23)	(0.26)
comlang_off	-0.14	-0.15	-0.21	-0.00	-0.16	-0.00	-0.10	-0.03	-0.13	-0.28	0.14	-0.01
	(0.22)	(0.19)	(0.19)	(0.20)	(0.25)	(0.25)	(0.25)	(0.32)	(0.20)	(0.22)	(0.23)	(0.24)
fta_wto	1.05***	1.14***	1.03***	0.73***	0.95***	0.90***	0.98***	1.23***	1.13***	0.88***	0.91***	1.12***
	(0.23)	(0.22)	(0.20)	(0.21)	(0.27)	(0.24)	(0.25)	(0.26)	(0.23)	(0.19)	(0.21)	(0.23)
colony	-0.53**	-0.36*	-0.32	-0.70***	-0.56**	-0.63**	-0.60**	-0.47*	-0.38	-0.58**	-0.70***	-0.52**
	(0.26)	(0.21)	(0.25)	(0.26)	(0.28)	(0.27)	(0.26)	(0.27)	(0.23)	(0.24)	(0.23)	(0.27)
STRI_o	-2.17***	-0.51	-0.77**	-6.89***	-3.72**	-5.26***	-5.34***	-4.34**	-0.44	-9.94***	-7.60***	-1.95***
	(0.78)	(0.49)	(0.32)	(1.03)	(1.50)	(1.01)	(1.46)	(1.82)	(0.44)	(1.60)	(1.53)	(0.63)
STRI_d	-1.63**	-1.17***	-1.08***	-2.97***	-1.57*	-0.55	-0.13	0.41	-0.73**	-5.01***	-1.77**	-0.06
	(0.83)	(0.42)	(0.36)	(1.15)	(0.81)	(0.70)	(0.53)	(0.85)	(0.34)	(1.55)	(0.87)	(0.40)
Constant	-37.51***	-36.75***	-35.35***	-31.96***	-37.34***	-39.64***	-37.74***	-44.76***	-37.40***	-31.55***	-36.82***	-40.53***
	(2.59)	(2.48)	(2.40)	(2.41)	(3.06)	(2.83)	(2.89)	(3.51)	(2.72)	(2.49)	(2.70)	(3.24)
Observations	3,784	3,784	3,784	3,784	3,784	3,784	3,784	2,812	3,612	3,784	3,784	3,784
R-squared	0.65	0.68	0.69	0.67	0.61	0.64	0.62	0.62	0.65	0.68	0.66	0.62
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by country pair in parentheses.
The dependent variable is exports, sector HS 87 only.
*** p<0.01, ** p<0.05, * p<0.1

the STRI for production of pharmaceuticals differs from those effects of services trade restrictions estimated for the motor vehicle industry. Trade restrictions in services are more important for trade in the motor vehicles industry than in pharmaceuticals. Secondly, the absolute value of the coefficients on the exporter's STRI are larger than on the importer's STRI. A similar pattern has been observed by Nordås and Rouzet (2017). Finally, trade restrictions in the transport, retail, and courier sectors turn out to be especially important for trade performance, and the negative effect of the STRI on trade performance is larger in the motor vehicles industry than in the pharmaceutical industry. The last observation reflects the fact that pharmaceuticals have a much higher value to weight ratio than motor vehicles and, hence, transport costs are a smaller share of c.i.f. import prices pharmaceuticals.

To illustrate, I compute the percentage change in exports and imports in both industries that corresponds to a reduction in the STRI index for distribution services from the mean value of 0.19 to 0.14. Such a modest trade liberalisation is associated with 14 per cent higher imports and 13 per cent higher exports of pharmaceuticals. Similarly, a reduction in the STRI index for distribution services from 0.19 to 0.14 corresponds to a 9 per cent increase in imports of motor vehicles and a 46 per cent increase in exports of motor vehicles. The estimated association between STRI for distribution and exports of motor vehicles is rather high. Motor vehicles are produced within global value chains using just-in-time supply chain management – a cost-effective distribution sector is crucial for the industry. While sector HS 87 is wide and includes motor vehicles and their parts, there are only a few dominant exporters of final motor vehicles in the world. Suppliers of parts and components are likely to be much more sensitive to barriers that can slow down delivery or jeopardize reliability of suppliers to deliver on time.

The analysis of the effect of the STRI on trade in apparel (sectors HS 61 and HS 62) uncovers an interesting pattern. Almost all coefficients on the STRI both for the importer and exporter are highly significant. As shown in Tables A.6 and A.7, the coefficients on the STRI for the importer have a negative sign as expected, whereas all coefficients on the STRI for the exporter are positive. As in the motor vehicles industry, while almost all countries in the world import apparel, only a few countries account for two-thirds of world exports.[22] Looking at the distribution of bilateral trade in the industry, I find it to be highly right-skewed and China's share is almost 50 per cent of

[22]World Trade Statistical Review, 2016.

total exports. Furthermore, the clothing industry is an example of a so-called buyer-driven value chain, i.e., a highly dispersed global production network where big multinational retailers control value-added activities such as branding and design but outsource labour-intensive manufacturing activities as sewing to foreign suppliers (Gereffi 1999). It is likely that countries with low STRI scores, i.e., with low regulatory barriers to trade in services, are those countries that export services (e.g., design) and import clothes. As Gereffi (1999) points out, the global value chains in the apparel industry are dispersed and decentralised. The coefficients on the STRI for the country of origin and country of destination in Tables A.6 and A.7 may reflect this characteristic of the industry.

To sum up, these findings support the hypothesis that barriers to trade in services are negatively related to trade in manufactured goods, and, therefore, services trade liberalisation may have a positive effect on trade in goods. I find that the STRI indices in telecommunications, accounting, legal, computer, road transport, and distribution services in the importing country are significantly and negatively associated with trade in goods. The relationship between the STRI and trade in goods for the exporting country is less clear. When trade at the sectoral level is included in the analysis, it appears that services trade restrictions are important for trade in pharmaceuticals, apparel, and motor vehicles. Another important finding is that the estimates of the STRI indices vary in different dimensions: not only across different services sectors, which confirms that some services are more important in production of goods than others, but even across importers and exporters and across manufacturing sectors.

From the theoretical background, outlined in Section 3.2, I expected to find a negative association between restrictions in services and trade in manufactured goods. In general, the qualitative results established in the thesis are in line with the predictions from the models of trade in intermediate products. Furthermore, the quantitative estimates of the impact on imports are in line with Hoekman and Shepherd (2017). They estimate that a 10 per cent increase in the overall restrictiveness of services trade policies in the importing country is associated with a 5 per cent decrease in bilateral trade in manufactured goods. Furthermore, Hoekman and Shepherd (2017) find that restrictions on transport, commercial banking, and retail distribution services are the most important for goods trade – a 10 per cent increase in sectoral trade barriers in services corresponds to a decrease in aggregated bilateral trade between 1 and 8 per cent. Although an overall index is not available for the OECD STRI, the coefficients estimated in the thesis indicate an impact of

services restrictions on trade in goods that lie within a comparable range: a 10 per cent decrease in the STRI score corresponds to an increase in goods imports in a range between 2 per cent and 7 per cent.[23]

The findings add to the previous literature by taking into account restrictions in both the exporter and importer and by including a broader range of service sectors, making the estimations more nuanced. As shown in Section 3.1, services constitute a large share of value-added exports of manufactured goods and the STRIs are associated with poorer performance of two of the services most important for value chains – logistics and telecommuniciations. Hence, the results suggest some important channels through which liberalisation of trade in services may boost trade in manufactured goods. Furthermore, the finding that the association between restrictive regimes in services and trade on goods is heterogeneous and varies within and across industries opens up for further studies to explore this heterogeneity.

5.3 Robustness Tests

To test the sensitivity of the results, I conduct several robustness tests. As mentioned in Section 4.1, without controlling for the MTR terms, the estimates would suffer from omitted variable bias. To simply include country fixed effects, as suggested by Feenstra (2004) and which has been widely applied in the gravity literature, is not feasible here, given that the STRI does not vary bilaterally. I use two alternative methods to check whether the main estimates are affected by omitted variables bias due to the issue of multilateral resistance or not.

One solution is to apply the Baier and Bergstrand (2009) transformation, i.e., to derive a first order Taylor approximation of multilateral resistance. Hoekman and Shepherd (2017) apply this method to control for multilateral resistance and modify each trade cost variable using the GDP-weights as follows:

$$v_{ij}^{*} = v_{ij} - \sum_{j=1}^{N} \frac{GDP_j}{GDP_{world}} v_{ij} - \sum_{i=1}^{N} \frac{GDP_i}{GDP_{world}} v_{ij} \tag{7}$$

where, as previously, the subscripts i and j indicate the exporting and importing country, respectively; and v is a trade cost variable. I follow Hoekman and Shepherd (2017) and apply the

[23]For example, a 10 per cent decrease in the STRI for telecoms corresponds to a reduction in the STRI score approximately by 0.02 – from the average value of 0.24 to 0.22. Based on the coefficients on the STRI reported in Table 4, the percentage change in imports from a reduction in the STRI in telecommunications is computed as follows: $[exp(-0.02 \times (-1.07)) - 1] \times 100$.

transformation in (7) to the following variables: bilateral distance, common official language, colonial links, participation in an RTA and the STRI for the exporting and importing countries. The gravity equation takes the form:

$$\begin{aligned} X_{ijt} =& exp[\beta_0 + \beta_1 STRI^*_{ikt} + \beta_2 STRI^*_{jkt} + \delta_1 ln(GDP_{it}) + \delta_2 ln(GDP_{jt}) + \\ & \delta_3 ln(Distance_{ijt})^* + \delta_4 Contiguity_{ijt} + \delta_5 Language^*_{ijt} + \delta_6 Colony^*_{ijt} + \\ & \delta_7 RTA^*_{ijt} + \eta_t + \epsilon_{ijt}] \end{aligned} \tag{8}$$

where all subscripts are defined as in (6). The variables marked with a star are modified by applying the Baier and Bergstrand (2009) transformation defined in (7).

The results of estimations using the Baier and Bergstrand (2009) approach are presented in column 2 in Table A.8. Equation (8) is estimated separately for each sector.[24] In the interest of brevity, only coefficients on the STRI are shown in Tables A.8 and A.9. The dependent variable in all cases is total exports of manufactured goods. The coefficients on the sectoral STRIs in columns 2 and 1 are almost identical. All significant coefficients have the same sign. The magnitude and significance of the coefficients are preserved compared to the baseline estimates.

To investigate whether the estimations with the disaggregated data are affected by the issue of multilateral resistance, I repeat the same procedure for the motor vehicles industry. The sector is selected due to the fact that the strongest negative association between trade performance and the STRI indices for the majority of services is found in the motor vehicles industry. The results are shown in column 2 in Table A.9. As with the robustness test of the baseline equation, applying the Baier and Bergstrand (2009) transformation to the gravity equation with sectoral trade flows does not alter the results. The magnitude, sign, and level of significance of the estimated coefficients on the STRI indices are almost identical compared to the main estimations (column 1). Thus, the results are robust to the Baier and Bergstrand (2009) transformation, which suggests that the omitted variable bias may not be a serious concern.

Additionally, I include in the estimated equation so-called one-way country fixed effects from Nordås and Rouzet (2017). The idea is to test the sensitivity of the exporting and importing

[24] In the original paper, Baier and Bergstrand (2009) apply a first order Taylor approximation to trade costs variables and then estimate the gravity equation using OLS. I follow, however, the approach implemented by Hoekman and Shepherd (2017) and apply the PPML estimator.

country estimates by including exporter-year fixed effects and importer-year fixed effects separately (Nordås and Rouzet 2017). The results appear in column 3 in Table A.8. Their approach generates slightly different estimated coefficients. For instance, the coefficients on the STRI that are insignificant in column 1 (accounting, legal, commercial banking, maritime and rail transport, courier services) become significant. But in the majority of these cases, the level of significance is very low. Their magnitude is almost unchanged, and all coefficients on the STRI indices have the same sign as in the main estimations.

I apply the same robustness test to trade in the motor vehicles industry. Even though the coefficients on the STRI indices have a slightly larger magnitude, the main results are not changed (column 3 in Table A.9). Despite some minor differences, this robustness test confirms that the association between the STRI and trade in goods — at both the aggregated and disaggregated levels — do not disappear when one-way country fixed effects are included.

A serious concern regarding trade data is the presence of zero trade flows and heteroscedasticity. As discussed in Section 4, to deal with the issues I rely on the PPML estimation technique rather than on the OLS estimator. Head and Mayer (2015) recommend to include OLS as part of the robustness checks to warrant the use of the PPML estimator. Following their recommendations, I run two corresponding OLS regressions – on total goods exports and on trade in the motor vehicles industry only. The coefficients on the STRI indices are summarized in column 4 in Tables A.8 and A.9. It is important to mention that the aggregated trade data used in the thesis contains only a small number of zero observations, and the share of zeros in the two-digit trade data is less than 10 per cent for the industries included in the analysis. As expected, the OLS coefficients on the STRI indices (and on the standard gravity variables) are larger in absolute terms than those estimated using the PPML technique.[25] It suggests that at least the PPML estimator does not overestimate the results.

Finally, there is one more concern that should be considered. The PPML estimator assumes that there is a constant variance-to-mean ratio of the model. Using the PPML technique, all

[25] As part of the robustness checks, I excluded zero trade flows from the sample and estimated (6) for total goods exports and trade in HS 87 with PPML. The coefficients on the STRI (not shown) are similar to those obtained with PPML using the whole sample and differ significantly from the estimates under OLS. In line with Santos Silva and Tenreyro (2006), the truncation has almost no effect, highlighting the importance of heteroscedasticity (rather than zero trade) for the differences between the results under PPML and OLS.

observations are equally weighted. However, it is possible that the dispersion grows as the number of observations increases (Magerman et al. 2016). Head and Mayer (2015) recommend to include in the robustness check an alternative PML estimator – the Gamma PML estimator (GPML). Like the Poisson PML, the Gamma PML is robust to heteroscedasticity and the presence of zero values. Contrary to the PPML, this estimator assumes that the dispersion increases with the number of observations and it assigns more weights to the observations with smaller means. The results in column 6 in Tables A.8 and A.9 show that the Gamma coefficients are slightly larger in absolute magnitude than the Poisson coefficients, a phenomenon that is often observed in practice and can occur in small samples (Head and Mayer 2015). As expected, the results from using both PPML and GPML are different from the OLS estimates.

6 Conclusion

In this thesis, I test the hypothesis that trade in goods is negatively affected by restrictions on trade in services. Using the OECD STRI, I find empirical evidence supporting the hypothesis and, therefore, supporting the idea that liberalisation of trade in services could stimulate trade in goods.

Firstly, I investigate the relationship between trade at the aggregated level and the sectoral STRI indices. I find that countries with higher STRI scores tend to have lower trade in goods. In particular, the STRI for telecommunications, accounting, legal, computer, road transport, and distribution services is significantly and negatively associated with imports of goods. However, the results for exports of goods do not show any clear pattern, which might be due to the fact that some industries are more service-intensive than others. The aggregated trade data might even out the differences between industries.

Secondly, I explore the relationship between the sectoral STRIs and bilateral trade for the most service-intensive manufacturing industries. I find a robust negative association between the STRIs and both imports and exports of goods for the high- and medium-high-technology industries – pharmaceuticals and motor vehicles. The results show that regulatory trade restrictions in telecommunications, distribution, and transport services have the largest impact on trade in these industries. In the apparel industry, there is a strong negative relation between the STRI indices for all services sectors for imports of goods, while exports are positively associated with the STRIs. The negative

association between the STRIs and trade in goods indicates that costs, faced by producers of goods, are raised by laws and regulations affecting both local and foreign suppliers of services. In the case of the apparel industry, the positive association between the STRIs and export performance may reflect the fact that big multinational retailers are lead firms in the textile and apparel supply chain and often outsource labour-intensive tasks (e.g., cutting and sewing) but more complicated and less labour-intensive activities (e.g., design and branding) are usually done by highly qualified specialists localised in head-quarter economies. The results are robust when other estimations techniques are applied.

In general, the main finding – the restrictive regimes in services are negatively related to international trade in goods – is largely in line with the previous literature and what theory predicts. I expand the previous findings by showing that the estimated association between services trade restrictions and trade in goods varies in different dimensions: across the service sectors, across importers and exporters and across manufacturing industries. Furthermore, I apply a more accurate measure of regulatory trade barriers in services and show that the high- and medium-high-technology industries, producing complex heterogeneous goods, could gain more from services trade liberalisation than other sectors.

Based on the results, it is clear that policymakers should consider lowering regulatory trade barriers in services in order to improve trade in goods. The findings suggest that liberalisation of trade in services, where barriers to trade are still high, might be an effective strategy aiming at performance in trade in goods, where tariffs are already very low. For the service-intensive high- and medium-high-technology industries, it is especially important to focus on trade policies in transport, logistics, distribution, and computer services. Moreover, policies, targeting regulatory trade barriers in business and financial services, would also have a solid positive impact on trade. Finally, to consider policies related to the telecommunication sector would be beneficial for trade in goods.

I find that there is a significant variation between the impact of services trade restrictions in the origin and destination countries on trade in goods at the sectoral level. Further exploring the determinants of these variations might be an interesting area for future studies. Another potentially interesting question to study is to investigate whether liberalisation of trade in services might increase welfare reducing inefficiency in economy.

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A Additional Tables

Table A.1. List of variables and sources

Variables	Definition	Year	Source
exports	Total exports value of manufactured goods from country i to country j in thousand US$, only manufacturing sectors	2014-2015	WITS
contig	Contiguity. Dummy variable. Equal to one if the exporter and the importer have a common land border.	2014-2015	CEPII
comlang_off	Common official or primary language. Dummy variable. Equal to one if the exporter and the importer have a common official or primary language.	2014-2015	CEPII
distw	Geodesic weighted distance between the exporter and importer.	2014-2015	CEPII
gdp_o	Gross domestic product in the exporting country in current US$.	2014-2015	CEPII
gdp_d	Gross domestic product in the importing country in current US$.	2014-2015	CEPII
colony	Colony. Dummy variable. Equal to one if the country pair has ever been in colonial relationship	2014-2015	CEPII
fta_wto	RTA. Dummy variable. Equal to one if the exporter and the importer are in the same RTA	2014-2015	CEPII
STRI_o	Services trade restrictiveness index for the exporting country, measured at the sectoral level, on scale from 0 to 1.	2014-2015	OECD STRI
STRI_d	Services trade restrictiveness index for the importing country, measured at the sectoral level, on scale from 0 to 1.	2014-2015	OECD STRI

Table A.2. Sector performance indicators, summary statistics

	(1)	(2)	(3)	(4)	(5)
Variables	**N**	**mean**	**sd**	**min**	**max**
Fixed broadband subscriptions (per 100 people)	88	26.40	11.20	1.24	45.11
Logistics performance index: Overall (1=low to 5=high)	44	3.53	0.38	2.64	4.12
Mobile cellular subscriptions per 100 people	88	121.70	19.62	74.48	164.50
Secure internet servers per 1 million people	88	935.00	908.10	5.54	3 407
Fixed telephone subscriptions per 100 people	88	32.40	15.47	1.99	60.03

Source: WDI.

Table A.3. List of countries in the estimations

Australia	Greece	Norway
Austria	Hungary	Poland
Belgium	Iceland	Portugal
Brazil	India	Russia
Canada	Indonesia	Slovak Republic
Chile	Ireland	Slovenia
China	Israel	South Africa
Colombia	Italy	South Korea
Costa Rica	Japan	Spain
Czech Republic	Latvia	Sweden
Denmark	Lithuania	Switzerland
Estonia	Luxembourg	Turkey
Finland	Mexico	United Kingdom
France	Netherlands	United States
Germany	New Zealand	

Note that all countries included in the estimations are countries covered by the OECD STRI.

Table A.4. Summary statistics for STRI indices

	(1)	(2)	(3)	(4)	(5)
Variables	**N**	**mean**	**sd**	**min**	**max**
STRI for telecommunications	3784	0.24	0.11	0.11	0.57
STRI for accounting	3784	0.32	0.20	0.08	1.00
STRI for computer services	3784	0.23	0.07	0.11	0.46
STRI for commercial banking	3784	0.24	0.09	0.13	0.50
STRI for courier	3784	0.31	0.17	0.12	1.00
STRI for distribution	3784	0.19	0.10	0.09	0.64
STRI for insurance	3784	0.22	0.10	0.11	0.56
STRI for legal	3784	0.37	0.23	0.09	1.00
STRI for logistics (cargo)	3784	0.27	0.14	0.13	1.00
STRI for maritime transport	3268	0.26	0.09	0.13	0.58
STRI for road freight transport	3784	0.21	0.07	0.12	0.42
STRI for rail freight transport	3698	0.30	0.23	0.15	1.00

Source: OECD STRI.
Notes: The number of observations corresponds to the number of observations in the gravity equation (6), where the STRIs are duplicated for each trading partner.

Table A.5. Manufacturing sectors coverage at two-digit level

Manufacturing sector	**HS 2002**
Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes	28
Organic chemicals	29
Pharmaceutical products	30
Articles of apparel and clothing accessories, knitted or crocheted	61
Articles of apparel and clothing accessories, not knitted or crocheted	62
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles	85
Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof	87

Table A.6. Cross-Border Exports of Goods (apparel and clothing accessories, knitted or crocheted) and STRI: PPML Estimations

	(1) Telecoms	(2) Accounting	(3) Legal	(4) Computer	(5) Banking	(6) Insurance	(7) Logistics	(8) Maritime	(9) Rail	(10) Road	(11) Distribution	(12) Courier
lgdp_o	1.17***	1.27***	1.26***	1.23***	1.14***	0.96***	1.14***	0.93***	1.15***	1.21***	1.18***	0.82***
	(0.08)	(0.13)	(0.12)	(0.10)	(0.09)	(0.09)	(0.12)	(0.11)	(0.12)	(0.11)	(0.10)	(0.05)
lgdp_d	0.80***	0.83***	0.86***	0.89***	0.89***	0.98***	0.91***	0.98***	0.85***	0.87***	0.87***	0.96***
	(0.07)	(0.12)	(0.13)	(0.11)	(0.11)	(0.14)	(0.15)	(0.17)	(0.14)	(0.12)	(0.13)	(0.11)
ldistw	-0.92***	-0.90***	-0.89***	-0.75***	-0.88***	-0.87***	-0.81***	-0.92***	-0.87***	-0.84***	-0.87***	-0.79***
	(0.08)	(0.14)	(0.12)	(0.10)	(0.10)	(0.11)	(0.14)	(0.11)	(0.16)	(0.10)	(0.11)	(0.08)
contig	0.30	0.29	0.16	0.33	0.39*	0.38	0.26	0.18	0.28	0.33	0.41*	0.40**
	(0.22)	(0.29)	(0.28)	(0.23)	(0.22)	(0.24)	(0.24)	(0.28)	(0.28)	(0.24)	(0.23)	(0.18)
comlang_off	-0.18	-0.17	-0.18	-0.41	-0.34	-0.36	-0.20	-0.34	-0.23	-0.15	-0.22	-0.19
	(0.28)	(0.28)	(0.28)	(0.28)	(0.26)	(0.27)	(0.31)	(0.40)	(0.30)	(0.29)	(0.28)	(0.29)
fta_wto	0.41*	-0.15	-0.09	0.49*	0.43*	0.48*	0.02	-0.01	-0.26	0.07	0.06	0.63**
	(0.21)	(0.26)	(0.26)	(0.26)	(0.24)	(0.27)	(0.29)	(0.26)	(0.31)	(0.23)	(0.23)	(0.25)
colony	-0.11	-0.85*	-0.70**	-0.05	-0.21	-0.21	-0.68	-0.63	-0.76*	-0.37	-0.48	0.00
	(0.28)	(0.44)	(0.34)	(0.35)	(0.30)	(0.34)	(0.42)	(0.43)	(0.41)	(0.36)	(0.36)	(0.32)
STRI_o	6.87***	2.39***	2.54***	11.48***	7.46***	6.88***	1.74***	6.58***	0.57*	11.94***	5.66***	4.22***
	(0.53)	(0.36)	(0.36)	(1.73)	(0.72)	(0.73)	(0.44)	(0.87)	(0.31)	(1.59)	(0.54)	(0.32)
STRI_d	-4.70***	-2.10**	-1.68***	-3.63***	-6.12***	-3.78***	-2.22	-3.37**	-1.15*	-5.75***	-6.24***	-2.68***
	(0.96)	(0.89)	(0.60)	(1.22)	(1.07)	(0.91)	(1.94)	(1.57)	(0.69)	(1.48)	(1.26)	(0.50)
Constant	-37.21***	-40.49***	-41.04***	-44.19***	-39.17***	-37.22***	-39.32***	-35.74***	-37.25***	-41.47***	-39.07***	-33.37***
	(3.80)	(6.67)	(6.94)	(6.16)	(5.64)	(6.29)	(7.27)	(8.11)	(7.24)	(6.79)	(6.47)	(4.14)
Observations	3,784	3,784	3,784	3,784	3,784	3,784	3,784	2,812	3,612	3,784	3,784	3,784
R-squared	0.73	0.44	0.50	0.66	0.64	0.56	0.43	0.44	0.34	0.57	0.55	0.71
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by country pair in parentheses.
The dependent variable is exports, sector HS 61 only.
*** p<0.01, ** p<0.05, * p<0.1

Table A.7. Cross-Border Exports of Goods (apparel and clothing accessories, not knitted or crocheted) and STRI: PPML Estimations

	(1) Telecoms	(2) Accounting	(3) Legal	(4) Computer	(5) Banking	(6) Insurance	(7) Logistics	(8) Maritime	(9) Rail	(10) Road	(11) Distribution	(12) Courier
lgdp_o	1.13***	1.20***	1.21***	1.21***	1.10***	0.94***	1.11***	0.91***	1.12***	1.19***	1.15***	0.83***
	(0.07)	(0.11)	(0.10)	(0.08)	(0.08)	(0.08)	(0.10)	(0.10)	(0.11)	(0.09)	(0.08)	(0.05)
lgdp_d	0.80***	0.83***	0.85***	0.89***	0.88***	0.96***	0.89***	0.95***	0.84***	0.87***	0.86***	0.94***
	(0.06)	(0.10)	(0.11)	(0.09)	(0.09)	(0.11)	(0.12)	(0.14)	(0.12)	(0.10)	(0.11)	(0.08)
ldistw	-0.87***	-0.84***	-0.84***	-0.73***	-0.85***	-0.84***	-0.79***	-0.89***	-0.82***	-0.82***	-0.85***	-0.76***
	(0.07)	(0.12)	(0.10)	(0.09)	(0.09)	(0.10)	(0.12)	(0.09)	(0.14)	(0.09)	(0.10)	(0.08)
contig	0.43**	0.42	0.31	0.42*	0.49**	0.46*	0.37	0.31	0.42	0.42*	0.50**	0.50***
	(0.20)	(0.28)	(0.28)	(0.23)	(0.21)	(0.24)	(0.24)	(0.28)	(0.28)	(0.24)	(0.23)	(0.18)
comlang_off	-0.15	-0.17	-0.15	-0.37	-0.29	-0.31	-0.17	-0.38	-0.21	-0.11	-0.22	-0.17
	(0.27)	(0.29)	(0.28)	(0.29)	(0.26)	(0.27)	(0.31)	(0.41)	(0.31)	(0.29)	(0.28)	(0.29)
fta_wto	0.34*	-0.18	-0.10	0.48**	0.34	0.41*	-0.00	-0.03	-0.25	0.06	0.03	0.46**
	(0.19)	(0.23)	(0.23)	(0.22)	(0.21)	(0.24)	(0.25)	(0.23)	(0.27)	(0.21)	(0.21)	(0.21)
colony	0.03	-0.58	-0.49	0.15	-0.06	-0.04	-0.44	-0.36	-0.54	-0.15	-0.27	0.08
	(0.30)	(0.42)	(0.31)	(0.35)	(0.31)	(0.34)	(0.41)	(0.43)	(0.41)	(0.35)	(0.36)	(0.34)
STRI_o	6.38***	1.92***	2.37***	11.30***	6.83***	6.46***	1.58***	6.43***	0.54*	12.29***	5.52***	3.70***
	(0.54)	(0.34)	(0.34)	(1.41)	(0.70)	(0.69)	(0.42)	(0.74)	(0.31)	(1.32)	(0.49)	(0.32)
STRI_d	-3.97***	-1.75**	-1.46***	-2.72**	-5.00***	-3.15***	-1.32	-2.76**	-0.94	-4.37***	-5.02***	-2.31***
	(0.84)	(0.70)	(0.54)	(1.22)	(1.07)	(0.87)	(1.47)	(1.40)	(0.59)	(1.50)	(1.34)	(0.44)
Constant	-36.65***	-38.42***	-39.85***	-43.73***	-38.11***	-36.18***	-38.09***	-34.54***	-36.42***	-41.50***	-38.23***	-32.82***
	(3.07)	(5.55)	(5.70)	(4.83)	(4.49)	(5.01)	(6.04)	(6.60)	(6.02)	(5.42)	(5.24)	(3.31)
Observations	3,784	3,784	3,784	3,784	3,784	3,784	3,784	2,812	3,612	3,784	3,784	3,784
R-squared	0.73	0.43	0.49	0.66	0.66	0.57	0.41	0.46	0.34	0.58	0.56	0.73
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered by country pair in parentheses.
The dependent variable is exports, sector HS 62 only.
*** p<0.01, ** p<0.05, * p<0.1

Table A.8. Cross-border exports of goods and STRI: comparison of estimates

Estimator	(1) Poisson PML		(2) BB transformation		(3) One-way FE		(4) OLS		(5) Gamma PML	
	Exporter	Importer	Exporter	Importer	Exporter	Importer	Exporter	Importer	Exporter	Importer
Telecoms	1.07**	-1.07*	1.07**	-1.07*	1.06***	-0.93***	-1.54***	0.53*	-0.53*	-0.11
	(0.45)	(0.56)	(0.45)	(0.56)	(0.38)	(0.32)	(0.29)	(0.31)	(0.28)	(0.31)
Accounting	0.25	-0.54**	0.25	-0.54**	0.36*	-0.58***	0.76***	-0.50***	0.80***	-0.53***
	(0.25)	(0.27)	(0.25)	(0.27)	(0.21)	(0.19)	(0.14)	(0.14)	(0.16)	(0.13)
Legal	0.25	-0.49**	0.25	-0.50**	0.37*	-0.55***	0.84***	-1.02***	0.47***	-0.80***
	(0.26)	(0.22)	(0.26)	(0.22)	(0.20)	(0.15)	(0.12)	(0.13)	(0.13)	(0.14)
Computer	0.43	-2.17***	0.45	-2.18***	0.80	-1.79***	-2.89***	-2.81***	-1.62***	-1.99***
	(1.13)	(0.60)	(1.13)	(0.60)	(0.86)	(0.45)	(0.47)	(0.45)	(0.48)	(0.44)
Banking	1.06	-0.80	1.06	-0.80	1.06**	-0.74**	-2.09***	-0.16	-1.37***	-0.40
	(0.66)	(0.56)	(0.66)	(0.56)	(0.52)	(0.36)	(0.36)	(0.35)	(0.33)	(0.35)
Insurance	0.44	-0.42	0.43	-0.43	0.54	-0.39	-2.33***	-1.05***	-1.69***	-1.09***
	(0.69)	(0.44)	(0.69)	(0.44)	(0.55)	(0.31)	(0.35)	(0.32)	(0.31)	(0.34)
Logistics	-0.38	-0.48	-0.38	-0.49	-0.42	-0.32	-2.35***	0.01	-1.79***	0.15
	(0.41)	(0.32)	(0.41)	(0.33)	(0.35)	(0.21)	(0.22)	(0.24)	(0.21)	(0.23)
Maritime	0.94	0.87*	0.92	0.85*	0.98*	0.55	-0.99**	-1.04**	-0.34	-0.45
	(0.74)	(0.49)	(0.74)	(0.50)	(0.57)	(0.42)	(0.39)	(0.42)	(0.36)	(0.41)
Rail	0.13	-0.22	0.13	-0.21	0.22	-0.31**	0.27**	-0.05	0.63***	-0.13
	(0.22)	(0.18)	(0.22)	(0.18)	(0.20)	(0.14)	(0.14)	(0.12)	(0.16)	(0.12)
Road	0.12	-3.23***	0.11	-3.24***	0.47	-2.59***	-3.32***	-2.44***	-1.99***	-2.03***
	(1.29)	(0.92)	(1.29)	(0.92)	(0.98)	(0.67)	(0.56)	(0.49)	(0.58)	(0.50)
Distribution	0.27	-1.14*	0.27	-1.15*	0.35	-1.04***	-1.36***	-1.19***	-1.19***	-1.32***
	(0.66)	(0.60)	(0.66)	(0.61)	(0.56)	(0.33)	(0.32)	(0.33)	(0.26)	(0.30)
Courier	0.97***	-0.01	0.97***	-0.01	0.96***	0.03	-0.67***	0.78***	-0.003	0.52***
	(0.34)	(0.28)	(0.34)	(0.28)	(0.24)	(0.19)	(0.19)	(0.17)	(0.17)	(0.19)
Year FE	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Importer-year FE					Yes					
Exporter-year FE						Yes				

The shown estimates are the coefficients on the STRI indices. Robust standard errors clustered by country pair in parentheses.
The dependent variable is total exports of manufactured goods.
All regressions include all control variables as in the baseline equation, see Section 4.2.
Specifications (1)-(3) estimated using the PPML estimator.
The STRI indices in specification (2) are modified using the Baier and Bergstrand (2009) transformation as defined in (7).
*** p<0.01, ** p<0.05, * p<0.1

Table A.9. Cross-border exports of goods (motor vehicles and their parts) and STRI: comparison of estimates

Estimator	(1) Poisson PML		(2) BB transformation		(3) One-way FE		(4) OLS		(5) Gamma PML	
	Exporter	Importer	Exporter	Importer	Exporter	Importer	Exporter	Importer	Exporter	Importer
Telecoms	-2.17***	-1.63**	-2.17***	-1.63**	-2.35***	-1.42**	-4.75***	-0.19	-3.45***	-0.64
	(0.78)	(0.83)	(0.78)	(0.83)	(0.66)	(0.62)	(0.58)	(0.58)	(0.58)	(0.61)
Accounting	-0.51	-1.17***	-0.51	-1.17***	-0.27	-1.33***	1.60***	-1.23***	0.97***	-1.29***
	(0.49)	(0.42)	(0.49)	(0.42)	(0.40)	(0.37)	(0.25)	(0.29)	(0.23)	(0.25)
Legal	-0.77**	-1.08***	-0.77**	-1.08***	-0.52*	-1.31***	1.17***	-1.43***	1.17***	-1.79***
	(0.32)	(0.36)	(0.32)	(0.36)	(0.29)	(0.32)	(0.24)	(0.26)	(0.29)	(0.19)
Computer	-6.89***	-2.97***	-6.90***	-2.98***	-6.28***	-3.15***	-7.92***	-3.23***	-6.86***	-3.55***
	(1.03)	(1.15)	(1.03)	(1.15)	(1.05)	(0.97)	(0.80)	(0.83)	(0.84)	(0.75)
Banking	-3.72**	-1.57*	-3.73**	-1.57*	-4.02***	-1.90***	-5.04***	-0.71	-3.83***	-1.48**
	(1.50)	(0.81)	(1.50)	(0.81)	(1.00)	(0.72)	(0.65)	(0.69)	(0.71)	(0.66)
Insurance	-5.26***	-0.55	-5.28***	-0.56	-5.32***	-0.97	-6.01***	-1.62***	-4.45***	-2.61***
	(1.01)	(0.70)	(1.02)	(0.70)	(0.75)	(0.62)	(0.64)	(0.63)	(0.66)	(0.59)
Logistics	-5.34***	-0.13	-5.35***	-0.14	-5.43***	-0.18	-6.53***	0.48	-5.93***	0.16
	(1.46)	(0.53)	(1.46)	(0.53)	(0.94)	(0.44)	(0.39)	(0.37)	(0.42)	(0.40)
Maritime	-4.34**	0.41	-4.36**	0.39	-4.77***	-0.37	-3.70***	-0.58	-2.16***	-1.91**
	(1.82)	(0.85)	(1.83)	(0.85)	(1.25)	(0.64)	(0.72)	(0.72)	(0.74)	(0.79)
Rail	-0.44	-0.73**	-0.43	-0.73**	-0.29	-0.76***	-1.59***	-0.60**	0.58**	-0.47*
	(0.44)	(0.34)	(0.44)	(0.35)	(0.39)	(0.29)	(0.33)	(0.26)	(0.26)	(0.25)
Road	-9.94***	-5.01***	-9.95***	-5.02***	-9.51***	-5.29***	-7.91***	-2.14**	-8.80***	-3.14***
	(1.60)	(1.55)	(1.60)	(1.55)	(1.43)	(1.32)	(0.89)	(0.90)	(1.10)	(0.84)
Distribution	-7.60***	-1.77**	-7.62***	-1.79**	-7.71***	-2.04**	-4.21***	-2.09***	-4.13***	-3.27***
	(1.53)	(0.87)	(1.53)	(0.87)	(1.18)	(0.81)	(0.61)	(0.58)	(0.54)	(0.49)
Courier	-1.95***	-0.06	-1.96***	-0.07	-2.01***	-0.20	-2.47***	0.44	-1.78***	0.32
	(0.63)	(0.40)	(0.63)	(0.40)	(0.44)	(0.37)	(0.32)	(0.34)	(0.29)	(0.34)
Year FE	Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Importer-year FE					Yes					
Exporter-year FE						Yes				

The shown estimates are the coefficients on the STRI indices. Robust standard errors clustered by country pair in parentheses.
The dependent variable is exports, sector HS 87 only.
All regressions include all control variables as in the baseline equation, see Section 4.2.
Specifications (1)-(3) estimated using the PPML estimator.
The STRI indices in specification (2) are modified using the Baier and Bergstrand (2009) transformation as defined in (7).
*** p<0.01, ** p<0.05, * p<0.1