Forthcoming in the Edward Elgar *Research Handbook on Trade in Services*

Trade Costs and Global Value Chains in Services

Sébastien Miroudot, OECD.

Ben Shepherd, Principal.

June 3rd, 2015.

Edward Elgar Research Handbook on Trade in Services

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Sébastien Miroudot (OECD) and Ben Shepherd (Developing Trade Consultants)*

Abstract

The paper builds on recent work measuring trade in value added and developing methodologies for estimating trade costs in order to empirically assess the costs faced by services exporters in the context of global value chains. The paper first calculates trade costs for intermediate and final services and compares these costs across countries and sectors, as well as with similar costs faced by goods exporters. It then uses these measures of services trade costs along with new policy data from the OECD's Services Trade Restrictiveness Index (STRI) to analyse the determinants of trade costs in each instance, and develop policy implications.

JEL Classification: F10, F15

Keywords: Trade Costs, Trade in Services, Global Value Chains, Trade in Value Added, Gravity.

* The views expressed in this paper are those of the authors and should not be attributed in any way to the institutions with which they are associated or to the membership of the OECD.

Introduction

While nearly two-thirds of all economic activity is made up of services, trade in services represents a small share of world trade, between one fifth and one quarter when measured on a balance of payments basis. But recent research has highlighted that many services are traded embodied in goods (OECD, 2013). With a value added approach, services account for almost half of world trade. On the one hand, this is explained by the increasing tradability of services due to technological progress but also to trade and investment liberalisation. On the other hand, this is the consequence of the fragmentation of production and the essential role of services in linking activities that are geographically dispersed in global value chains (GVCs). More than ever before, the world economy relies on transport, logistics, financial services and a variety of business services to move goods, people and capital around. All the new evidence on global value chains points out to the importance of services inputs in trade.

The literature on trade in goods has already started to assess the implications of the fragmentation of production on trade costs and their analysis (Noguera, 2012). Theoretical models have also been developed to extend the gravity model to services (Anderson *et al.*, 2014) and to empirically measure trade costs for services (Miroudot *et al.*, 2013a). In this paper, we propose to further integrate the GVC perspective into the analysis of trade in services with new measures of trade costs distinguishing between services inputs and services provided for final consumption. We also look at the policy determinants of these trade costs, using recently released information on barriers to trade in services.

1. The role of services in global value chains

1.1 Services links in global value chains

From Adam Smith to the latest growth theories, the division of labour has been at the heart of explanations of productivity growth. GVCs can be seen as just the latest level in the international division of labour. They have contributed to the upward shift in productivity observed from the mid-1990s to the mid-2000s. Trade, and not just the ICT revolution, has increased growth (Feenstra et al., 2013), in particular because trade in intermediate goods and services improves the allocation of capital and labour across sectors and countries (Jones, 2011). Services play an important role in the value chain because they enable companies to manage production processes that are split across countries (Jones and Kierzkowski, 2001). Without these service links (transport, communication, logistics, finance, etc.), there could be no global value chain.

1.2 Services as value adding activities

But services are not just the “glue” in global value chains; they are also increasingly seen as “value adding activities” in their own right (Dermirkan *et al.*, 2011; Low, 2014). Services are behind enterprise innovation at several levels. Increasingly, R&D and design activities at the beginning of the value chain are being outsourced and becoming service inputs into GVCs.

Even if R&D is conducted in-house, it is also through services (training, education) that the necessary human capital is maintained. Skill improvements, and likewise consulting services and other types of business services, can increase the productivity of firms at any stage in the value chain. Another type of innovation is product innovation. More and more firms are developing their value added by bundling goods and services. Instead of selling products, firms sell solutions; customer services are an integral part of their strategy to add value. Interactions between producers and customers lead to higher levels of customization. These tailored solutions also enhance productivity and contribute to growth.

1.3 Services value chains

The fragmentation of production, which has long taken place in manufacturing industries, is now increasingly occurring also in services. De Backer and Miroudot (2013) indicate that the length of value chains and the use of foreign inputs have increased in several service industries, such as financial services and business services. Rather than a linear value chain, these services are produced through a network of activities in what looks more like a "spider" than a "snake" (Baldwin and Venables, 2010). Gereffi and Fernandez-Stark (2010) discussed GVCs in business services in depth by explicitly distinguishing between horizontal activities (*i.e.* services that are needed by any type of company) and vertical activities (*i.e.* services that are part of a specific value chain in the manufacturing sector).

2. Estimating trade costs for services when production is fragmented

2.1 Gravity and trade costs for services

There are challenges in measuring trade in services (Broussolle, 2014) and comprehensive bilateral trade data for services are not easily available. This could explain why for a long time the gravity literature has chiefly focused on trade in goods. But recently, it was shown that what applies for goods is also relevant for services (Walsh, 2008).

Anderson *et al.* (2014) provide a theoretical foundation for the gravity equation and use it to analyse bilateral trade flows in services. The structural gravity model explains bilateral trade at user prices as a function of the expenditures in the importing country and sales in the exporting economy expressed as a share of world output (the frictionless value of trade) and a variable bilateral trade cost affected by trade costs with other partners (the distortion in trade induced by trade frictions).

Assuming identical preferences or technologies across countries (i.e. a globally common constant elasticity of substitution σ^k across varieties of services *k*), the structural gravity equation is:

$$X_{ij}^k = \frac{Y_i^k . Y_j^k}{Y^k} \left(\frac{t_{ij}^k}{P_j^k . \Pi_i^k} \right)^{1-\sigma^k} \quad (1)$$

where X_{ij}^k is the value of exports of service *k* from country *i* to country *j* at destination prices, Y_i^k the sales of service *k* (to all destinations, at destination prices) in country *i*, Y_j^k the expenditures on service *k* in country *j* (from all origins), and Y^k is world output of service *k* (the sum of all sales/expenditures in all countries) . $t_{ij}^k \geq 1$ is a variable bilateral trade cost between country *i* and country *j* for service *k* but bilateral trade is also affected by trade costs with other partners, summarised in two multilateral resistance terms:

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

$$\left(\mathrm{P}_j^k\right)^{1-\sigma^k} = \sum_i \left(\frac{t_{ij}^k}{\Pi_i^k}\right)^{1-\sigma^k} \frac{Y_i^k}{Y^k} \tag{3}$$

Π_i^k is the outward multilateral resistance and aggregates the incidence of all bilateral trade costs borne by the producers of service *k* in country *i.* P_j^k is the inward multilateral resistance and accounts for the incidence of all bilateral trade costs on buyers of service *k* in country *j.* These two multilateral resistance terms account for the fact that it is relative prices, and thus relative trade costs, that matter for the determination of the global pattern of trade and production. However, they are unfortunately not directly observable.

What Novy (2013) suggests, building on Head and Ries (2001), is to calculate trade costs in a way that does not require information on multilateral resistance, or the relative levels of tariffs and other measures around the world. The trick is to multiply gravity equation (1) describing trade flows from *i* to *j* by the corresponding equation for trade from *j* to *i*. What is obtained is:

$$X_{ij}^k X_{ji}^k = \left(\frac{Y_i^k Y_j^k}{Y^k}\right)^2 \left(\frac{t_{ij}^k t_{ji}^k}{\Pi_i^k \Pi_j^k P_i^k P_j^k}\right)^{1-\sigma} \tag{4}$$

Substituting in the above equation the product of outward and inward multilateral resistance given by equations (1), and rearranging, the proposed measure for trade costs is:

$$\tau_{ij}^k \equiv \left(\frac{t_{ij}^k t_{ji}^k}{t_{ii}^k t_{jj}^k}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{ii}^k . X_{jj}^k}{X_{ij}^k . X_{ji}^k}\right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{5}$$

τ_{ij}^k measures bilateral trade costs $t_{ij}^k t_{ji}^k$ relative to domestic trade costs $t_{ii}^k t_{jj}^k$ and is the geometric mean of barriers to trade in both directions. One is subtracted in order to obtain a tariff equivalent.

This measure was used by Miroudot *et al.* (2013a) to assess trade costs for services and compare them with trade costs for goods. It is 'top down' in the sense that it infers trade costs from observed patterns of trade and production. It captures the full range of cost factors affecting international trade in services (including unobservable trade costs). It

should be clear that these trade costs are not only related to restrictive trade policies or to regulations put in place by governments, they correspond to broad trade frictions that are also explained by the preferences of consumers for domestic services or by cultural differences across countries. The measure includes any type of trade frictions that raise the costs of foreign service suppliers as compared to domestic suppliers. The methodology is theory-based and relies on an identity relationship rather than econometric estimation.

2.2 Trade costs for intermediate and final services

To move from gross trade in services to value added trade, the first step is to decompose trade into intermediate and final flows. Instead of subscript *k* corresponding to different varieties of services, we now use subscript *m* for intermediate services (*i.e.* services used as inputs by companies in the production process) and subscript *f* for final services (*i.e.* services consumed by households and governments, as well as services purchased by firms for investment purposes). Total trade in services from *i* to *j* is defined as:

$$X_{ij} \equiv X_{ij}^{m} + X_{ij}^{f} \tag{6}$$

To facilitate the exposition, we have only two categories of services but *m* and *f* can also be regarded as different varieties of intermediate and final services, and the approach can be generalised to intermediate and final products (not distinguishing between goods and services).

Following Noguera (2012), we decompose gravity equation (1) into intermediate and final trade flows[1]:

$$X_{ij}^{m} = \frac{Y_i \alpha_j Y_j}{Y} \left(\frac{t_{ij}^{m}}{\Pi_i^{m} \mathrm{P}_j^{m}} \right)^{1-\sigma} \tag{7}$$

$$X_{ij}^{f} = \frac{Y_i (1-\alpha_j) Y_j}{Y} \left(\frac{t_{ij}^{f}}{\Pi_i^{f} \mathrm{P}_j^{f}} \right)^{1-\sigma} \tag{8}$$

where α_j is the share of intermediate expenditure in total sales. For simplicity, we assume that there is the same elasticity of substitution among varieties of intermediate and final products but we could have different elasticities in the above equations.[2] Unlike Noguera (2012), we do not assume that trade costs (and multilateral resistance terms) are the same for intermediate and final products, precisely because we are interested in analysing the difference between the two.

[1] The model extends Anderson and van Wincoop (2003) by adding an intermediate goods composite which is used to produce final goods and other intermediates in combination with domestic value added. Households have constant elasticity of substitution (CES) preferences defined over final goods and firms combine varieties of domestic and foreign intermediates also via a CES aggregator. See Noguera (2012) for the details of the model and its assumptions.

[2] When looking at the evolution of trade costs over time or when looking at the change in bilateral trade, the value of σ does not matter, as pointed out by Novy (2013) and Noguera (2012). This is why we don't need to worry about this simplification.

The next step is to look at the product of outward and inward multilateral resistance. For intermediate services, we use equation (7) for country's *i* intranational trade (X_{ii}^m), i.e. goods both produced and sold in the same country, and for country's *j* intranational trade (X_{jj}^m). It gives us:

$$\Pi_i^m P_i^m = \left(\frac{Y_i^2 \alpha_i}{Y X_{ii}}\right)^{\frac{1}{1-\sigma}} t_{ii}^m \tag{9}$$

$$\Pi_j^m P_j^m = \left(\frac{Y_j^2 \alpha_j}{Y X_{jj}}\right)^{\frac{1}{1-\sigma}} t_{jj}^m \tag{10}$$

The product of the gravity equations for intermediate services in both directions is then:

$$X_{ij}^m X_{ji}^m = \alpha_i \alpha_j \left(\frac{Y_i Y_j}{Y}\right)^2 \left(\frac{t_{ij}^m t_{ji}^m}{\Pi_i^m P_i^m \Pi_j^m P_j^m}\right)^{1-\sigma}$$

$$= \alpha_i \alpha_j \left(\frac{Y_i Y_j}{Y}\right)^2 \left(\frac{t_{ij}^m t_{ji}^m}{\left(\frac{Y_i^2 \alpha_i}{Y X_{ii}}\right)^{\frac{1}{1-\sigma}} t_{ii}^m \left(\frac{Y_j^2 \alpha_j}{Y X_{jj}}\right)^{\frac{1}{1-\sigma}} t_{jj}^m}\right)^{1-\sigma}$$

$$= X_{ii}^m X_{jj}^m \left(\frac{t_{ij}^m t_{ji}^m}{t_{ii}^m t_{jj}^m}\right)^{(1-\sigma)}$$

And $$\frac{t_{ij}^m t_{ji}^m}{t_{ii}^m t_{jj}^m} = \left(\frac{X_{ii}^m X_{jj}^m}{X_{ij}^m X_{ji}^m}\right)^{\frac{1}{\sigma-1}} \tag{11}$$

Similarly, for final services:

$$\frac{t_{ij}^f t_{ji}^f}{t_{ii}^f t_{jj}^f} = \left(\frac{X_{ii}^f X_{jj}^f}{X_{ij}^f X_{ji}^f}\right)^{\frac{1}{\sigma-1}} \tag{12}$$

We thus obtain two measures of trade costs for intermediate and final services when taking the geometric mean of the barriers in both directions:

$$\tau_{ij}^m \equiv \left(\frac{t_{ij}^m t_{ji}^m}{t_{ii}^m t_{jj}^m}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{ii}^m X_{jj}^m}{X_{ij}^m X_{ji}^m}\right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{13}$$

$$\tau_{ij}^f \equiv \left(\frac{t_{ij}^f t_{ji}^f}{t_{ii}^f t_{jj}^f}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{ii}^f X_{jj}^f}{X_{ij}^f X_{ji}^f}\right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{14}$$

3. Dataset and statistical issues

3.1 The World Input-Output Database (WIOD)

To estimate trade costs in services, this paper relies on the World Input-Output Database (Timmer *et al.*, 2014). The dataset consists of a time-series of world input-output tables covering the period 1995 to 2011, with detailed data for 40 economies (27 EU countries and 13 other major advanced and emerging economies). The advantage is that these tables are consistent with national accounts, harmonised across countries and account for all inter-country and inter-industry transactions in 17 service industries, distinguishing between intermediate and final services. The World Input Output Tables have both the information on domestic sales and imports/exports of services, which is all that is needed to calculate trade costs.

To build these tables, a variety of statistics are used but the main information comes from international supply-use tables. This is a more reliable source for trade in services as compared to balance of payments data. However, the national tables have no bilateral dimension and trade has to be allocated to partners on the basis of trade statistics that are generally of lower quality. Balancing procedures are then used to make the data consistent across countries and to solve the observed discrepancies between trade flows reported in national accounts and in trade statistics. These adjustments are based on assumptions that may introduce some bias in the estimation of trade costs but we still regard these data as more reliable than BOP statistics.

3.2 The OECD Services Trade Restrictiveness Index (STRI)

To assess barriers to trade in services, we use the information from a new dataset that was recently released by the OECD and that provides Services Trade Restrictiveness Indices (STRIs) for 18 sectors. The OECD STRI covers a wider range of trade barriers as compared to a similar index released by the World Bank that focuses only on the restrictions relevant for the General Agreement on Trade in Services (GATS). Moreover, the information is more recent and was fully verified by all the countries. The indices are available for 40 economies (all OECD Members and the BRIICS). The country coverage is not exactly the same as the WIOD dataset both in terms of countries and industries, requiring more aggregation and working with a sub-set of 32 countries.

4. Main findings on the evolution of trade costs for services 1995-2011

The two previous sections set out a methodology for calculating trade costs in intermediate and final services, and discussed data sources. This section applies the methodology to the data, and provides an overview of results.

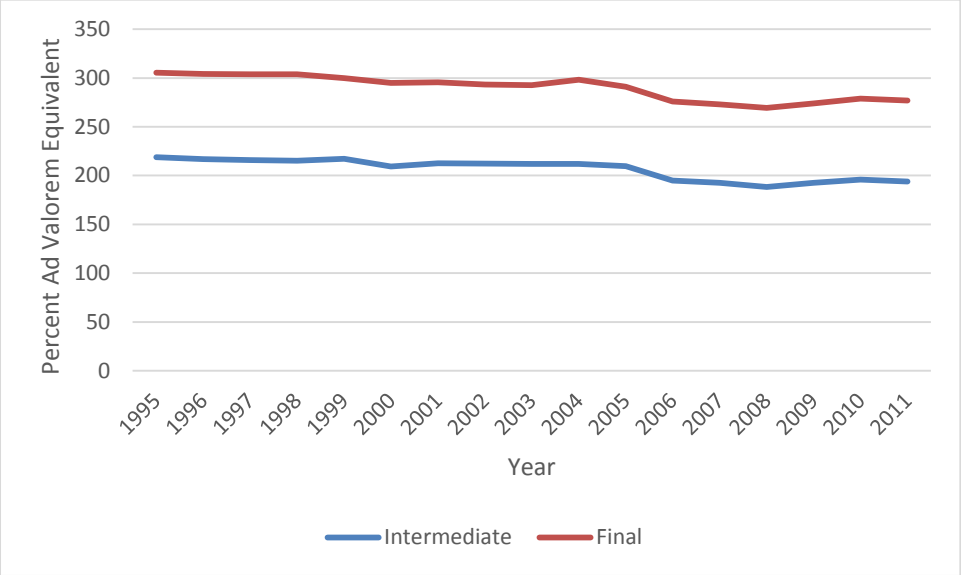
Figure 1 plots trade costs for intermediate and final services over the full sample period, namely 1996-2011. The figure shows simple averages across all countries for which data are available in a given year. Trade costs in both cases are expressed in *ad valorem* equivalent

terms, which means that the assumption of a common elasticity of substitution for both sectors plays a role in determining the relative levels of trade costs. It is immediately apparent that for the full period, trade costs are lower in intermediate services than in final services. In 2011, trade costs for final services were 277% *ad valorem*, compared with 194% for intermediate services. This difference is highly significant from an economic point of view, because it indicates that intermediate services flow between countries more easily than final services, in other words that businesses have easier access to imported services than do final consumers. It is important to stress that the numbers involved are very high, much higher than for goods trade, for example, but this finding is in line with previous work (Miroudot et al., 2013a).[3]

The overall pattern followed by trade costs is highly similar for the two cases. The overall trend is clearly downwards, particularly from 2004/2005 onwards. There is evidence that the trend has been halted, and potentially slightly reversed, since the Great Trade Collapse of 2008-2009, although the changes involved are relatively small. This finding is consistent with the high level of disruption to value chains caused by the Global Financial Crisis and the ensuing trade collapse. However, the evidence from goods sectors, which we would expect services to follow, albeit with an apparent lag, is that value chains recover relatively quickly from economic shocks, even major ones. One potential reason for this resilience is that lead firms make relationship specific investments in building GVC supplier networks, so shocks tend to result in a hiatus in that relationship rather than its complete undoing. Shepherd and Cattaneo (2014) examine GVC responses to major shocks in the Asia-Pacific, and find that even in extreme cases, like the Thai floods or the Great Tohoku Earthquake, both of which occurred in 2011, recovery of trade flows generally took no more than 12 months. It is therefore likely that more recent data would disclose a continuing downward trend in trade costs.

[3] Trade costs for pure cross-border services trade are estimated to be high because many services still require proximity of producers and consumers. Although information and communication technologies have lessened that effect in some sectors, their impacts are by no means homogeneous from one activity to another. In addition, services trade costs are elevated due to factors like regulatory heterogeneity, which make it more difficult to do business abroad than at home for services firms. Research on the sources of trade costs in services sectors, and their relative importance, is ongoing.

Figure 1: Trade costs for services, total trade, 1995-2011.



Source: Authors' calculations.

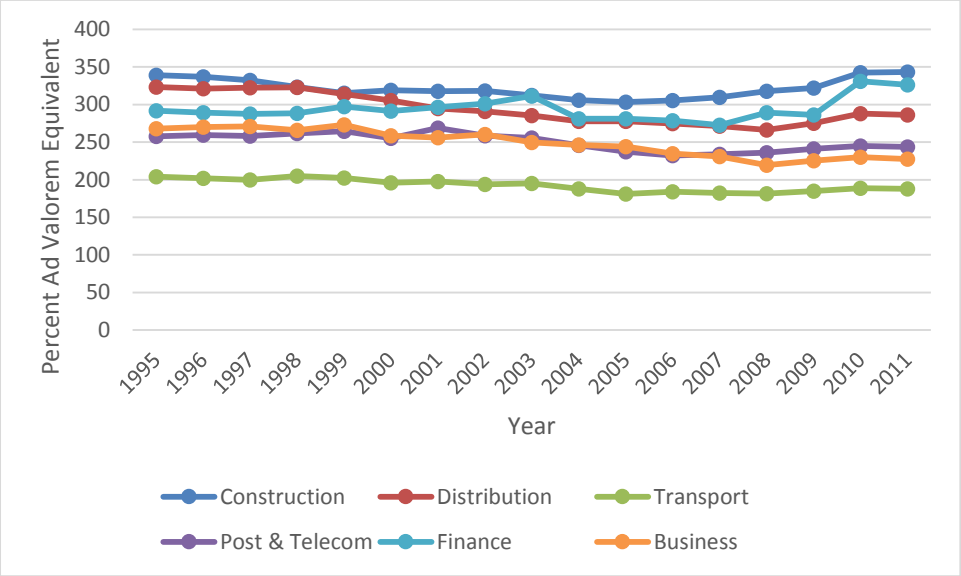
The similarity of the time paths of the two types of trade costs is reinforced by a consideration of the relative change between the beginning of the sample period and the end. Intermediate trade costs declined by 11.5%, and final trade costs fell by 9.3%. Although the rate of decline is slightly faster for intermediates, the difference is not very large. The overall conclusion to be drawn is that, based on aggregate data, trade costs are following a relatively similar downward path, at similar speeds, for both final and intermediate services. We emphasize that the relative decline in trade costs takes account of the different initial baselines, and as Novy (2013) has shown, it is relatively insensitive to the parameter choice made for the elasticity of substitution.

Although aggregate results are informative, it is important to drill down to the sectoral level to examine the potentially different ways in which final and intermediate trade costs have evolved over time due to sectoral specificities, including regulation and other measures that impact the cost to services firms of doing business abroad.

Figure 2 presents sectoral results for intermediate trade costs. The hierarchy of *ad valorem* equivalents by sector is relatively stable over time: intermediate trade costs are lowest in transport, followed by business services and post and telecommunication services. Construction consistently has the highest levels of trade costs. Interestingly, the positions of finance and distribution change in the second half of the sample. By 2011, intermediate trade costs in distribution are substantially lower than those in finance. An important part of the reason is a large uptick in finance trade costs after 2009. This period coincides with a tightening of prudential and other regulations in many countries following the Global Financial Crisis, as well as a general re-pricing of risk that seems to have reduced the sector's appetite for cross-border activity somewhat.

With the exception of finance, which has the particularity of a major crisis part way through the sample, sectoral trends in intermediate trade costs mimic the aggregate trend: trade costs are falling, but at different rates in different sectors. The largest fall in trade costs is in the business services sector (15%), followed by distribution (12%), transport (8%), and post and telecommunications (6%). Trade costs in construction increased very slightly (1%), but can essentially be regarded as static through time. In finance, trade costs increased by 12%, mostly in the 2009-2010 period.

Figure 2: Trade costs for intermediate services, by sector, 1995-2011.



Source: Authors' calculations.

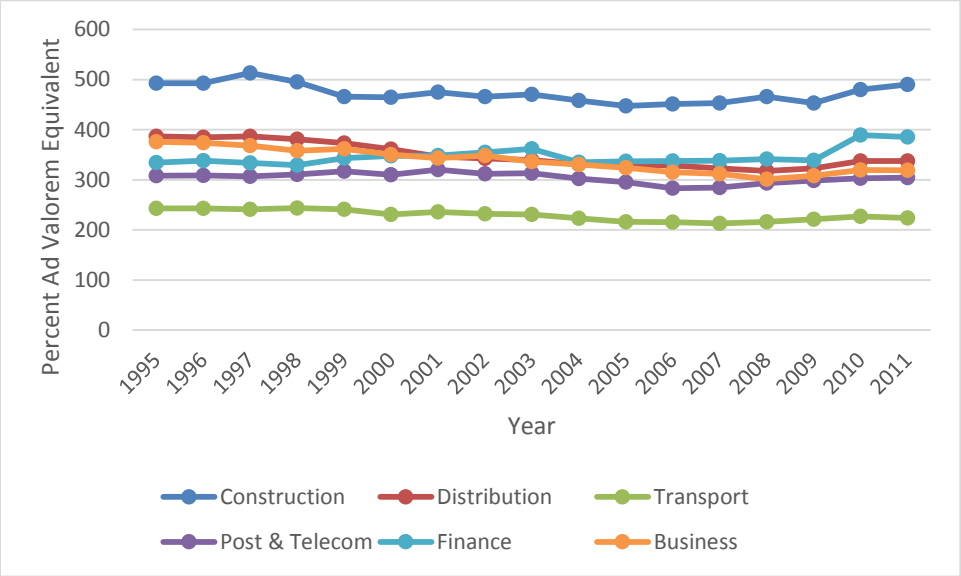
The overall pattern of final trade costs (Figure 3) is reasonably similar to the case of intermediate trade costs, but with some important differences. First, as indicated by the aggregate data, trade costs are higher for final services compared with intermediates. This finding holds true in all cases, and the differences can be quite large, in excess of 40% in the cases of business services and construction.

In terms of the distribution of final trade costs across sectors, the sector with the highest trade costs is construction, and the sector with the lowest trade costs is transport; this pattern was also observed for intermediate trade costs. Trade costs for three of the four other sectors follow a converging path, and the sample period ends with them at reasonably similar levels, intermediate between construction and transport. The exception to the overall trend is again finance, which is relatively static for most of the period, but which then jumps to a noticeably higher level post-2009. The reason for this observation is most likely the same as in the case of intermediate services: the policy and market reaction to the Global Financial Crisis.

Although there is generally a downwards trend in the level of final trade costs, it is not as consistent or marked across sectors as was the case for intermediate services. The

downwards trend is largest in the case of business services, which registered a fall in trade costs of 15% over the sample period, followed by distribution (13%). Changes for the other sectors are considerably smaller: 8% for transport, and 1% each for construction and post and telecommunications. The case of finance again stands out, as just noticed, with a 15% increase in trade costs over the sample period.

Figure 3: Trade costs for final services, by sector, 1995-2011.



Source: Authors' calculations.

Comparing Figure 2 and Figure 3 suggests three important conclusions based on the trade costs data for final and intermediate services. First, the sectoral data support the insight from aggregate data to the effect that final trade costs are considerably higher than intermediate trade costs. Second, both final and intermediate trade costs are generally on a downwards trend, but the rate of change varies considerably across sectors. The trend is noticeably more pronounced in the case of intermediate trade costs. Finally, the financial services sector stands out as the only one in which both final and intermediate trade costs have increased substantially over the sample period. The increase is largely due to regulatory changes induced by the Global Financial Crisis, which suggests that policy might have played an important role, along with market factors such as the re-pricing of risk. To further explore the links between applied services trade policies and trade costs outcomes, the following section presents results from fully specified econometric models in which intermediate and final trade costs are linked to data on restrictions to services trade, as well as to a set of control variables.

5. Econometric analysis: barriers to trade in services and trade costs

This part of the paper analyses the determinants of trade costs in final and intermediate services. Following Novy and Chen (2011), the approach is to specify econometric models

with trade costs as the dependent variables, and a set of gravity-like variables assumed to influence trade costs as the independent variables. Models are estimated separately for final and intermediate services. The key variable of interest is the STRI: we expect it to have a positive and statistically significant coefficient, which would indicate that more restrictive services trade policies tend to increase trade costs. Such a result would be in line with those of van der Marel and Shepherd (2013), but with the added dimensions of: a focus on trade costs rather than trade flows; a distinction between intermediate and final trade; and use of the OECD STRI rather than its World Bank counterpart, which has the advantages noted above.

To take a first pass at the data, pooled estimation is used with fixed effects by exporter-sector and importer-sector to account for unobserved heterogeneity. The flexibility of the fixed effects formulation means that in terms of observables, it is only necessary to focus on data that vary bilaterally and at the sector level. The two estimating equations are as follows, again treating trade in final services and trade in intermediate services separately:

$$\log\left(\tau_{ij}^{f,k}\right) = b_1 \log\left(STRI_{ij}^{k}\right) + b_2 \log(distance_{ij}) + b_3 common\ language_{ij} + b_4 colony + b_5 same\ country + b_0 + \sum_{i=1}^{N_i}\sum_{k=1}^{K} d_i^k + \sum_{j=1}^{N_j}\sum_{k=1}^{K} d_j^k + e_{ij}^k \quad (15)$$

$$\log\left(\tau_{ij}^{m,k}\right) = b_1 \log\left(STRI_{ij}^{k}\right) + b_2 \log(distance_{ij}) + b_3 common\ language_{ij} + b_4 colony + b_5 same\ country + b_0 + \sum_{i=1}^{N_i}\sum_{k=1}^{K} d_i^k + \sum_{j=1}^{N_j}\sum_{k=1}^{K} d_j^k + e_{ij}^k \quad (16)$$

where: STRI comes from the OECD dataset, and is transformed into a bilateral variable by taking the geometric average of the exporter and importer scores; distance, common language, colony, and same country are taken from the CEPII distance dataset; the d terms are fixed effects; and e is the error term. As in the exposition above, i and j index exporters and importers respectively, and f and m refer to final and intermediate trade. The k index refers to sectors within each type of trade.

Equations 15 and 16 are both log-linearized models with strong similarities to the standard gravity model, from which they are of course derived. The choice of estimation method is therefore an issue. Following Santos Silva and Tenreyro (2006),[4] the model is estimated by Poisson pseudo-maximum likelihood, which we are confident provides estimates that are consistent where alternative methods, such as OLS, may not be.

[4] Those authors show that heteroskedasticity in the error term—which is highly likely in practice—leads not only to inconsistency of the estimated standard errors, as in a typical linear model, but also to inconsistency of the parameter estimates. The authors provide a compelling case for the use of the Poisson pseudo-maximum likelihood (PPML) estimator as an alternative to OLS. PPML is consistent under weak assumptions. In particular, it can easily be adjusted to be fully robust to heteroskedasticity, and as a PML estimator, it does not require that the data are in fact distributed as Poisson; all that is necessary for consistency is that the conditional mean function is correctly specified.

Estimation results are in Table 1. With the exception of the same country dummy, all gravity model controls have coefficients with the expected signs, and sensible magnitudes, and are statistically significant at the 1% level in both the final and intermediate trade models. Economies that are more distant from each other have higher trade costs, while those that share a common language, or where one economy was once a colony of the other, exhibit lower trade costs.

The key variable of interest is the STRI. In both models, it has a positive coefficient that is 1% statistically significant. For final trade, a 10% increase in the STRI (i.e., a higher level of restrictiveness) is associated with an increase in trade costs of 2.7%. For intermediate trade, a similar change in the STRI is associated with a 3.1% increase in trade costs. Although the elasticity for intermediate trade is slightly larger than for final trade—which could indicate that intermediate trade is more sensitive to policy restrictions than final trade—the difference between the two is not statistically significant, so this apparent difference should be interpreted cautiously. In general, however, it can be safely concluded that policy is an important determinant of trade costs in services both in terms of trade in final services and trade in intermediate services.

Table 1: Estimation results for the pooled models.

	(1) Final	(2) Intermediate
Log(STRI)	0.265***	0.307***
	(0.000)	(0.000)
Log(Distance)	0.148***	0.156***
	(0.000)	(0.000)
Common Language	-0.161***	-0.179***
	(0.001)	(0.001)
Colony	-0.178***	-0.185***
	(0.000)	(0.000)
Same Country	-0.082	-0.122
	(0.256)	(0.129)
N	5510	5626
R2	0.681	0.625

Source: Authors' calculations.

The estimation results presented in Table 1 give a general idea of the links between trade costs and trade in intermediate and final services. However, it is likely that different sectors respond differently, which means that the pooled estimation approach—although useful for identifying average effects—may be insufficiently flexible to bring out some types of cross-sectoral heterogeneity. To deal with this possibility, equations 15 and 16 are re-estimated separately sector by sector. The exporter-sector and importer-sector fixed effects are replaced with exporter and importer fixed effects. Other than that, the estimation models are identical, but are applied to one sector at a time.

The trade costs data cover six sectors: construction, distribution, transport, post and telecommunications, finance, and business services. Of the six, transport needs to be dropped from the sectoral estimates due to insufficient variation in the STRI across countries. Results are therefore presented for the remaining five countries. Table 2 covers construction, distribution, and post and telecommunications, and Table 3 covers finance and business services.

Results for the first three sectors in Table 2 are mixed. With the exception of the same country dummy, the gravity control variables have appropriately signed and statistically significant coefficients of sensible magnitude. By contrast, only three of the six models have STRI coefficients that are positive and statistically significant; the remainder are not statistically significant at the 10% level or better. Results are strongest for post and telecommunications, which is a service sector that is widely traded internationally. Interestingly, the coefficient for intermediate trade is larger than that for final trade, which provides some evidence that services trade restrictions matter more for intermediate trade than for final trade. However, the relative imprecision in the estimates means that the

difference between the two coefficients is not statistically significant, and should therefore be interpreted with caution.

For distribution, by contrast, it is only final trade that has the expected positive and statistically significant coefficient. One factor that is potentially important for this sector is the nature of services trade barriers *de facto*, and those that are captured by the STRI. The STRI focuses primarily on retail services, although both retail and wholesale are in theory covered by the data. An important difference between the two is that barriers to wholesale trade tend to be more related to competition policy issues that are not fully taken into account in the STRI. The STRI focuses on issues like retail shop opening hours, which are true policy restrictions to services trade. Given this focus, and the fact that final goods trade has a heavier retail to wholesale ratio in terms of sectoral activity than does intermediate goods trade, the results for distribution might be explained by a better "fit" between the policy data and trade costs for final as opposed to intermediate trade.

Data is also an important issue for construction services. It is well known that construction services are poorly tracked in international trade data. Relatively little true trade in construction services passes through the balance of payments[5], and what is recorded sometimes mixes in other types of trade, such as the supply of construction materials (goods trade) or professional services (engineering and architecture). Trade costs as calculated in this paper rely on trade data that have been reconciled with national accounts, but there is evidence of significant under-reporting of this sector in the trade component of the national accounts, even in countries that are known from other sources to be significant exporters (e.g., France, Japan, and the USA). In light of these considerations, it seems likely that data reliability issues plague this sector, and it is perhaps not surprising that results are not strong compared with other sectors.

[5] But there is cross-border trade in construction services because the provision of the service through commercial presence (Mode 3) when the duration of the contract is less than one year is regarded as cross-border. In addition, some services included in construction, such as plumbing, interior design, repair and installation, are provided through Mode 4.

Table 2: Regression results for the sectoral models.

	(1) CSN Final	(2) CSN Intermediate	(3) DIS Final	(4) DIS Intermediate	(5) PTC Final	(6) PTC Intermediate
Log(STRI)	-0.037	0.197	0.171***	0.042	0.154*	0.195**
	(0.819)	(0.263)	(0.001)	(0.447)	(0.094)	(0.038)
Log(Distance)	0.152***	0.188***	0.129***	0.154***	0.187***	0.195***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common Language	-0.160**	-0.139*	-0.112**	-0.103*	-0.222**	-0.181*
	(0.039)	(0.075)	(0.038)	(0.085)	(0.033)	(0.083)
Colony	-0.228**	-0.220**	-0.158**	-0.195***	-0.275***	-0.274***
	(0.025)	(0.038)	(0.013)	(0.000)	(0.000)	(0.001)
Same Country	0.045	-0.019	-0.135*	-0.108	-0.020	-0.095
	(0.584)	(0.837)	(0.085)	(0.177)	(0.862)	(0.428)
N	664	728	958	964	946	946
R2	0.809	0.795	0.689	0.598	0.502	0.535

Source: Authors' calculations.

Table 3 presents results for the two remaining sectors, namely financial services and business services. For financial services, the gravity model control variables all have parameters with the expected signs, magnitudes, and statistical significance. In business services, by contrast, it is only distance (both models) and the same country dummy (intermediate trade) that are statistically significant, although all parameters have the expected signs and magnitudes; the common language dummy is marginally significant in the intermediate trade model (prob. = 0.104).

Results for the STRI are also very different from one sector to the other. For financial services, the relevant parameter is only correctly signed in the intermediate trade regression, and it is significant at the 15% level, but not the 10% level that is standard. By contrast, the STRI coefficient is correctly signed, of appropriate magnitude, and highly statistically significant in both business services models. Indeed, the coefficients for business services are the largest observed for any sector. Interestingly, the coefficient for intermediate trade is more than twice as large as the coefficient for final trade, and the difference is marginally statistically significant at the 10% level. In the case of business services, there is therefore weak evidence that trade barriers in services have more of a negative effect on trade in intermediate services than on trade in final services.

In terms of data "fit", the case of financial services is similar to that of distribution services, discussed above. Although there are pure policy restrictions that affect trade in financial services, there are also issues of competition policy and broader behind-the-border regulatory stance that affect foreign firms' ability to do business in a given market. In addition, the STRI captures a certain number of restrictions that are more relevant to retail financial services than to wholesale financial services. It therefore seems plausible that data reliability at least partly explains the lack of statistically significant results for finance, which at first glance seems surprising given the strong results in business services, another sector that is highly internationalized.

Table 3: Regression results for the sectoral models (continued).

	(1)	(2)	(3)	(4)
	FIN Final	FIN Intermediate	BUS Final	BUS Intermediate
Log(STRI)	-0.053	0.187	0.398**	0.871***
	(0.649)	(0.144)	(0.016)	(0.000)
Log(Distance)	0.145***	0.131**	0.098***	0.099***
	(0.000)	(0.019)	(0.000)	(0.000)
Common Language	-0.192*	-0.213*	-0.058	-0.125
	(0.056)	(0.059)	(0.310)	(0.104)
Colony	-0.149**	-0.165*	-0.062	-0.034
	(0.047)	(0.067)	(0.288)	(0.569)
Same Country	-0.196*	-0.222*	-0.095	-0.151*
	(0.071)	(0.079)	(0.170)	(0.057)
N	970	972	956	998
R2	0.546	0.493	0.710	0.618

Source: Authors' calculations.

6. Conclusion: Main policy implications

This chapter has used new data to present the first evidence on trade costs in services, distinguishing between services supplied cross-border for final consumption, and those provided as intermediates. The data have been analysed using a theory-consistent methodology that infers the level of trade costs from the observed pattern of trade and production across countries. We have found that final trade costs are higher in all sectors than intermediate trade costs, and that they are falling more slowly. Although there is a generalized downwards trend in both types of trade costs, an important exception is financial services, where evidence suggests that trade costs have increased substantially in the wake of the Global Financial Crisis.

The second set of empirical findings in the chapter relates more particularly to the role played by policy in determining the level of trade costs. Using the OECD's new Services Trade Restrictiveness Index, we have found clear evidence of a link between restrictive services trade policies and the level of trade costs, although the relationship is tight in some

sectors but not others. Interestingly, we have found some evidence indicating that intermediate trade costs are more sensitive to applied services trade policies than are final trade costs. In light of the importance of intermediate trade in services for production and trade of both services and goods in the GVC era, this is an important finding.

The fact that many services are traded embodied in goods implies that services trade negotiators should not limit their attention to barriers on trade in services. Trade protection on goods has an indirect impact on services trade and some authors have suggested looking at a new mode of supply of services, so called "Mode 5", to account for this indirect trade in services (Cernat and Kutlina-Dimitrova, 2014). Since service exporters also use goods as inputs, they are also affected on the import side. Miroudot *et al.* (2013b) show that tariffs in some industries account for a non-negligible share of the value of service exports. For example, hotels and restaurants providing services to tourists (Mode 2 trade in services) incur significant costs related to the high tariffs observed in the agriculture and food sectors upstream.

A corollary is that the trade restrictiveness observed in the service sector has a detrimental impact on exports of manufacturing goods. The 'servicification' of economies implies that many manufacturing industries would export more if they were not limited by the barriers on their service inputs (National Board of Trade, 2012).

The rise of GVCs and the variety of roles that services—including internationally traded services—play within them reinforces the importance of services policies from the point of view of promoting economic activity, increasing productivity, and supporting exports and imports. From one perspective, services are important because they are the "glue" holding GVCs together. The GVC business model simply cannot function without cross-border flows of transport, logistics and distribution, finance, and business services, amongst others. However, this role is not the only one that services play in GVCs. They also enter directly into the production function of goods (and other services) traded within GVCs. It has long been recognized that liberalization of services trade policies—broadly understood to include behind-the-border barriers—can have significant "knock on" effects for the rest of the economy, in particular through increased productivity of firms that use services inputs. That observation is all the truer against the backdrop of an increased role for GVCs in production and trade all over the world. Paying increased attention to services barriers is an important part of taking a value chain view of trade policy (cf. WEF and World Bank, 2013).

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