What is so special about Trade in Services?[1]

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This article argues that trade in services has a specific feature that does not apply to trade in goods. As the traded service is produced where it is consumed (i.e. in the host country), we propose that it must use interactively inputs from both the export and host countries. We consider the O-ring theory to show this proposition. We apply this original framework to a *new dataset* on *bilateral* trade in *services* from the OECD and find that wages from both sides of the transaction and other policies affecting them or the product markets are indeed affecting trade in services in the same way. This finding could also explain why we find lower trade in bilateral services than goods.

[1] The title of the paper is not as original as some would tend to think. It has been borrowed from section titles in two other papers on trade in services (i.e. Philippa Dee, 2001 and Mattoo, 1999), which stress some specific features to services but that are different from that shown here. We thank participants at the Midwest International Meetings 2003 in Pittsburgh and especially Alex Skiba for his excellent comments and suggestions on an earlier draft of the paper. Financial support from the Leverhulme Trust under the programme grant F114/BF is gratefully acknowledged. The opinions engaged are personal and do not engage the OECD neither its member countries.

1. Introduction

We know much more about trade in goods than we do about trade in services. The most common reason is the lack of internationally comparable and well-structured data. This urged 6 main international organisations[2] to publish a *Manual on Statistics of International Trade in Services* (MSITS) that makes recommendations for governments and institutions to provide 'coherent conceptual framework within which countries can structure the collected statistics related to trade in services'[3].

However, our limited knowledge in that area has another explanation. Services, apart from tourism, were used to be considered non-tradable in many trade textbooks and few theories have been developed so far to explain the specific features that services could have over goods. Following Deardorff (1985), Melvin (1988) do seminal contributions by suggesting that the existence of trade in input services (or *producer services*) together with output commodities in an Heckscher-Ohlin type model leads to a reconsideration of the law of comparative advantage. One important force altering that law is the fact that the producer service is delivered abroad while its owners continue to consume in their home country.

Ethier and Horn (1992) propose another characteristic related to *consumer type services*: the production function of the consumer service is different from that of commodities as it implies a service-product that is more customised to the taste of the consumer[4]. After assuming this distinction, the authors show how freeing trade in services –jointly or not with trade in goods- could result in higher welfare.

Other theories model implicitly consumer service trade through modelling foreign commercial presence. Markusen's joint work on FDI, with few other researchers, summarised recently in his book 'Multinational Firms and the Theory of International Trade' (2002) might be applied to goods as well as to commercial presence of foreign owned firms providing services to consumers

[2] The organisations are UN, EC, IMF, OECD and the WTO and the United Nations Conference on Trade and Development.

[3] Quoted from page 1 of the 'Manual on Statistics of International trade in Services', jointly published by the above organisations.

[4] See the survey of Philippa Dee (2001) for more insights on Ethier and Horn (1992)'s work.

abroad. Besides, Markusen , Rutherford and Tarr (2000) explicit the role of producer services (i.e managerial and engineering consulting) that are transferred through foreign direct investment.

While they appear to be very insightful, all these theories can hardly explain the large majority of international trade flows in services *observable* from available datasets. Although the GATS distinguishes among four modes of supply in service trade: 1/ Cross-border supply (e.g. transport, financial services, consulting, etc…), 2/ Consumption abroad (e.g. tourism), 3/ Commercial presence (e.g. the activity of foreign affiliates) and 4/ movement of individuals (*e.g.* temporary movement of workers), National Balance of Payments Statistics identify only service transactions between residents and non-residents. Thus, only modes 1, 2 and part of mode 4 are actually reported, which rules out all attempts to explain *observed* trade in services figures with *commercial presence* type theories related to consumer services. Also, figure 1 reports that Transport and Tourism are by far the most important traded services, followed by Financial Intermediation and finally, Consulting, Real Estate activities and Telecommunications. Again, this leaves out little power to alternative existing theories like those of Melvin, Ethier and Horn or Markusen, Rutherford and Tarr.

In this article, we propose an original set up based -from the supply side- on the O-ring theory developed by Michael Kremer (1993). A service that is exported from one country to another is the result of a process using different tasks in both countries, which interact with each other. In fact, from table 2 one can see that in most observed industries, the production process of the traded service is completed in the host country (i.e. where it is consumed). Thus, some tasks are performed by domestic inputs and others are performed by foreign inputs. If one of these tasks in *either* country were imperfectly performed it would affect the productivity of the whole chain of tasks with which it interacts and thus the production/trade of the delivered service. Hence, the quality of the undertaken task matters in both countries. At the extreme, if one of these tasks in *either* country happen not to be undertaken, the whole production/consumption of the service sold abroad vanishes. A direct implication is that any given group of tasks undertaken by production factors in the host (importing) country cannot be substituted to services of the same type of factors in the exporting country to produce the eventually traded service. Many examples tend to support the argument: In Transport for example, route infrastructure or airports in the *two* countries are needed in

order to supply internationally the service. In order to set up a telecommunication, the *two* countries should be equipped with computers, reliable telephone cables, etc…. In tourism, Tour Operators in one country sell holidays to be consumed in a foreign country, which price not only depends on say, marketing or advertisements provided in the former country but also on the costs of accommodation, catering and other leisure activities performed in the latter. Labour is also needed in *both countries* to perform all of these tasks. Besides, the intensity of trade depends on the performance quality of both domestic and foreign tasks.

This aspect, we argue, is a specific feature to trade in services. Although production of final goods could be fragmented over different producing sites in several countries, those tasks undertaken abroad by foreign factors of production might not interact with those at home. In fact, domestic factors can still be able to produce the final good with an already produced stock of intermediary inputs, whether this stock is locally provided or produced in a foreign country.

This characteristic for the internationally traded service has some implications for policy. As tasks from both countries interact, all the modes of regulations from *both* countries could be affecting the quality of the tasks, which could result in higher input prices, higher price of the traded services and hence lower bilateral trade. This is clearly not the case for trade in manufacturing where regulations in one country might increase the relative competitiveness of its partners.

We use a new OECD dataset on *bilateral* trade in services to test for the interaction of tasks in both countries. Also, our work stands as one of the first attempts to assess the determinants of *bilateral* trade in services together with a very recent study by Grünfeld and Moxnes (2003). Our findings are consistent with the O-ring theory. Especially, labour wages, infrastructure in transport and that in telecommunications in both countries are affecting interactively bilateral trade in services. We also produce evidence on host country's regulations (tax wedge, product market regulations) having similar negative effects on bilateral exports in services than the source country's regulations.

2. Some stylised facts

So far, the OECD has made available only *aggregated* values of *bilateral* trade in services, which does not inform about the type of service traded within country pairs. Thus, in order to understand what kind of

services are hidden behind this aggregation, we look at another OECD data that provides sectoral information of *total* service trade by country (i.e. not broken up into country-partner pairs)[5].

Figure 1 shows the average industry structure of OECD in exports and imports services. Most services traded, whether exported or imported, relate to tourism (around 30 per cent) and transport (around 25 per cent), followed by the business services (12 per cent) and financial services (6 per cent). The composition of services trade is similar at the individual country level[6]. In other words, a large share of trade in services is related to international movements of manufactured goods and people. Yet, the most striking feature of services trade is that trade intensity appears to be much lower than for manufactured goods, with both exports and imports flows in manufacturing several times higher than the corresponding flows in services in all OECD countries for which data are available. Indeed we have compared two ratios in each OECD country: the proportion of trade in goods to total GDP in goods and the proportion of trade in services to total GDP in business services. It appears that the trade intensity in goods ratio is 2 to 7 higher in most countries, but in some extreme cases, like Mexico it is even 10 times higher. See table 1 for more details[7].

In international trade textbooks, lower services trade intensities are often related to the cost of transport, which is, for some services, much higher than the cost of shipping manufactured goods.[8] Also, the influence of geographical and structural factors, such as location and size of the economy, on trade in services and manufactured goods may differ. Cross-country patterns of export intensities and import penetration ratios suggest that these factors play partly the same role as for trade in goods (Figure 2). Trade is strong in relatively small and well-located countries -- such as Austria, Belgium, the Netherlands and Ireland -- and weak in relatively large or remote countries -- such as the United States, Japan and Australia.

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[5] Data on trade in services by sector (bilateral information is not available) are based on the *OECD Statistics on International Trade in Services 1990-1999*.

[6] Results available upon request.

[7] Such gaps between trade in goods and services could be narrowed once cross-border supply through commercial presence (*i.e.* FDI) is taken into account. However, it can also be argued that the Commercial Presence (C.P) type of supply has to be compared with Greenfield Investments (G.I) instead of pure trade in goods, as both CP and GI are considered to be Foreign Direct Investment.

[8] For instance, services provided by a barber are hardly tradeable between cities or regions within a country, not to mention across borders. However, the provision of many other services, including some of the most dynamic ones

However, these patterns are less clear than for manufacturing. We perform a Spearman correlation test and find that indeed, the cross-country correlation between export intensities in manufacturing and services is relatively low (around 0.2), though the correlation of import penetration ratios is higher (around 0.6). This suggests that other forces are impinging on the openness of OECD economies to services trade.

3. Some Theory

3.1 Demand side

As for trade in goods, one can obtain a bilateral import demand function for services from a Sub-utility CES function where consumers determine the quantities of each service variety to consume under their budget constraint. To see this, assume there are $F \geq 2$ trading countries, each of them being associated with a representative consumer as well as a representative service sector producing a differentiated good (industry index *k* implicit in the whole section). The representative consumer of country *f*, $f \in \{1,...,F\}$, maximises the Spence-Dixit-Stiglitz sub-utility function U_f subject to his or her budget constraint, where:

$$U_f = \left[\sum_{d=1}^{D} \sum_{v=1}^{n_d} \alpha_f x_{vdf}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

x_{vdf} stands for total demand of variety *v* addressed to its producer in country d and n_d for the number of varieties produced in country *d* and available in country *f*. The parameter of preference α_f can be viewed as proxies of home bias or also revealing taste or perceived quality of goods (See Feenstra (1994), Head and Mayer (2000) or also Erkel Rousse and Mirza (2002)). Finally, σ is the elasticity of substitution between the different available varieties ($\sigma > 1$).

The first order conditions lead to demand equations per variety. Summing over the number of varieties supplied by country *i*, one can obtain the bilateral export expression of country *i* to country *j:*

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over the past two decades (such as communication, financial intermediation and business services) involves lower transportation costs, which are further decreasing as information and communication technologies (ICT) spread out.

$$EX_{df} = N_d . x_{vdf} = N_d . \alpha_{df}^{\sigma} . \left(\frac{P_{df}}{IP_f} \right)^{-\sigma} . \left(\frac{E_f}{IP_f} \right) \qquad (1)$$

with $IP_f = \left[\sum_{d=1}^{D} \sum_{v=1}^{N_d} \alpha_{df}^{\sigma} P_{vidf}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$ the price index of the composite product and E_f the total expenditure devoted to consuming the differentiated good in country *f*.

While it is very convenient to assume the existence of varieties in Tourism (e.g. several sites to visit, different hotels and restaurants where to go, etc…), this hypothesis might not be very suitable for transport services where they could be assumed to be relatively homogenous. We can show however that a particular case of the demand function (1) would arise if we consider CES functions where goods are only differentiated by their country of origin (Armington type hypothesis) but still perfectly homogenous within each country (see for instance Deardorff, 1995). Equation (1) would be retrieved, but as only one variety is produced by country ($N_d = 1$), the number of varieties would not enter the equation anymore.

3.2 Supply side

As noted earlier, on the supply side an O-ring production function (Kremer, 1993) is considered. Assume a production of a variety of a traded service that consists of different tasks, which interact with each other. For simplicity, all varieties are treated equally which allows to remove the subscript *v* from the following relations. A group of tasks are undertaken in the domestic country *d*, and another group in the foreign country *f*. Each task *k* in a country *h* ($\forall h \in \{d, f\}$) employs a number $L_{k,d}$ and $L_{k,f}$ of domestic and foreign inputs respectively. The performance *q* of these inputs ranges from 0 to 1[9]. If the task is perfectly performed (*q*=1) then the quality of the task and the contribution to the production process are maximal. If the task is not performed (*q*=0), then the chain of production stops and the output is 0. Put differently, different tasks are complementary within and between countries[10]. The supply of a service that is traded abroad can then be expressed by:

$$Y_{df} = \prod_{k=1}^{K_d} q_{k,d} L_{k,d} \prod_{k=K_d+1}^{K} q_{k,f} L_{k,f} . \qquad (2)$$

[9] The variable *q* is also thought to measure the probability to perform perfectly the task.
[10] See Kremer and Maskin (1996) for more details about complementarity of tasks.

All of these tasks are associated with a quality $q_{k,h}, \forall h \in \{d, f\}$ of the performance that might differ across countries. If foreign inputs do not participate in the production process, then $q_f = 0$, and the transaction between the two countries is not realised (Y=0).

If the same service had to be sold to the domestic market and assuming a quality of the performance differing across countries because of structural differences, then the technology between a traded service and its peer sold at home, would be different. Indeed, as equation (3) below suggests,

$$Y_d = \prod_{k=1}^{K} q_{k,d} L_{k,d}. \qquad (3)$$

the same delivered service Y would imply only domestic inputs. This simple result is very specific to the nature of the transaction as the production process of a service end where it is to be consumed (i.e. in the importing country).

In Kremer's original framework (1993), the producers had to choose the quality and price of inputs that maximise their profit function. Here instead, producers choose the quantity of labour for each task, given a certain quality of performance and price of inputs. This deviation from Kremer's framework leads to a relation that is very close to a Cobb-Douglas function where firms have to choose optimal quantities of different inputs given factor prices. However, the specific feature that trade in services does not occur if foreign inputs are not accounted for is more relevant to the spirit of the O-ring theory.

We assume that equilibrium wages are provided from competitive labour markets and do not depend on the quality of the performance. Quality can be thought to be an externality, function of other factors outside the firm but specific to the service industry. This externality could be related to structural policies in each country like infrastructure of routes, telecommunications, market regulations in the service sector, etc.

Given wages and performance quality, a dual cost expression of the service production function can be easily derived[11]. Total cost can then be expressed as: $TC_d = KY^{1/K} \prod_{k=1}^{K_d} \left(\frac{w_d}{q_d} \right)^{1/K} \prod_{k=k_d+1}^{K} \left(\frac{w_f}{q_f} \right)^{1/K}$

Noting μ_f the mark up of the firm realised on the foreign market, CM_d the marginal cost of the service and τ_{df} the transaction cost from trading, the bilateral price expression obtained at equilibrium is:

[11] This is done by minimising total costs under the constraint of a given production (equation 2).

$$P_{df} = \mu_f . Y_d^{\frac{1-K}{K}} \prod_{k=1}^{K_d} \left(\frac{w_{k,d}}{q_{k,d}} \right)^{1/K} \prod_{k=k_{d+1}}^{K} \left(\frac{w_{k,f}}{q_{k,f}} \right)^{1/K} . T_{df} \quad (4)$$

Again, in the Armington case of perfect competition but with products differentiated by country of origin, the price would equal the marginal cost of exports which is a particular case of equation 4 above, where the mark up μ_i would equal 1. Note from (4) that an increase in the quality of the tasks, or in increase in wages in either country reduces export prices.

Replacing (4) in (1), and noting $\bar{x}_h = \prod_k x_{k,h}^{1/K}$ the geometric mean of a variable *x* in country *d* or *f*, the expression of trade in services becomes:

$$EX_{df} = E_f N_d . Y_d^{\sigma\left(\frac{K-1}{K}\right)} T_{df}^{-\sigma} \bar{w}_d^{-\sigma} \bar{w}_f^{-\sigma} \bar{q}_d^{\sigma} \bar{q}_f^{\sigma} . \left(\frac{1}{IP_f} \right)^{1-\sigma} . \alpha_{df}^{\sigma} \mu_d^{-\sigma} \quad (5)$$

4. Data

Data on trade in services with partner disaggregation (bilateral trade) is taken from the *OECD Statistics on International Trade in Services 1999-2000*. Information for trade in services is available for two years only, where the data is covering 20 countries and 27 partners.

Activity type data in services was taken from STAN-OECD. In fact, data relative to Wholesale, Hotel and Retaurants (sector 50-55 in ISIC nomenclature), Construction (ISIC 45), Transport and Communication (ISIC 60-64), Financial Intermediation (ISIC 65-67) and Real Estate/ Business activities (ISIC70-74), were aggregated to one big sector of tradable services. We could then extract some country data relative to value added, and average wages in tradable services.

1/ The expenditure of the importing country (E_f) is proxied by value added (VA_f) in services[12] and the composite variable $N_d.Y_d$ relative to the source country is represented by services value added of the exporting firms (VA_d).

2/ Geometric Average of Wages of the exporting and importing countries $(\overline{w}_d)$ and $(\overline{w}_f)$, are proxied by the ratio of total compensation to total employment in tradable services (resp. called hereafter $wage_d$ and $wage_f$). One can show that this ratio is very close to the weighted average of wages.

3/ Transaction costs T_{df} are represented by Geographical distance (*dist*). Around 30 percent of trade in services is in the transport sector which price should be, by nature, highly affected by distance. Also, distance should inform on the extent of networks in trade in services in general as it has been shown to be the case for goods (see Rauch, 1996). Transactions are also expected to be reduced in Free Tade Areas (FTA).

4/ The geometric averages of performance quality in the domestic and foreign countries $\overline{q_d}$ and $\overline{q_f}$ are represented by a series of variables that we propose to introduce progressively in the tested equation. Average Human capital in the source and importing countries (resp. hc_d and hc_f) are the first of these variables. Human capital is provided by the OECD and is measured as the average number of years of education in the population. We also expect in both countries the infrastructure in transport and telecommunications as to increase the quality of the performed task in related services. Indeed, even if factors of production have adequate skills in running a particular task, the absence of such infrastructures related to services would cancel out that task and thereby the whole cross-border transaction. Infrastructure

[12] A better proxy would have been apparent consumption in services. However, as we lack of production in services data for some countries that is necessary to compute apparent consumption, we preferred taking value added. In any case, value added and apparent consumption were very correlated (more than 0.95) for countries where data on production was available.

indicators are new variables provided by the OECD and based on measures of quality and quantity of telecommunications and transport[13].

We also introduce two *Product market regulation variables* in the service sector that enter the equation to test in an alternative manner. Regulations might affect an efficient functioning of the market and thus might reduce the average quality of undertaken tasks represented by $\overline{q_d}$ and $\overline{q_f}$. Also, market regulation in the importing country should affect mark-ups μ_f realised on that market which, in our setting, reduces exports. The two alternative indicators representing product market regulations in both countries are: Barriers to entry in services and Product market Regulations. The latter combines barriers to entry with other observed regulations in services in 1998. These data are also provided by the OECD.

By referring to the proxies above, the empirical counterpart of the 'service' equation (4) when transformed into log can be written as:

$$\log EX_{dft} = a_1.\log VA_{dt} + a_2.\log VA_{ft} - a_3 \log dist_{df} + a_4\, fta_{df} \qquad (6)$$
$$- a_5 \log wage_{dt} - a_6 \log wage_{ft} + a_7 \log \overline{q_{dt}} + a_8 \log \overline{q_{ft}} + \lambda_d + \lambda_f + \lambda_t + u_{dft}$$

As already noted, the variables representing the quality of performance are progressively inserted to the equations we estimate. Let us also assume in a first stage that the price index variable (IP_t), the brand image (α_f) and mark-ups (μ_f) that evolve with the partner country *f* and possibly over time *t* are to be captured by the fixed effects λ_f and λ_t.

The 3-dimension-panel structure of the data implies to add country (λ_d), partner (λ_f) and time specific effects (λ_t). However, their introduction would create multi-collinearity, as some of the RHS variables used are mainly varying across countries (country specific variables) or partners (partner specific) whereas

[13] The telecoms index is a weighted average of several components: Mainlines per capita index, Mobiles per capita, the percentage of Digital lines, Answer Seizure Ratio and Fault Clearance Rate. The transport infrastructure index is also a weighted average of Aircraft Departures per capita and Length of Motorways per capita.

the variance in time is very small (only 2 years available). The fist attempt is then to run OLS type regressions where the three types of fixed effects are constrained to equal the constant: $\lambda = \lambda_d + \lambda_f + \lambda_t$.

However, we propose hereafter an alternative method that deals with multicolinearity problems associated with inclusion of fixed effects. As in Erkel Rousse and Mirza (2002) and Nicoletti et al (2003), we express the variables in deviations from: 1/ the mean exporter ($\overline{\log EX_{.ft}}$) and 2/ the mean importer ($\overline{\log EX_{d.t}}$). In addition however, we propose in this paper to run the two new obtained relations simultaneously by applying the Seemingly Unrelated Regression (SUR) method. This TLS-SUR method would then account implicitly for fixed effects but also for correlation among the residuals of the two equations.

Namely, the variables of equation (6) can be expressed in deviations from the means 1/ across countries and 2/ across partners, which leads to two equations of trade in services TLS_d and TLS_f respectively:

$$\Delta_d \log EX_{dft} = a_1.\log VA_{dt} - a_3\Delta_d \log dist_{df} + a_4\Delta_d fta_{df} - a_5\Delta_d \log wage_{dt} + a_7\Delta_d \log \overline{q_{dt}} + a_9 + v_{dft} \qquad (\text{TLS}_\text{d})$$

and

$$\Delta_f \log EX_{dft} = a_2.\log VA_{ft} - a_3\Delta_f \log dist_{df} + a_4\Delta_f fta_{df} - a_6\Delta_f \log wage_{ft} + a_8\Delta_f \log \overline{q_{ft}} + a_{10} + e_{dft} \qquad (\text{TLS}_\text{f})$$

We have assumed $a_9 + v_{idf,t} = \Delta_d\lambda_d + \Delta_d u_{df,t}$ and $a_{10} + e_{ij,t} = \Delta_f\lambda_f + \Delta_f u_{df,t}$ with a_9 and a_{10} two intercepts, while $v_{df,t}$ and $e_{dfj,t}$ are two transformed residuals. By expressing the variables in deviations from the means we reduce the number of parameters to be estimated in each TLS-type equation. In fact, in the TLS_f equation, export country specific effects and variables (indexed by '*d*' or the couple '*dt*') are accounted for in a non-parametric way. In the same fashion, import country specific effects variables (indexed by '*f*' or the couple '*ft*') are implicitly accounted for in the TLS_d equation. Notice that in that equation, the price index variable that appears in the theoretical relation but that is non observable from the data is already (IP_f) accounted for in a non-parametric way.

The transformed residuals are correlated by construction. The SUR method that we propose by running simultaneously the two equations accounts for correlation among these two residuals and hence should lead to more efficient parameter estimates. Also, we constrain the coefficients of variables reappearing in both equations (like Distance and FTA) to be the same across the two equations.

5. Results

Table 2 shows the first results based on OLS equations and TLS separated equations (run non-simultaneously). In these 'benchmark' regressions the quality of performance is represented only by human capital. In eqwuation 1, we run a typical gravity equation on services where no variables specific to the importing country that are related to inputs and performance quality are inserted. The effects of value added related to both countries and that of the formation of a Free Trade area are positive and significant while distance and high wages in the domestic countries reduce competitiveness. These results are very comparable to those we could obtain in a regression of trade in goods. However, when we introduce the wage and human capital variables relative to the importing country in equation 2, the R2 increases of 12 percentage points. In addition, the effect of wages in the importing country are negative and statistically significant with a magnitude that is very close to that of the exporting country wage effect. The same observation can be made on the quite similar effects in magnitude and significance that are observed on the variable of human capital relative to both countries.

We then run the two transformed least squares regressions TLS_d and TLS_f separately to account for fixed and time effects (equations 3 and 4 respectively in table 2). For most variables, the results appear to be similar, at least in their statistical significance, to the unified OLS regressions. Nevertheless, the FTA variable effect is positive and significant in the TLS_d regression only, while the distance negative effect is significantly smaller in the TLS_f regression. However, as the parameters on distance on the one hand, and FTA on the other hand, should be equal across the two *TLS* equations in theory, we apply hereafter this constraint to our following specifications.

Equation 5 in table 3 presents the SUR-TLS regression where the two TLS are run simultaneously. We obtain the same results than those of column 2 in table 2, all consistent with theory. Thus, even when accounting implicitly for fixed effects and running simultaneously the two TLS regressions we retrieve the original result of wages and human capital in the importing country are affecting its import of services in the way suggested by our theoretical framework.

Our observed wage variable is only an imperfect proxy of costs as it might inform on the productivity of labour as well, which effect might be positive on trade. In that respect, the parameter on wages is a mixed effect of pure cost and productivity and should then be biased downward compared to a pure cost effect. Now, the introduction of human capital should partly capture that productivity effect. However, one could still cast doubt on wages as being fully capturing costs even when human capital is considered in the regression. Especially, if the wages in the importing country are more responsive to productivity than costs, then the negative effect obtained on these wages is more the reflection of higher productivity in the importing country. Then in that particular configuration, what makes an exporting country less competitive is the higher productivity of its partner. This leads us to a more traditional reasoning that we use to make for trade in goods, at odds with our applied O-ring theory.

The only way to show then that the O-ring theory is still the best to fit the data is to demonstrate that the information contained in the wage variable is more a cost than a productivity information. There are two alternative ways to do so. First, instead of considering wages one might consider a component of it that informs on pure cost. Alternatively, one could run an instrumental variable regression where wages would be instrumented by pure cost type variables.

Indeed, equation 6 of table 3 shows the results of a regression where wages have been replaced by wedge taxes on labour, that are supposed to inform purely on costs[14]. Indeed, the wedge tax on labour in both the exporting and importing countries is affecting negatively bilateral exports. Moreover, the parameters' absolute values are higher than those related to wages in equation 5, which is consistent with the assumption that the latter hold mixed information on costs and productivity.
The significance of the rest of the parameters remains the same as expected but because wages have been replaced by one of their component, the values of the parameters are now lower. In fact, wages might be correlated to other variables in the regression like value added or human capital. When wages are omitted from the equation to test, and as the wedge variable cannot fully capture wage variation, some information previously held by wages could then be retrieved in the residuals. This then might produce a correlation between the explanatory variables and the residuals, which ends up biasing downward their parameters.
In order to avoid this scenario to be repeated we then re-introduce wages to the TLS equations to test, but now we propose to instrument wages.

[14] Recall that average wages are the ratio of total compensation to employment where compensation includes necessarily labour taxes on wages.

Hence, hereafter we set up a 3SLS type regression that is basically a SUR method with some endogenous explanatory variables to which we apply instrumental variables. We thus instrument wages by the wedge tax in 1998, employment and most other exogenous variables at hand (Value Added, distance, FTA)[15]. The important point to mention here is that we need instruments that inform on costs. It is obvious from above that wedge taxes is indeed informing on one of the cost parts of wages. Besides, the relation between employment and wages should also be of a cost nature either when it is to consider the supply side or the demand side of the labour market. Notice however that we do not consider human capital, as an additional instrument, as we know that human capital informs about productivity, not on costs.
Equation 7 from table 3, shows the results. The same results than those of equation 5 are retrieved with higher parameter estimates (in absolute values) on import and export country wages. Hereafter, we maintain the same set up to run alternative regressions.

The mean quality of the performance in either country has been proxied so far by average human capital. We propose hereafter to extend the number of variables that could represent performance. Equation 8 adds to our specification telecom and transport infrastructure variables related to both countries. Their effect appears to be positive and statistically significant. Also, either related to telecommunication or transport infrastructure, the effect of infrastructure on trade in services in the import country is the same than that of its peer from the export country. Table 3 shows an additional Chi2 test that does not reject the equality of the coefficients. Hence, we constrain these coefficients to be the same for the following regressions. This result suggests that the quality of performing a task in one country, is not only related to the underlying infrastructure of that country but to the partner's country infrastructure as well. Good infrastructure in one country is a necessary but not a sufficient condition to be able to trade in services. Both countries should be well equipped in order for the service to be traded. It is important to notice however, that FTA is not significant when we introduce these infrastructure variables.

Equations 9 and 10 introduce two alternative variables of market regulation. In equation 9, the barriers to entry variable is considered. Only, the importing country's barriers to entry seem to be reducing imports to that country. The exporting country's barrier to entry does not appear to have a significant effect. This result seem to be consistent with our theory as long as market regulations are only affecting mark-ups obtained from exporting in the host market (see theoretical equation 5 above). The quality of performing a task would not be then related to barriers to entry. However, the second indicator of market regulation that

[15] Both import and export country wages were instrumented in the same manner. The instruments are all expressed as deviations from the means as to match the transformation already made for the instrumented variables. We have introduced some exogenous variables as instruments to increase the number of instruments in order to obtain more

is more general than the Barriers to entry one, appears to be affecting trade in services from both ends of the transaction as coefficients related to both countries' variables are negative and statistically significant. Then, the quality of performing a task might be affected by stringent measures to regulate the markets in both countries.

6. Conclusion and Discussion

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precise estimations. Note however, that we have conducted other regressions where only wedge and employment were considered and found very similar results. Figures are provided upon request.

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Table 1:Comparison of trade intensity in services and trade intensity in goods

	Goods		Services			
country	exp. Intensity (1)	imp. Intensity (2)	exp. Intensity (3)	imp. Intensity (4)	Ratio (1/3)	Ratio (2/4)
AUT	0.47	0.54	0.13	0.1	3.78	5.42
CAN	0.51	0.43	0.06	0.08	7.86	5.66
CZE	0.4	0.41	0.12	0.09	3.3	4.76
DEU	0.33	0.28	0.05	0.08	6.22	3.51
DNK	0.48	0.47	0.07	0.08	6.48	5.71
FIN	0.31	0.24	0.08	0.09	4	2.82
FRA	0.28	0.27	0.08	0.07	3.38	3.92
GBR	0.29	0.33	0.06	0.06	4.79	5.21
HUN	0.49	0.51	0.14	0.07	3.63	7.52
ITA	0.23	0.21	0.07	0.07	3.07	2.89
JPN	0.09	0.05	0.02	0.03	4.8	1.84
KOR	0.15	0.14	0.05	0.04	2.84	3.42
MEX	0.38	0.38	0.04	0.04	9.79	9.82
NLD	0.6	0.53	0.18	0.14	3.36	3.65
NOR	0.44	0.31	0.17	0.17	2.5	1.85
POL	0.18	0.31	0.1	0.06	1.94	5.32
PRT	0.31	0.48	0.1	0.08	3.13	6.31
SWE	0.44	0.37	0.11	0.12	3.98	3.03
USA	0.11	0.15	0.02	0.02	4.74	7.16

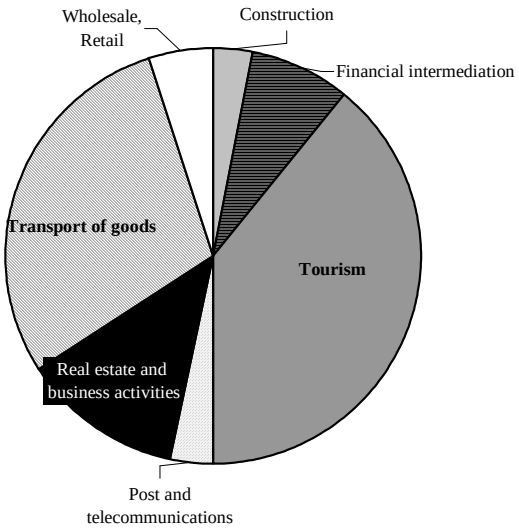
Note: 1/ exports (import) intensity in goods equals the ratio of exports (imports) to GDP in goods (manufacturing+Agriculture+Mining)

2/ exports (import) intensity in services equals the ratio of exports (imports) to GDP in internationally tradable business services

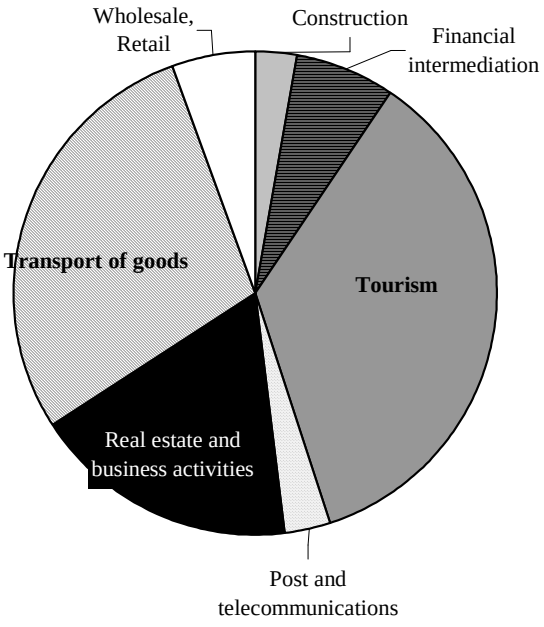
Figure 1. **Composition of services trade in the OECD area,[1] 1999**

OECD average[2]

Panel A: **Exports[3]**



Panel B: **Imports[3]**

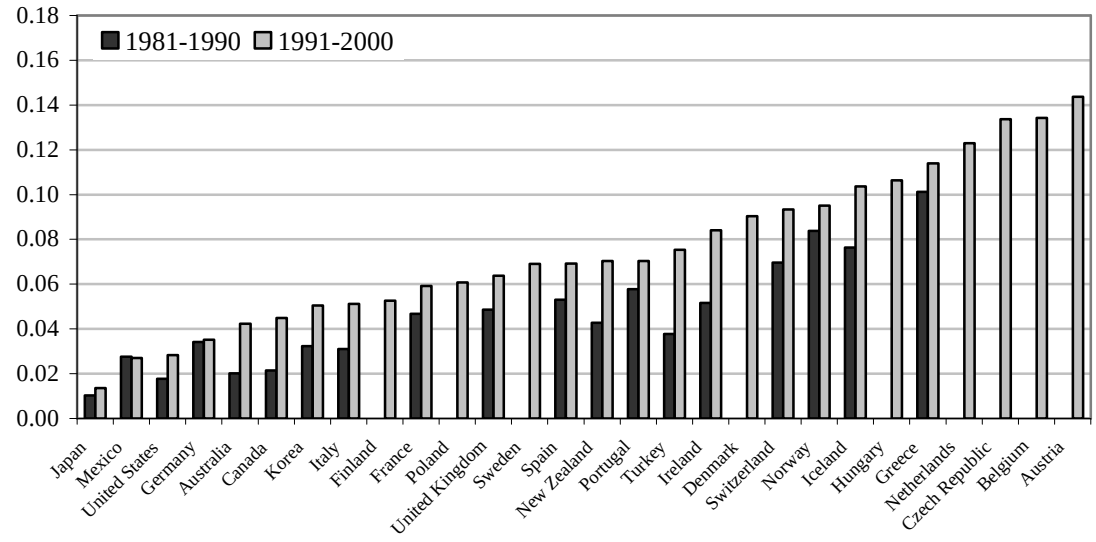


1. Service trade reported by balance of payments statistics includes only cross-border supply and consumption abroad. Service supplied through commercial presence or movement of individuals are excluded.
2. Simple average.
3. Ratio of exports or imports in each industry to total exports or imports.

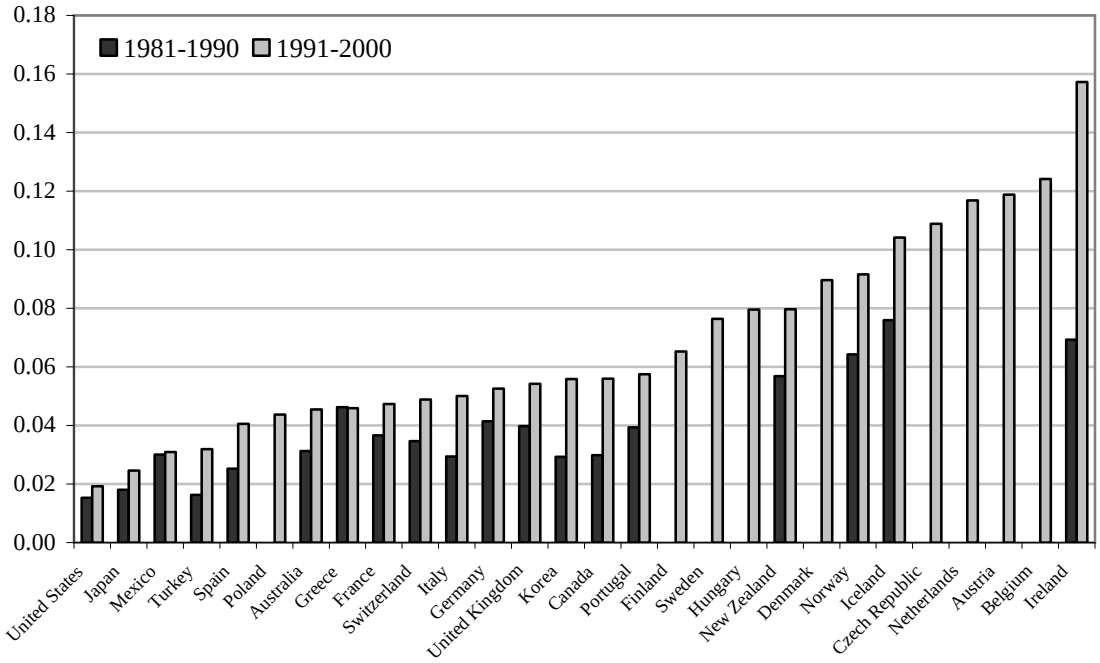
Source: OECD.

Figure 2. **Intensity of global trade in services, 1980s and 1990s**

Panel A. Export Intensity



Panel B: **Import penetration**[2]



1. Export intensity is defined as the ratio of exports to GDP.
2. Import penetration is defined as the ratio of imports to domestic absorption.

Source: OECD.

Table 2: Determinants of trade in services- Basic Equations

	1	*2*	3	4
	OLS1	***OLS2***	***TLSd***	***TLSf***
log VA exporter	**0.829*** **	**0.891*** **	**0.856*** **	
	[0.046]	[0.037]	[0.033]	
log VA importer	**0.509*** **	**0.888*** **		**0.787*** **
	[0.042]	[0.036]		[0.036]
log distance	**-0.195*** **	**-0.208*** **	**-0.937*** **	**-0.258*** **
	[0.065]	[0.049]	[0.077]	[0.057]
fta	**1.012*** **	**1.560*** **	**-0.136**	**1.329*** **
	[0.145]	[0.121]	[0.192]	[0.121]
log wage exporter	**-0.620*** **	**-0.708*** **	**-0.695*** **	
	[0.069]	[0.064]	[0.053]	
log wage importer		**-0.699*** **		**-0.603*** **
		[0.048]		[0.050]
log hc exporter	**2.713*** **	**2.859*** **	**2.082*** **	
	[0.464]	[0.361]	[0.298]	
log hc importer		**3.650*** **		**3.590*** **
		[0.357]		[0.391]
Constant	-14.150***	-27.344***	-0.345***	0.052
	[1.379]	[1.563]	[0.042]	[0.042]
Observations	385	385	387	387
R-squared	0.72	0.84	0.78	0.68

White-Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Determinants of trade in services- complete specifications

		5	6	7	8	9	10
		SUR-TLS1	*SUR-TLS2*	*3SLS-TLS VI*	*3SLS-TLS infra-telecoms*	*3SLS-TLS +agbe*	*3SLS-TLS +apmr*
log VA exporter	***TLSd***	**0.928*** **	**0.566*** **	**0.957*** **	**1.053*** **	**1.015*** **	**1.018*** **
		[0.027]	[0.028]	[0.027]	[0.031]	[0.024]	[0.025]
log VA importer	***TLSf***	**0.823*** **	**0.508*** **	**0.810*** **	**0.872*** **	**0.844*** **	**0.842*** **
		[0.031]	[0.026]	[0.031]	[0.026]	[0.026]	[0.026]
l_distance	***TLSd=TLSf***	**-0.324*** **	**-0.552*** **	**-0.328*** **	**-0.716*** **	**-0.736*** **	**-0.686*** **
		[0.045]	[0.067]	[0.049]	[0.054]	[0.054]	[0.053]
fta	***TLSd=TLSf***	**1.207*** **	**0.715*** **	**1.189*** **	**0.163**	**0.03**	**0.2**
		[0.113]	[0.160]	[0.124]	[0.144]	[0.141]	[0.135]
log wage exporter	***TLSd***	**-0.773*** **		**-0.865*** **	**-1.016*** **	**-0.903*** **	**-0.982*** **
		[0.037]		[0.038]	[0.045]	[0.035]	[0.035]
log wage importer	***TLSf***	**-0.594*** **		**-0.640*** **	**-0.801*** **	**-0.790*** **	**-0.779*** **
		[0.043]		[0.042]	[0.038]	[0.037]	[0.037]
log hc exporter	***TLSd***	**2.549*** **	**0.990** **	**2.555*** **	**2.234*** **	**2.041*** **	**2.039*** **
		[0.310]	[0.467]	[0.311]	[0.278]	[0.275]	[0.286]
log hc importer	***TLSf***	**2.818*** **	**2.205*** **	**3.146*** **	**2.597*** **	**2.329*** **	**2.422*** **
		[0.349]	[0.462]	[0.343]	[0.287]	[0.283]	[0.278]
log wedge exporter	***TLSd***		**-1.414*** **				
			[0.203]				
log wedge importer	***TLSf***		**-0.841*** **				
			[0.218]				

(continues next page)

Table 3 (continued): Determinants of trade in services- complete specifications

		5	6	7	8	9	10
		SUR-TLS1	*SUR-TLS2*	*3SLS-TLS VI*	*3SLS-TLS infra-telecoms*	*3SLS-TLS +agbe*	*3SLS-TLS +apmr*
log infra-transport	***TLSd***				**0.335*** **		
(exporter)					[0.085]		
log infra-transport	***TLSf***				**0.340*** **		
(importer)					[0.061]		
log infra-transport	***TLSd=TLSf***					**0.262*** **	**0.275*** **
						[0.049]	[0.050]
log infra-telecoms	***TLSd***				**2.518*** **		
(exporter)					[0.535]		
log infra-telecoms	***TLSf***				**2.431*** **		
(importer)					[0.391]		
log infra-telecoms	***TLSd=TLSf***					**2.091*** **	**2.308*** **
						[0.317]	[0.306]
log Av. Entry Barr	***TLSd***					**-0.038**	
(exporter)						[0.090]	
log Av. Entry Barr	***TLSf***					**-0.507*** **	
(importer)						[0.108]	
log Av. PMR	***TLSd***						**-0.356*** **
(exporter)							[0.128]
log Av. PMR	***TLSf***						**-0.536*** **
(importer)							[0.117]
Constant	***TLSd***	0.088*	0.093	0.107**	0.031	0.087**	0.048
		[0.046]	[0.057]	[0.046]	[0.043]	[0.043]	[0.042]
Constant	***TLSf***	-0.370***	-0.462***	-0.379***	-0.597***	-0.552***	-0.562***
		[0.042]	[0.058]	[0.043]	[0.056]	[0.044]	[0.043]
Observations		395	336	374	374	374	374
R-squared	***TLSd***	0.7	0.59	0.7	0.74	0.74	0.74
R-squared	***TLSf***	0.66	0.54	0.65	0.71	0.72	0.72
Chi2-test: 1/ transport_exp=transport_imp					0.001		
2/ telecoms_exp=telecoms_imp					0.02		

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%