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What is so Special about Trade in Services?

by

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Abstract

This article argues that trade in services has a specific feature that does not apply to trade in goods. As the traded service is partly produced where it is consumed (*i.e.* in the importing country), we propose that it must use interactively inputs from both the exporting and importing countries. The modelling of the specificity of traded services is inspired from the O-ring production function presented in Kremer (1993). We then test our analytical framework using a new OECD dataset on bilateral trade in services. We find that policy and non-policy factors affecting the use of inputs in the exporting or importing country indeed have a similar impact on the same flow of traded service between those countries. This finding may contribute to explain why bilateral commerce in tradable-services is typically weaker than bilateral trade in goods.

JEL : F10, F20

Keywords: Trade, Services

Outline

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Non-Technical Summary

This article argues that trade in services has a specific feature that does not apply to trade in goods. As the traded service is partly produced where it is consumed (*i.e.* in the importing country), we propose that it must use interactively inputs from both the exporting and importing countries.

We consider an original set up in which the supply side is based on a framework inspired from the O-ring theory developed by Michael Kremer (1993)[1]. 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, 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 to be 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, independent of the location in which this task is accomplished, its quality matters in both countries. At the extreme, if one of these tasks in *either* country happens not to be undertaken, the whole production/consumption chain of the service sold abroad breaks down. A direct implication is that any given group of tasks undertaken by production factors in the host country cannot substitute for 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 exchange, 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, whose price depends not only, say, on the costs of accommodation, catering and other leisure activities performed at destination, but also on marketing or advertisements provided in the origin country. Labour is also needed in *both countries* to perform all of these tasks. Thus, the intensity of trade depends on the costs and quality of the tasks performed in both the domestic and foreign countries.

This special feature of internationally-traded services has implications for policy. As tasks accomplished in both partner countries interact, costly institutions or regulations in *either*

[1] Our set up is inspired from Kremer's in the sense that it considers a production function that is mainly similar. As shown in the heart of the text however, the choice of instruments to maximize the profit function is not the same.

country, could result in a higher price of the same traded service and hence provoke lower bilateral trade. This is clearly not the case for trade in manufacturing where, for instance, costly regulations in one country may increase the relative competitiveness of its trading partners.

We use a new OECD dataset on *bilateral* trade in services to test for the interaction of tasks in both countries. Thus, our work represents one of the first attempts to assess the determinants of *bilateral* trade in services. Our findings are consistent with our theoretical framework of services supply. Especially, labor costs, human capital and infrastructure supply (in transport and telecommunications) in both countries have a similar impact on the same flow of traded service. Moreover, using alternative indicators of some costly-type product market regulations provided by the OECD, we also show that restrictive regulations in importing and exporting countries have symmetric negative effects on bilateral services exports. These findings may contribute to explain why bilateral commerce in tradable-services is typically weaker than bilateral trade in goods.

Further, our findings have many new implications for the partial and general equilibrium trade literature. The endless debate regarding the impact of trade on labour markets might take another turn when applied to services trade. For instance, at the industry level, and due to the specific feature of co-production of the traded service, imports of services might perfectly be consistent with higher employment. Besides, another intuition that follows our findings is that HOV tests, based on differences in endowments, might be difficult to apply to services trade. In services trade, under the hypothesis of co-production of traded services, endowments appear not to be country specific. Independent of its location, each resource is needed to perform the export and import transaction of services. Further research in these areas are therefore useful to clarify these intuitions.

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 six main international organisations[1] to publish a *Manual on Statistics of International Trade in Services* (MSITS) that makes recommendations for governments and institutions to provide a 'coherent conceptual framework within which countries can structure the collected statistics related to trade in services'[2].

However, our limited knowledge in that area has another explanation. Services, apart from tourism, were usually considered to be non-tradable in many 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) gave a seminal contribution by suggesting that the existence of trade in factor services (or *producer-type services*) in an Heckscher-Ohlin type model leads to a reconsideration of the law of comparative advantage. One important reason is that while factor services are delivered abroad their owners continue to consume in their home country. This modifies world prices in a way that alters the natural specialisation of countries, which would prevail in the absence of factor movements.

Ethier and Horn (1992) focus on another characteristic related to *consumer-type services*: the production function of this type of services is different from that of commodities as it involves a product that is more customised to the taste of the consumer[3]. Based on this assumption, the authors show how liberalising trade in services could result in higher welfare.

Other theories implicitly model trade in consumer-type services through foreign commercial presence. For instance, Markusen (2002) summarises his joint work with other researchers in a

[1] The organisations are UN, EC, IMF, OECD and the WTO and the United Nations Conference on Trade and Development.
[2] Quoted from page 1 of the 'Manual on Statistics of International trade in Services', jointly published by the above organisations.
[3] See the survey of Philippa Dee (2001) for more insights on Ethier and Horn (1992)'s work.

textbook that analyses goods-producing FDI as well as commercial presence of foreign-owned firms providing services to consumers abroad[4].

While being very insightful, these analyses can only explain a small amount of the international trade flows in services that are *directly observable* from available datasets. The GATS distinguishes among four modes of supply in services 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). However, national Balance of Payments Statistics identify only services 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-type services. As a matter of fact, Transport and Tourism are by far the most important traded services, followed by Financial Intermediation and finally, Consulting, Real Estate activities and Telecommunications.

In this article, we propose an original set up in which the supply side is based on a framework inspired from the O-ring theory developed by Michael Kremer (1993)[5]. 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, 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, independent of the location in which this task is accomplished, its quality matters in both countries. At the extreme, if one of these tasks in *either* country happens not to be undertaken, the whole production/consumption chain of the service sold abroad breaks down. A direct implication is that any given group of tasks undertaken by production factors in the host (importing) country cannot substitute for 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,

[4] Markusen, Rutherford and Tarr (2000) consider both consumer and factor type services through foreign presence and managerial and engineering consulting transferred through FDI.

route infrastructure or airports in the *two* countries are needed in order to supply internationally the service. In order to set up a telecommunication exchange, 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, whose price depends not only, say, on the costs of accommodation, catering and other leisure activities performed at destination, but also on marketing or advertisements provided in the origin country. Labour is also needed in *both countries* to perform all of these tasks. Thus, the intensity of trade depends on the costs and quality of the tasks performed in both the domestic and foreign countries.

This aspect, we argue, is a specific feature of trade in services. Namely, inputs from ***two*** countries ***need to*** interact ***to trade*** the service. In manufacturing goods however, inputs from ***different*** countries ***might*** interact ***to produce*** the final output*, although* ***before trading it***. Indeed, while production of final goods in manufacturing can also be fragmented over different producing sites in several countries, the interaction between tasks undertaken by factors of production at home and abroad is not as crucial as for services. In fact, domestic factors are able to produce the final good with any existing stock of intermediate inputs, which could be provided locally or produced in a foreign country. Nevertheless, when some interaction of inputs from different origins prevails it takes place only at the production stage. At the shipping stage however, it is transport activity and thus trade in services that takes the lead again.

This special feature of internationally-traded services has implications for policy. As tasks accomplished in both partner countries interact, costly institutions or regulations in *either* country, could result in a higher price of the same traded service and hence provoke lower bilateral trade. This is clearly not the case for trade in manufacturing where, for instance, costly regulations in one country may increase the relative competitiveness of its trading partners.

We use a new OECD dataset on *bilateral* trade in services to test for the interaction of tasks in both countries. Thus, our work represents 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 our theoretical framework of services supply. Especially, labour costs and infrastructure supply (in transport and telecommunications) in both countries are found to

[5] Our set up is inspired from Kremer's in the sense that it considers a production function that is mainly similar. As shown in the heart of the text however, the choice of instruments to maximize the profit function is not the same.

affect interactively bilateral trade in services. Moreover, using alternative indicators of product market regulation provided by the OECD, we also show that restrictive regulations in importing and exporting countries have symmetric negative effects on bilateral services exports.

2. Stylised facts

The OECD covers only aggregate values of *bilateral* trade in services, providing no information on the type of services traded among country pairs. Thus, in order to gauge the relative importance of different kind of services in OECD bilateral trade flows, we briefly look at sectoral information on *multilateral* services trade by country (i.e. not broken up into country-partner pairs)[6].

Figure 1 shows the average industry structure of OECD trade in services. Most services traded, whether exported or imported, relate to tourism (around 30 per cent) and transport (around 25 per cent), followed by business services (12 per cent) and financial services (6 per cent). The composition of services trade is similar at the individual country level[7]. 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 export and import 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 (Table 1): the share of goods trade in total manufacturing GDP and the share of services trade in total business services GDP. The trade intensity ratios in goods are 2 to 7 times higher than in services, and in some extreme cases, like Mexico, they are even 10 times higher.[8]

Relatively low services trade intensities have traditionally been related to the cost of transport, which is for some services much higher than the cost of shipping manufactured goods.[9] Also, the

[6] 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*.

[7] Results available upon request.

[8] 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.

[9] For instance, services provided by a barber are hardly tradable 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

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 partly play 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. However, these patterns are less clear than for manufacturing. The Spearman correlation statistic points out 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 intensity of services trade in OECD economies.

3. Analytical Framework

In what follows, we propose a simple analytical framework that emphasizes the role of partner countries' co-production of the traded service and take the resulting relation to the test.

3.1 Demand side

As for trade in goods, one can obtain an import demand function for services in a setting where consumers determine the consumption of each service variety subject to their budget constraint. To see this, assume that there are $F \geq 2$ trading countries, each of which being associated with a representative consumer as well as a representative service sector producing a differentiated good. 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 preference parameter

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over the past two decades (such as communication, financial intermediation and business services) involves lower

α_f can be viewed either as a proxy for home bias or as revealing a brand image of the good perceived by consumers from country *f* (Head and Mayer (2000) or also Erkel Rousse and Mirza (2002) provide examples). 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:*

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

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 total expenditure devoted to consuming the differentiated good in country *f.*

The existence of different varieties in services is a general assumption. This hypothesis might not be very suitable for some specific transactions however such as freight services, which can 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 remain valid, 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, the supply side is inspired from an O-ring production function (Kremer, 1993) . Thus, let us assume that the production of a variety of a traded service involves different tasks, which interact with each other. For simplicity, all varieties are treated equally. This makes it possible 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*

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transportation costs, which are further decreasing as information and communication technologies (ICT) spread out.

$(\forall h \in \{d, f\})$ employs a number $L_{k,d}$ and $L_{k,f}$ of domestic and foreign inputs respectively. Within any assigned task, inputs are perfect substitutes but remain complementary between tasks, because tasks themselves are complementary[10]. Each homogenous group of inputs undertake a task with a probability q to perform it perfectly. The variable q is also thought to represent the quality of performance of the task. If it 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 breaks down and there is no output. The supply of a service that is traded abroad can then be expressed by an interaction of a task-chain as follows:

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

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

In Kremer's original framework, 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 prices of inputs and their quality of performance. This deviation from Kremer's framework noted earlier[11] leads to a relation that is very close to a Cobb-Douglas production 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 close to the spirit of the O-ring theory.

Performance-quality can be function of human capital of those assigned to a particular task. It can also be thought to be an externality related to structural policies in each country like infrastructure supply or market regulations in the service sector.

[10] See Kremer and Maskin (1996) for more details about complementarity of tasks.
[11] See introduction.

Given the cost of labour and the quality of performance, a dual cost expression of the service production function can be easily derived[12]. Total cost can then be expressed as:

$$TC_d = KY^{1/K} \prod_{k=1}^{K_d} \left(\frac{w_d}{q_d} \right)^{1/K} \prod_{k=k_d+1}^{K} \left(\frac{w_f}{q_f} \right)^{1/K}$$

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

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

Again, note that perfect competition *à la* Armington arises as a particular case where the price would equals marginal cost of exports and the mark-up μ_i reduces to unity. Note from (4) that an increase in the quality of the tasks, or a decrease in wages in either country reduces export prices.

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

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

4. Empirical implementation

Data on trade and economic structure

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

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

Activity data in the services industries were drawn from the OECD's STAN database. Tradable services were proxied by an aggregate including 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), for which we constructed value added, and average wages.

The expenditure of the importing country (E_f) is proxied by value added (VA_f) in services,[13] while the composite variable $N_d.Y_d$ relative to the source country is proxied by services value added of the exporting firms (VA_d).

The geometric average of wages of the exporting and importing countries $(\overline{w}_d)$ and $(\overline{w}_f)$ is proxied by the average compensation (total compensation per employee) in the tradable services sector (respectively called hereafter $wage_d$ and $wage_f$).

Transaction costs T_{df} are proxied by geographical distance between capital cities (*dist*). Around 30 percent of trade in services is in the transport sector, whose 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). Transaction costs are also expected to be reduced in free tade areas (fta).

Policy and other variables

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 introduce progressively in the estimated equations. We expect average human capital in the source and importing countries (resp. hc_d and hc_f) to increase the quality of the performed tasks in all services. Human capital is measured as the average number of years of education in the population. We also expect the transport and telecommunications infrastructure available in both countries to increase the quality of the performed tasks, especially in related services. Indeed, even

[13] 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.

if factors of production have adequate skills in running a particular task, the absence of such infrastructures would make it difficult to accomplish that task, thereby jeopardising the whole cross-border transaction. We measure infrastructure supply as a combination of various indicators of the quality and quantity of telecommunications and transport infrastructure.[14]

We investigate two different channels through which product market regulation in services industries may affect trade in services. First, we expect regulations to affect the efficient functioning of services markets which might end-up reducing the quality of the performed tasks in the tradeable services sector. Second, regulations that restrict competition in the importing country should also increase the mark-ups μ_f , thereby reducing exports in our setting. We use two alternative indicators of regulation to capture these effects: a summary measure of legal barriers to entry in services markets and a broader indicator combining both barriers to entry and other observed regulations in 1998 (such as public ownership, price controls and restrictions to business operations).These indicators are drawn from Nicoletti and Scarpetta (2003), who provide details on sources and methodologies.

Estimation

Using the above empirical approximations, the log-linear version of the bilateral services exports equation (4) can be written as:

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

where the 3-dimension-panel structure of the data implies to add country (λ_d), partner (λ_f) and time specific effects (λ_t) and u_{dft} is a random disturbance. For simplicity, we assume at first that the

[14] The human capital index was obtained by weighting the statutory length of three levels of education (lower secondary, upper secondary and tertiary) by the share of the population having reached each of these levels. The relevant data were drawn from OECD's *Education at a glance* and *Labour Force Statistics*. The telecoms index is a weighted average of: Mainlines per capita, Mobiles per capita, the percentage of Digital lines, Answer Seizure Ratio and Fault Clearance Rate. The transport infrastructure index is a weighted average of Aircraft Departures per capita and Length of Motorways per capita. Both the human capital and infrastructure indicators are described in detail in Nicoletti *et al.* (2003).

variation of the price index variable (IP_{ft}), the brand image (α_f) and the mark-ups (μ_f) across partner countries *f* and, possibly, over time *t* is captured by the fixed effects λ_f and λ_t.

It should be stressed that the explicit introduction of the three kinds of fixed effects would generate multi-collinearity, as some of the RHS variables used are mainly varying across countries (henceforth country-specific variables) or partners (henceforth partner-specific variables) whereas the variance over time is very small (only 2 years available).

To tackle these multicollinearity problems, we adopt a three-pronged estimation strategy. First, as a benchmark, we run OLS-type regressions, where the three types of fixed effects are constrained to equal the constant: $\lambda = \lambda_d + \lambda_f + \lambda_t$.

Second, we apply an alternative estimation method (henceforth called Transformed Least Squares, or TLS) that deals with multicollinearity 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 the mean exporter ($\overline{\log EX_{.ft}}$) or the mean importer ($\overline{\log EX_{d.t}}$), obtaining two alternative relationships to test in which potential multicollinearity problems are reduced.

Third, we estimate these two equations simultaneously using the Seemingly Unrelated Regression (SUR) method, which makes it possible to account further for the correlation among the residuals of the two equations as discussed below.

To apply the TLS-SUR method, the variables of equation (6) can be expressed in deviations from the means across countries or across partners, leading to the following two simplified equations for bilateral services exports:

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

and

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

where we have assumed $a_9 + v_{dft} = \Delta_d \lambda_d + \Delta_d u_{dft}$ and $a_{10} + e_{dft} = \Delta_f \lambda_f + \Delta_f u_{dft}$ (with a_9 and a_{10} being two intercepts), while v_{dft} and e_{dft} 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 this way we also account non-parametrically for the price-index variable (IP_f), which is not observable from the data.

The transformed residuals are correlated by construction. The SUR method accounts for this correlation and hence should lead to more efficient parameter estimates. Also, we constrain the coefficients of variables appearing in both equations (like *dist* and *fta*) to be the same across the two equations.

5. Results

Table 2 shows a first set of results based on the OLS and TLS regressions run separately. In these 'benchmark' regressions the quality of performance is represented only by human capital. In regression 1, we estimate a ***typical gravity*** relationship for services trade to investigate whether or not it roughly compares to that of trade in goods found in the literature. We thus deliberately omit variables specific to the importing country that are related to inputs and performance quality. All variables have the expected signs and are significant, with value added in both countries and free trade areas increasing bilateral exports, while distance and high labour costs in the exporter country reduce them. Indeed, these results are quite close to those that would be obtained in a regression of bilateral trade in goods. Interestingly, however, when we introduce the wage and human capital variables relative to the importing country (column 2), both variables have the expected sign and are highly significant, increasing the regression R^2 by 12 percentage points. Moreover, their estimated coefficients have the same magnitude as their counterparts in the exporting country.

We then run the two transformed least squares regressions TLS_d and TLS_f separately to account for fixed and time effects (columns 3 and 4 respectively in table 2). For most variables, the results change very little relative to the OLS regression. . The two main differences are that the effect of

the *fta* variable is only positive and significant in the TLS_d regression, and the negative effect of distance is significantly smaller in the TLS_f regression. Nevertheless, in subsequent specifications we constrain the parameters on distance on the one hand, and *fta* on the other hand, to be equal across the two *TLS* equations, as would be expected in theory.

Column 5 in table 3 reports the results of the regression in which the two TLS specifications are run simultaneously using the SUR method. We obtain the same results as in column 2 of table 2, all consistent with theory. Thus, even when accounting implicitly for fixed effects and running simultaneously the two TLS regressions we find results for wages and human capital in the importing country that are consistent with our theoretical framework: our proxies for costs and quality of performance affect bilateral trade in roughly the same way independent from the location of production. A cautionary note is in order, however, because the results could also be consistent with a more traditional view in which exports are reduced by higher productivity possibly captured by human capital in the importing country, due to lower absolute comparative advantage for the exporter.

Our wage variable might also reflect skill premia related to higher productivity of labour, which is only partly captured by the human capital variable. One way to show that our theoretical framework is unambiguously supported by the data is to demonstrate that the wage variable captures information about costs rather than productivity. We attempt to do so in alternative ways. First, instead of considering wages we consider a component of them, tax wedges, representing only pure costs. Second, we run an instrumental variable regression where wages are instrumented by a set of variables that represent costs.

Equation 6 of table 3 reports the results of the regression in which wages have been replaced by the tax wedge on labour.[15] The tax wedges of both the exporting and importing countries negatively affect bilateral exports. Moreover, the estimated parameters are higher in absolute value than those estimated in earlier regressions, consistent with the notion that wages convey mixed information on costs and skill premia.

[15] Average wages are the ratio of total compensation to employment where compensation includes labour taxes on wages.

The signs and significance of the rest of the parameters remain unchanged, but the magnitude of the estimated parameters is now lower, reflecting the fact that wages have been replaced by one of their components. Indeed, wages may be correlated with other variables in the regression, such as value added or human capital. When wages are omitted, some information previously conveyed by wages is dumped in the residuals since the tax wedge cannot fully capture wage variation. This results in a correlation between the explanatory variables and the residuals, which ends up biasing downward the parameter estimates.

To avoid this omitted variable bias, we re-estimate the TLS equations instrumenting wages with a larger set of variables, including the tax wedge , employment in the business sector and most other exogenous variables at hand (*VA*, *dist*, *fta*)[16]. It is worth stressing that all these instruments convey information about costs. Therefore, we do not include as an additional instrument human capital, that mainly conveys information about productivity.

Column 7 in table 3, shows the results of the 3SLS instrumental variable regression using the SUR approach. Notice that the results remain the same as in column 5 though, as expected, the parameter estimates of wages in the importing and exporting countries are higher in absolute value. From now on, we maintain the same basic set up as in column 7 to further explore the role of performance quality and its determinants.

The average quality of performance in either country has been proxied so far by human capital. We now try to capture the effect of performance quality by using a range of other variables related to the business environment in services. As a first step, column 8 adds to our basic set up the indicators of the supply of telecommunications and transport infrastructure in both countries. Consistent with our theoretical framework of services supply, their estimated effects on bilateral services exports are positive and statistically significant and are the same in the importing country regression (TLS_d) as in the exporting country one (TLS_f). Table 3 shows that the equality of their coefficients cannot be rejected by a formal additional Chi2 test. Hence, we constrain these coefficients to be the same for the following regressions. This result suggests that the quality of

[16] We instrument in the same way the wages of both importing and exporting countries. The instruments are all expressed as deviations from the means to match the transformation that was made for wages in the TLS equations. We have added some exogenous variables to the set of instruments to increase the precision of the estimates. We have also run simpler regressions including only the tax wedge and employment as instruments and found very similar results. The results are available upon request.

performing a task in one country, is not only related to the infrastructure supply in that country but also to the partner country infrastructure. 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.

Columns 9 and 10 in table 3 look at the effects of two alternative product market regulation variables on bilateral services exports. In column 9, we restrict the focus on legal barriers to entry. In this case, only the barriers to entry raised by the importing country significantly curb bilateral services trade. Barriers to entry in the exporting country do not have any significant effect on trade. This result may reflect the fact that barriers in the exporting country are only affecting the mark-ups it can obtain from exporting in the host market (see theoretical equation 5 above), but have no bearing for the quality of tasks performed in the two trading countries. Conversely, restrictions on access to the host country's markets naturally curb trade by making exports to that country more difficult (*e.g.* because access to the host country's distribution network is limited). The results change, however, when we introduce a broader indicator of market regulation (column 10), including a wider range of restrictions that can affect the way complementary tasks are undertaken in the two countries to produce the traded service. In this case, regulation appears to be affecting trade in services from both ends of the transaction, as the coefficients of the regulatory indicators are negative and statistically significant in both countries. This result may reflect the fact that the quality of the performed tasks suffer in both countries from exceedingly stringent measures to regulate services markets.

6. Conclusion and Discussion

This article has argued that trade in services has a specific feature that does not apply to trade in goods. As the process of production of a traded service ends where it is consumed (*i.e.* in the importing country), we propose that it must use interactively inputs from both the exporting and importing countries.

We have modelled that specificity of traded services by a production function, on the supply side, that is inspired from the O-ring theory presented in Kremer (1993). Production arises from a set

of interacting tasks performed in the exporting and importing countries. If one of the latter is imperfectly performed it affects the output of the whole chain. Hence, factors that adversely affect the cost or the efficiency of such tasks in *either one* of the two trading partners can contribute to curb the same flow of bilateral trade. This might be one explanation of why we have observed that bilateral services trade is typically weaker than goods trade.

We have shown that this proposition is consistent with observed data on bilateral services trade among OECD countries. In particular, labour costs, human capital and infrastructure supply (in transport and telecommunications) in both countries are found to affect interactively bilateral trade in services. Moreover, using alternative indicators of product market regulation provided by the OECD, we also show that restrictive regulations in importing and exporting countries have symmetric negative effects on bilateral services exports.

Hence, our findings suggest that policy can play a larger role than it is usually thought in facilitating services trade. Aside from eliminating border barriers, our results suggest that a co-ordination of more business-friendly policies among partners can also facilitate such trade, for instance by improving the co-supply of crucial infrastructure and easing those services regulations at both ends of transactions.

Our analysis is among the first to have exploited the bilateral trade dimension to elucidate the determinants of services trade flows. However, it has several limitations. First, by focusing on aggregate data, it was unable to distinguish among trade of different types of services. Since each traded service has many idiosyncrasies, important issues may have been overlooked. Second, it left out other important modes of international services supply, such as commercial presence and movement of people. These modes account for a significant part of exchanges of services across countries. Third, it only looked at the effects of wages, infrastructure supply and regulation in the OECD area, which comprises a relatively homogeneous set of countries. The cost of labour, infrastructure conditions and regulatory environments are much more variable outside of the OECD area. Subject to the availability of the data, further research could therefore usefully explore whether our findings are robust to a more disaggregated analysis including also LDCs.

Finally, our findings have many new implications for the partial and general equilibrium trade literature. The endless debate regarding the impact of trade on labour markets might take another

turn when applied to services trade. For instance, at the industry level, and due to the specific feature of co-production of the traded service, imports of services might perfectly be consistent with higher employment. Besides, another intuition that follows our findings is that HOV tests, based on differences in endowments, might be difficult to apply to services trade. In services trade, under the hypothesis of co-production of traded services, endowments appear not to be country specific. Independent of its location, each resource is needed to perform the export and import transaction of services. Further research in these areas are therefore useful to clarify these intuitions.

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

country	Goods exp. Intensity (1)	Goods imp. Intensity (2)	Services exp. Intensity (3)	Services 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

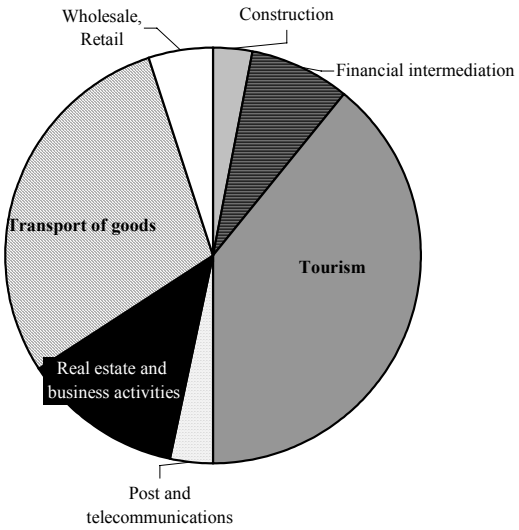
Note: 1/ exports (import) intensity in goods equals the ratio of exports (imports) to GDP in goods (manufacturing+Agriculture+Mining)

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

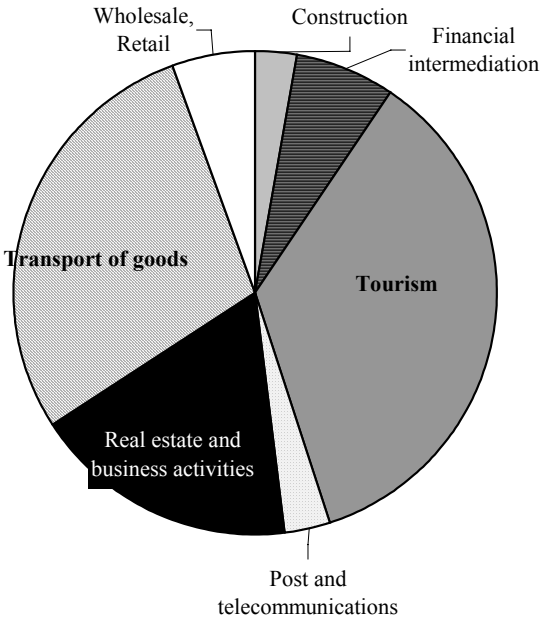
Figure 1. **Composition of services trade in the OECD area,[1] 1999**

OECD average[2]

Panel A: **Exports[3]**



Panel B: **Imports[3]**

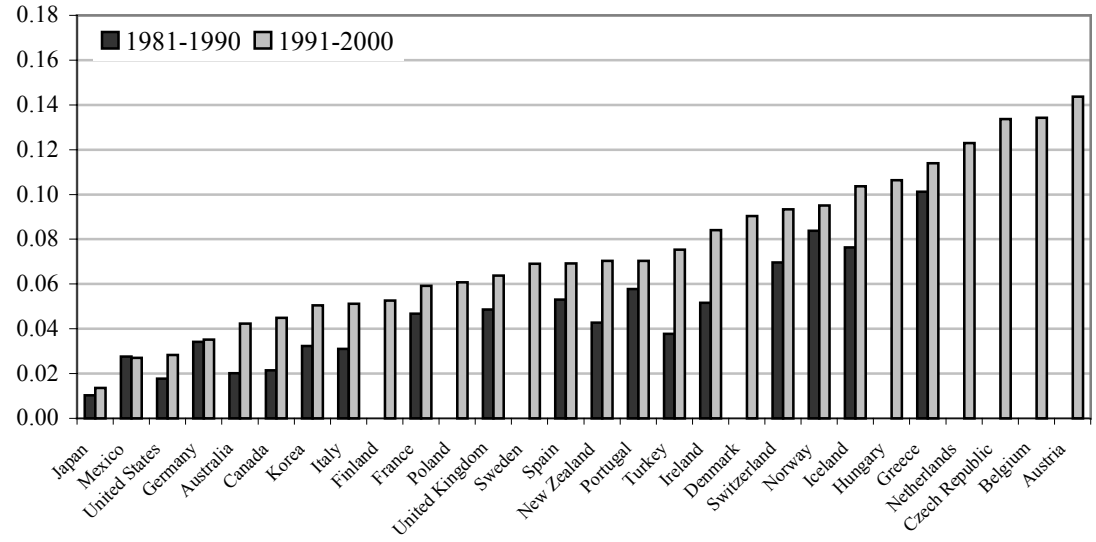


1. Service trade reported by balance of payments statistics includes only cross-border supply and consumption abroad. Service supplied through commercial presence or movement of individuals are excluded.
2. Simple average.
3. Ratio of exports or imports in each industry to total exports or imports.

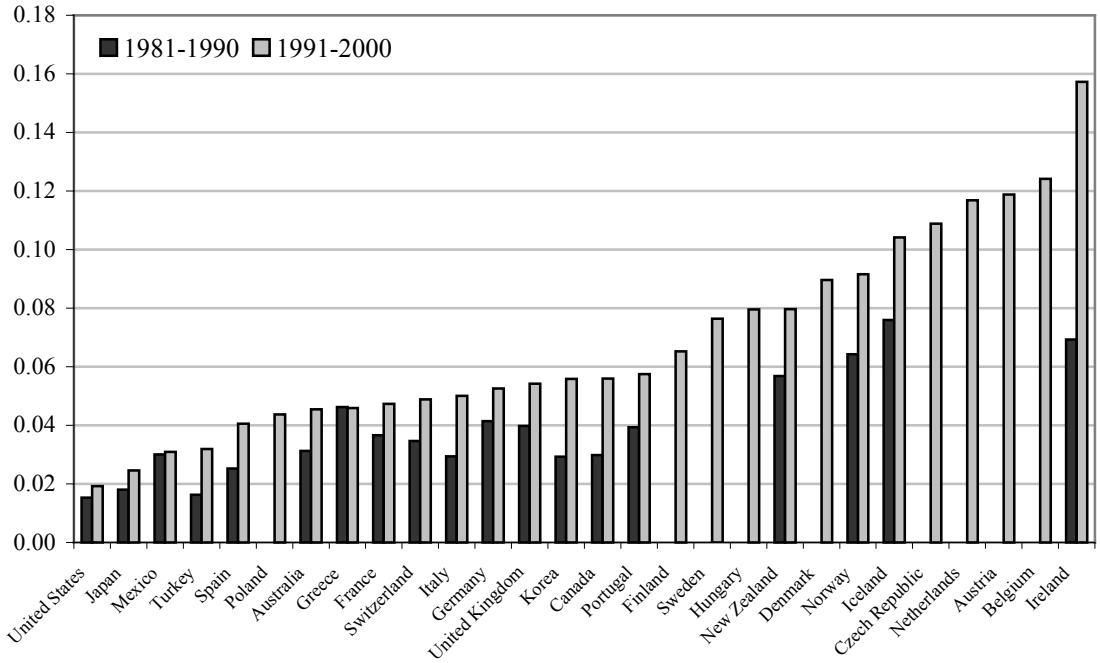
Source: OECD.

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 (exporter)	***TLSd***				**0.335***** [0.085]		
log infra-transport (importer)	***TLSf***				**0.340***** [0.061]		
log infra-transport	***TLSd=TLSf***					**0.262***** [0.049]	**0.275***** [0.050]
log infra-telecoms (exporter)	***TLSd***				**2.518***** [0.535]		
log infra-telecoms (importer)	***TLSf***				**2.431***** [0.391]		
log infra-telecoms	***TLSd=TLSf***					**2.091***** [0.317]	**2.308***** [0.306]
log Av. Entry Barr (exporter)	***TLSd***					**-0.038** [0.090]	
log Av. Entry Barr (importer)	***TLSf***					**-0.507***** [0.108]	
log Av. PMR (exporter)	***TLSd***						**-0.356***** [0.128]
log Av. PMR (importer)	***TLSf***						**-0.536***** [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%