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# Complementarity of Inputs across Countries in Services Trade

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This article argues that trade in certain services has a specific feature that does not necessarily apply to goods. In those services, the production process ends in the country where they are eventually consumed (*i.e.* in the importing country). Hence, we propose that services trade must use interactively inputs from both exporting and importing countries and thus, should be affected in the same manner by their respective costs. We test our analytical framework using a macro dataset on bilateral trade in services and a specific industry dataset on Air passenger international transportation. We find results consistent with our theoretical framework: policy and non-policy factors affecting the use of inputs in both the exporting and the importing country have a symmetric impact on the bilateral flow of services between those countries.*

## I. Introduction

In the past 50 years, world services trade grew by as much as trade in goods LIPSEY (2006). However, the factors that are usually put forward to explain the growth of trade in goods might not be responsible for the surge in services trade. Think for instance of all trade agreements on tariffs and non-tariff barriers or the increasing share of developing countries' in world trade (KRUGMAN 1995). Until the mid-nineties, trade agreements have been mainly related to goods and the share in world services trade for developing countries was still relatively small. Consequently, services must have some characteristics that do not necessarily apply to goods.

Only few theories have been developed so far in the literature to explain some of the specific features that services could have vis-à-vis goods. By following a traditional Heckscher-Ohlin model structure, DEARDORFF (1985) and MELVIN (1989) have already shown that the existence of trade in factor services (or producer-type services) leads to a reconsideration of the law of comparative advantage.[1] In contrast, ETHIER and HORN (1991) focus on a characteristic related to consumer-type services, where the production function is different from that of commodities

1. One important reason is that, while factor services are delivered abroad, their owners continue to consume in their home country. This alters the natural specialisation of countries, which would prevail in the absence of factor movements.

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as it involves a product that is more customised to the taste of the consumer.[2] Finally, some theories implicitly model trade in services through foreign commercial presence which also significantly departs from trade in goods' literature. For instance, MARKUSEN (2004) summarises his work with other researchers in a textbook that jointly analyses goods-producing foreign direct investment and commercial presence of foreign-owned firms providing services to consumers abroad.[3]

Recently however, BHAGWATI *et al.* (2004) argued that the theoretical tools to study services trade should be similar to those that handle goods trade. But these authors referred to what they call arm's length provision of services. These services, being part of what is called Mode 1 by the GATS, would be provided either by individuals (designers, accountants, etc…) or firms (call centers, software programmers, etc…).

In this article, we try to bring a complement to the literature by arguing that many services that are traded and directly observable from balance of payments, still need a proximity between the buyer and the supplier, and this has different implications for economic theory and policy. We note that, for services such as transport, communication and banking, trade can only occur if inputs from both trading countries are jointly used. In transport, for instance, 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 and reliable telephone cables; in banking, financial flows between countries hinge on open and efficient capital markets at both ends of international transactions. Even in tourism, tour operators in one country sell holidays to be consumed in a foreign country, whose price depends not only on the costs of accommodation, catering and other leisure activities performed at destination, but also on marketing or advertisements provided in the origin country. Besides, for all of the listed above service activities, labour in both countries is needed to perform all these tasks. Admittedly, the interaction between tasks among trading partners characterises only a subset of the traded services, because not all of them are partly produced where they are consumed (think, for instance, of a business service commissioned to a foreign consultancy firm). However, following LIPSEY (2006) and our FIGURES AA and AB in the APPENDIX, one third to one half of the share of services trade in the world in general, and the OECD in particular, is still represented by transportation, communication, insurance, financial services and tour operators' type tourism activities.[4] Hence, our argument would seem to characterise a share of services that is large enough to potentially affect the determinants and the patterns of bilateral services trade.

This special feature of internationally-traded services has implications for modelling. Common gravity models of trade cannot capture adequately the interaction between inputs in partner countries and may need to be amended to reflect this joint production process. In this paper, we propose that exports of services result from a process using different tasks in both countries which

2. See the survey by (DEE-2001) for more insights on this line of thinking.

3. MARKUSEN, RUTHERFORD and TARR (2000) consider both consumer and factor type services through foreign presence and managerial or engineering consulting transferred through foreign direct investment.

4. We do not observe the sole share of tour operators in the tourism and travel industry. The "one-half" figure would then correspond to the case where most of the Travel industry is represented by the tour operators activity while the "one-third" figure would be more suitable to the case where the tour operators share is small.

interact with each other. In fact, in these services industries, the production process of the traded service is often completed in the host country (*i.e.* where it is consumed).[5] Thus, some tasks are performed by domestic inputs and others are performed by foreign inputs. When one of these tasks (in either country) is imperfectly performed, the productivity of the whole chain of tasks with which it interacts is affected, thereby curbing the production/trade of the delivered service. Hence, independent of the location in which interactive tasks are accomplished, the efficiency with which the task is undertaken (*i.e.* quality of the task) 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 exporting country cannot substitute for tasks in the host (importing) country to produce the eventually traded service.

If our argument is correct, there are also implications for policy. As tasks accomplished in both partner countries interact, institutions or regulations in either country are likely to impact bilateral trade. For instance, product market regulations that restrict unnecessarily firm choices or the intensity of competition that they face may have repercussions on the cost or quality of the service supplied. Think for instance of the trade implications of barriers to entry in telecommunication markets. To the extent that these barriers prevent efficiency in the services supplied, not only telecommunications trade will be affected, but also trade in financial services, that hinges on the cost and reliability of data transmission. Moreover, inefficiencies in institutions or regulations in both countries will have a cumulative effect on bilateral trade flows. Ceteris paribus, one should observe at one extreme, relative intense services trade between countries that share low labour costs and efficient institutions and regulations and, at the other extreme, relatively low services trade in countries having high labour costs and unnecessarily restrictive product market regulations.

Some might argue however that task complementarity across countries is now becoming common even for goods. In nowadays trade, firms are dividing their production process across countries, where each task is undertaken in a different country along its comparative advantage (GROSSMAN and ROSSI-HANSBERG 2008). One should note though that the interaction of inputs from different countries is not a necessary condition for goods to be produced. In fact, although production might be fragmented over different producing sites, domestic factors can always substitute for foreign ones to produce the same final goods. Rather, that interaction of inputs should be a necessary condition for the goods to be shipped from the supplier to the hands of the final consumer (BROWN *et al.* 1996, HORN and SHY 1996). But at that stage, services activities such as transport and retail take the lead again. To put it differently, goods may not be co-produced by both partners but the services related to the trading of those goods would be.

Besides, in intangible services, tasks are bundled between two countries at a time to produce a transaction. Put differently, tasks in services trade are undertaken bilaterally. In contrast, tasks undertaken to produce and trade goods, might be more multilateral (*i.e.* undertaken by more than two countries).

5. In its definition of services, the Manual on Statistics of International Trade mentions that "Services...cannot be traded separately from their production...by the time their production is completed they must have been provided to the consumer."

In the empirical section, we use first the OECD dataset on bilateral trade in services to test for the interaction of tasks in both trading partners.[6] Our work represents one of the few attempts to assess the determinants of bilateral trade in services, together with some very recent studies by GRÜNFELD and MOXNES (2003), KOX and LEJOUR (2005), KIMURA and LEE (2006) or CEGLOWSKI (2006). Our findings are consistent with our theoretical framework of services supply. Especially, labour costs and infrastructure supply (in transport and telecommunications) in both trading countries are found to affect symmetrically bilateral trade in services. Moreover, using indicators of product market regulation provided by the OECD, we also show that restrictive regulations in importing and exporting countries affect in similar ways bilateral services exports.

We also run exactly the same type of regressions on trade in goods. As mentioned earlier, we expect the co-production feature not to hold for goods at the production but only at the shipping and distribution stages (due to services activities). Hence, the proportion of services in the total value of the traded good would be sufficiently small so that we expect inputs from the import country to matter less. Our results tend to confirm this intuition.

Finally, we also employ our framework on one typical industry of services, that of Passenger Air Transportation. Again our results tend to confirm what we had already found at the aggregate level of services trade.

## II. A simple framework

In this section, we present an analytical framework in which tasks performed in both trading partners concur to produce and exchange a traded service. The purpose is to obtain a simple expression relating bilateral services exports to the economic and policy features of the importing and exporting countries.

### II.*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 subject to their budget constraint. To see this, assume that 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 service product. The representative consumer of country $f$ (with $f \in \{1,...,F\}$) maximises the following Spence-Dixit-Stiglitz sub-utility function ($U_f$) subject to his budget constraint:

$$U_f = \left[ \Sigma_{d=1}^{D} \Sigma_{s=1}^{Nd} x_{df}^{s\ \frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

where $x_{df}^{s}$ denotes the demand for a service $s$ addressed to a given producer in country $d$, with $d \in \{1,...,D\}$. The variable $Nd$ denotes the number of differentiated services delivered to country $f$ by producers of country $d$, and $\sigma$ is the elasticity of substitution between the different available differentiated services ($\sigma > 1$).

6. That dataset identifies only services transactions between residents and non-residents under modes 1, 2 and part of mode 4 as defined by the GATS. The latter 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).

The first-order conditions lead to demand functions per differentiated service as follows:

$$x_{df}^{s} = \left[\frac{P_{df}^{s}}{IP_f}\right]^{-\sigma}\left[\frac{E_f}{IP_f}\right] \tag{1}$$

with $IP_f = \left[\Sigma_{d=1}^{D}\Sigma_{s=1}^{Nd}P_{df}^{s\,1-\sigma}\right]^{\frac{1}{1-\sigma}}$ the price index of the composite product, $P_{df}^{s}$ the delivered price of the service and $E_f$ total expenditure devoted to consuming the differentiated service in country *f*.

## II.2 *Supply side*

Assume that the production of a traded service involves different tasks, which interact with each others. A group of tasks is undertaken in the domestic country *d*, and another group in the foreign country *f*. Each task *k* in a country $h\ (\forall h\{d,f\})$ employs a number of inputs which are perfect substitutes, but tasks themselves are complementary. A task is undertaken with a probability *q* to be perfectly performed. The variable *q* can be thought to represent the quality of performance of the task and takes values constrained as: $0 < q \leq 1$. Such a technology can then be easily represented by a Cobb-Douglas cost function. By assuming a fixed cost $F_s$ to produce/trade a differentiated service, total costs faced by an exporter can then be expressed as:

$$\begin{aligned} C_{df} &= C\left(w,q,x_{df},F_s\right) \\ &= \left[\prod_{k=1}^{K_d}\left(\frac{w_{dk}}{q_{dk}}\right)^{\alpha_{dk}}\prod_{k=K_{d+1}}^{K}\left(\frac{w_{fk}}{q_{fk}}\right)^{\alpha_{fk}}\right]\tau_{df}x_{df} + F_s \end{aligned} \tag{2}$$

where $w_{hk}/q_{hk}$ variables $(\forall h\{d,f\})$ represent effective costs of inputs used to produce/trade an additional service (*i.e.* input prices *w* adjusted by the quality of performance *q*). The $\alpha_{hk}$ parameter stands for the elasticity of costs to effective input prices involved in task *k* in country *h*. The interaction of factor costs across the two partners provides then the marginal cost of producing/trading a service *x*. In particular, if a task is poorly performed by inputs located in the importing country (low $q_{fk}$), the effective cost rises, increasing the total cost of the service.

Besides, trading internationally the service implies iceberg-type transaction costs $\tau_{df}$ (with $\tau_{df} > 1$). In international transport and/or tourism service activities, these costs can be directly related to distance. The further away is the destination, the more transportation of goods and/or people are costly. Besides, as much as trade in goods, there are transaction costs from trading services. In these services sector (like financial intermediation), transaction costs arise from additional travels, training, translation or even time-lags. One expect all these costs to be also linked to distance.

Each producer has a monopoly on his differentiated service and thus sets a price that equalises marginal revenue to marginal cost. However, as in (KRUGMAN-1979) we assume that there are many firms in the market so that they take the price index $IP_f$ as given. Let us denote by $\mu_f = (\sigma/\sigma - 1)$ the mark up of the firm that prevails on the foreign market and by $MC_{df} = dC_{df}/dx_{df}$ the marginal cost of the service. Then, one can actually show that at equilibrium the price is set over marginal cost by the relation $P_{df} = \mu_f MC_{df}$.[7] Taking this relation

7. This can be simply obtained from choosing the optimal quantity of services $x_{df}$ to be supplied by maximising profits $(P_{df}x_{df} - C_{df})$ under the demand constraint [Eq. (1)].

into account and accounting in an add-valorem manner for transaction costs from trading, we obtain the following delivered price relation:

$$P_{df} = \mu_f \prod_{k=1}^{K_d} \left( \frac{w_{dk}}{q_{dk}} \right)^{\alpha_{dk}} \prod_{k=K_{d+1}}^{K} \left( \frac{w_{fk}}{q_{fk}} \right)^{\alpha_{fk}} \tau_{df} \tag{3}$$

Within exporters from a given country, the price of a supplied service appears then to be positively related to both importer and exporter input costs. Further, it is negatively related to the quality of performance at both ends of the service transaction.

To simplify, denote $\bar{z}_h = \prod_k z_{hk}^{\alpha_{hk}}$ the (weighted geometric) mean of any variable $z$ relative to a country $h$. Replacing in, aggregating over the $N_d$ exporters of services delivered to country $f$ by producers of country $d$, and rearranging terms, one obtains the following expression of bilateral services exports:

$$EX_{df} = E_f \; N_d \; \tau_{df}^{-\sigma} \left( \bar{w}_d \right)^{-\sigma} \left( \bar{w}_f \right)^{-\sigma} \left( \bar{q}_d \right)^{\sigma} \left( \bar{q}_f \right)^{\sigma} \left( \frac{1}{IP_f} \right)^{1-\sigma} \mu_f^{-\sigma} \tag{4}$$

This expression is similar to a gravity equation which could be obtainable in settings based on new trade theories where expenditure, the number of delivered products, transaction costs and *effective* input costs (*i.e.* input costs relative to their performance) of the exporting country enter the trade equation. Now, however, the *effective* input costs of the host country enter the equation. Thus, one should expect from the data that, in both countries, performance and input costs affect the cross border transaction in the same manner. As we are assuming a market where firms are sufficiently small so that they cannot behave strategically, the price index would then be given (see above). That might not be the case in reality, however. We use econometric methods below that account for that potential deviation from the theory.

The implementation of the testable relation (4) requires data on trade, activity and proxies of performance quality, the latter being hardly observable from existing data. As mentioned below, performance quality shall be approached by several of its possible determinants such as human capital, infrastructure supply and other regulation policies.

We use in what follows two types of data: aggregated bilateral data from OECD along with data on the Air transportation industry jointly set by OECD and ICAO. The second type of data is thus industry specific. We expect the latter to be more in line with the theory we are testing than the former. However, the former is still highly informative as it can be used to run in parallel services trade and goods trade regressions based on similar variables of interest and then to compare directly the impact of destination-type variables on these two types of trade.

## III. Empirical implementation on aggregate trade and activity data

### III.1 *Trade and activity*

Data on bilateral trade in services are drawn from the OECD *Statistics on International Trade in Services 1999-2000*. Our estimations concern 17 OECD exporters and 27 OECD partners

(importers), for which sufficient data were available.[8] Activity data in the services industries were drawn from the OECD's STAN database. Tradable services were proxied by an aggregate including "Wholesale and Retail Trade and Hotels and Restaurants" (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,[9] while the $N_d$ variable is proxied by services value added of the source country ($VA_d$). The geometric averages of input prices in the exporting ($\bar{w}_d$) and importing ($\bar{w}_f$) countries were proxied by the average labour compensation (total compensation per employee) in the tradable services sector of those countries (respectively called hereafter $wage_d$ and $wage_f$), abstracting from other inputs for simplicity. In some regressions, wages were proxied by the tax wedge on labour income.[10] Transaction costs $\left(\tau_{df}\right)$ were proxied by geographical distance between capital cities in logs (*dist*), contiguity (*contig*) and common language (*comonlang*). 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 2001). Finally, transaction costs are expected to be lowered by participation in free tade areas (*fta*).

### III.2 *Quality of performance variables*

The geometric averages of performance quality in the domestic and foreign countries $\bar{q}_d$ and $\bar{q}_d$ 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 traded services. Human capital was measured as the average number of years of education in the working-age population. We also expect the transport and telecommunications infrastructure supply in both countries to increase the quality of the performed tasks, especially in related services. Indeed, even if factors of production have adequate skills in running a particular task, the absence of such infrastructures would make it difficult to accomplish the task, thereby jeopardising the whole cross-border transaction. We measure infrastructure supply as a combination of various indicators of the quality and quantity of the telecommunications and transport networks.[11]

8. The excluded OECD exporters were Belgium/Luxembourg, Switzerland, Czech Republic, Hungary, Iceland, Ireland, Korea, Mexico, New Zealand, Poland, Slovakia and Turkey; the excluded OECD importers were Belgium/Luxembourg and Slovakia.

9. A better proxy would have been apparent consumption in services. However, production data necessary to compute apparent consumption are missing for several countries. Therefore, we opted for value added. In any case, value added and apparent consumption are very correlated (more than 95 per cent) in countries where production data are available.

10. The tax wedge is expressed as employees' and employers' social security contributions and personal income tax less transfer payments as a percentage of gross labour costs (from the OECD Database on the Tax/Benefit Position of Employees).

11. 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, GOLUB, HAJKOVA, MIRZA and YOO (2003) and GOLUB (2003).

Product market regulation in services industries may affect trade in services through the quality of performance in foreign and domestic countries. Regulations that restrict competition or fail to address market failures (*e.g.* in network access) are expected to affect the efficient functioning of services markets, by reducing the quality of the performed tasks in the tradable services sector. We use two alternative OECD indicators of regulation to capture this effect: 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 regulation and restrictions to business operations). Both these indicators are simple averages of industry-specific indicators in 12 non-manufacturing industries.[12] The indicators are cardinal and rank regulations from 0 to 1, from the least to most restrictive of market mechanisms.

### III.3 *Toward a testable equation*

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

$$\begin{aligned}\ln EX_{dft} = {} & a_1 \ln VA_{dt} + a_2 \ln VA_{ft} - a_3 \ln dist_{df} + a_4 contig_{df} + \\ & a_5 comlang_{df} + a_6 \ln fta_{df} - a_7 \ln wage_{dt} - a_8 \ln wage_{ft} + \\ & a_9 \ln \bar{q}_{dt} + a_{10} \ln \bar{q}_{ft} + \lambda_d + \lambda_f + \lambda_t + \mu_{dft}\end{aligned} \tag{5}$$

where $\lambda_f$ is an importer fixed effect that should capture the price index and markup, both specific to country $f$ [see Eq. (4)]. For a more accurate estimate of the rest of the parameters, and because the data are reported across 3-dimensions (exporter, importer and time), we have also added exporter fixed effects ($\lambda_d$) and time-specific effects ($\lambda_t$). The variable $\mu_{dft}$ is a random disturbance. It should be stressed that the explicit introduction of the three kinds of fixed effects would generate multi-collinearity, as some of the Right Hand Side (RHS) variables used are mainly varying across exporters (henceforth country-specific variables) or importers (henceforth partner-specific variables) whereas the variance over time is very small (only two 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 multi-collinearity 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 ($\ln EX_{.ft}$), or the mean importer ($\ln EX_{d.t}$), obtaining two alternative regression equations in which potential multicollinearity problems are reduced. To simplify notation, we express the deviation of variable $z_{dft}$ from the mean exporter as $\Delta_d z_{dft}$, and its deviation from

12. The indicators cover, at various levels of detail, the following broad industry aggregates in 1998: energy, gas and water; post and telecommunications; wholesale, retail trade and hotels and restaurants; transport; business and financial services. See NICOLETTI, SCARPETTA (2003).

the mean importer as $\Delta_f z_{dft}$.[13] 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. Besides, we constrain the coefficients of variables appearing in both equations (like *distance*, *FTA*, *contiguity* and *common language*) to be the same across the two equations.

Thus Equation (5) can be decoupled into the following two simplified equations for bilateral services exports:

$$\begin{aligned} TLS_d \;:\; \Delta_d \ln EX_{dft} = {} & a_1 \Delta_d \ln VA_{dt} - a_3 \Delta_d \ln dist_{df} + a_4 \Delta_d contig_{df} + \\ & a_5 \Delta_d comlang_{df} + a_6 \Delta_d \ln fta_{df} - \\ & a_7 \Delta_d \ln wage_{dt} + a_9 \Delta_d \ln \bar{q}_{dt} + a_{11} + \upsilon_{dft} \end{aligned} \tag{6}$$

$$\begin{aligned} TLS_f \;:\; \Delta_f \ln EX_{dft} = {} & a_2 \Delta_f \ln VA_{ft} - a_3 \Delta_f \ln dist_{df} + a_4 \Delta_f contig_{df} + \\ & a_5 \Delta_f comlang_{df} + a_6 \Delta_f \ln fta_{df} - \\ & a_8 \Delta_f \ln wage_{ft} + a_{10} \Delta_f \ln \bar{q}_{ft} + a_{12} + \epsilon_{dft} \end{aligned} \tag{7}$$

where we have assumed $a_{11} + \upsilon_{dft} = \Delta_d \lambda_d + \Delta_d \mu_{dft}$ and $a_{12} + \epsilon_{dft} = \Delta_f \lambda_f + \Delta_f \mu_{dft}$ (with $a_{11}$ and $a_{12}$ being two intercepts), while $\upsilon_{dft}$ and $\epsilon_{dft}$ are two transformed residuals. Note that 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 [Eq. (7)], export country-specific effects and variables (indexed by $d$ or the couple $dt$) are accounted for in a non-parametric way. Import country-specific effects variables (indexed by $f$ or the couple $ft$) are accounted for in the same fashion in the $TLS_d$ equation [Eq. (6)]. Moreover, in this way we are also able to 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.

### III.4 *Results*

Before showing the results related to TLS-SUR type equations that we have run, TABLE I shows a first set of results based on OLS regressions and TLS regressions run separately. In these regressions, which we take as "benchmark", the quality of performance is represented only by human capital. In column 1, we estimate a typical gravity relationship for services trade to investigate whether or not it roughly compares to usual findings for trade in goods. 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 participation in free trade areas increasing bilateral exports of services, while distance and high labour costs in the exporter country reduce them. Indeed,

13. The deviations are expressed in algebra as: $\Delta_d z_{dft} = (z_{dft} - \bar{z}_{.ft})$ and $\Delta_f z_{dft} = (z_{dft} - \bar{z}_{f.t})$, where $z_{.ft}$ is the average value of a variable $z$ across all $D$ exporters and $z_{d.t}$ is its average value across all $F$ importers.

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, remarkably increasing the fit of the regression. Moreover, their estimated coefficients have roughly 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 in TABLE I). For most variables, qualitatively the results change very little relative to the OLS regressions. The two main differences are that the effect of the *FTA* variable is only positive and significant in the $TLS_d$ regression, and that in the $TLS_f$ regression, the effects of distance and common language are significantly smaller while that of contiguity is higher. Nevertheless, as mentioned earlier, we constrain in subsequent specifications the parameters on *distance*, *FTA*, *common language* and *contiguity*, to be equal across the two TLS equations, as would be expected from the theory.

Column 5 in TABLE II 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 I, all consistent with theory. Thus, even accounting implicitly for fixed effects and running simultaneously the two TLS regressions we find that results for wages and human capital in both the exporting and importing countries are consistent with our theoretical framework: our proxies for costs and quality of performance affect bilateral trade in roughly the same way, independent of the location of production.

A cautionary note is in order, however, because our wage variable might also reflect skill premia related to higher productivity of labour, which might be only partly captured by the human capital variable in the regression. If this argument happens to apply, then our results could also be consistent with a more traditional view in which exports are reduced because of higher productivity (embodied in higher wages) in the importing country. One way to avoid this interpretation would be then to demonstrate that the wage variable captures information about costs rather than productivity, the latter being already captured by the human capital variable. We attempt to do so in alternative ways. First, instead of considering wages we consider labour tax wedges that represents one of their cost-component. Second, we run an instrumental variable regressions where wages are instrumented by a set of variables that represent costs.

Equation 6 of TABLE II reports the results of the regression in which wages have been replaced by the tax wedge on labour.[14] The tax wedges of both the exporting and importing countries negatively affect bilateral exports. Moreover, the estimated parameters are higher in absolute value than wage-based parameters estimated in earlier regressions, consistent with the notion that wages convey mixed information on costs and skill premia. The signs and significance of the rest of the parameters remain unchanged, but the magnitude of the estimated parameters is now lower, due to 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

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

**TABLE I.** — DETERMINANTS OF TRADE IN SERVICES, BASIC EQUATIONS

| **Dependent variable:** | **Bilateral Services Exports** | | | |
|---|---|---|---|---|
| **Specification:** | **(1) OLS** | **(2) OLS** | **(3) TLS$_d$** | **(4) TLS$_f$** |
| Services VA$_d$ | 0.800*** [0.046] | 0.871*** [0.037] | 0.835*** [0.033] | |
| Services VA$_f$ | 0.490*** [0.042] | 0.871*** [0.037] | | 0.764*** [0.036] |
| Distance | -0.179*** [0.066] | -0.203*** [0.047] | -0.890*** [0.068] | -0.171*** [0.050] |
| Contiguity | 0.374** [0.165] | 0.223 [0.163] | 0.263* [0.143] | 0.677*** [0.182] |
| Common language | 0.728*** [0.156] | 0.455*** [0.125] | 0.573*** [0.113] | 0.249* [0.148] |
| FTA | 1.025*** [0.141] | 1.542*** [0.118] | -0.087 [0.181] | 1.331*** [0.113] |
| Wage$_d$ | -0.591*** [0.070] | -0.688*** [0.064] | -0.671*** [0.053] | |
| Wage$_f$ | | -0.684*** [0.048] | | -0.590*** [0.050] |
| Human capital$_d$ | 2.374*** [0.458] | 2.634*** [0.360] | 1.837*** [0.305] | |
| Human capital$_f$ | | 3.441*** [0.344] | | 3.440*** [0.399] |
| Labor tax wedge$_d$ | | | | |
| Labor tax wedge$_f$ | | | | |
| Constant | -12.594*** [1.415] | -25.744*** [1.588] | -0.330*** [0.042] | 0.075* [0.042] |
| Observations | 385 | 385 | 387 | 387 |
| R-squared | 0.73 | 0.84 | 0.8 | 0.69 |

1/ Robust standard errors in brackets, 2/ * significant at 10%; ** significant at 5%; *** significant at 1%.
3/ All variables are in logs except for FTA, Common Language and Contiguity. 4/ Wages are proxied by the average of labour compensation. 5/ Human capital is proxied by the average years of education.

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 by 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*, *Distance*, *FTA*).[15] It is worth stressing that all these instruments convey information about

15. 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.

costs. Therefore, we do not include as an additional instrument human capital, that is rather correlated with productivity. Column 7 in TABLE II, 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 trading countries. Consistent with our theoretical framework of services supply, their estimated effects on bilateral services exports are positive and statistically significant and are very similar in the importing and the exporting country.

**TABLE II.** — DETERMINANTS OF TRADE IN SERVICES, COMPLETE SPECIFICATIONS

| | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|
| **Specification:** | | **SUR-TLS** | | | | **3SLS-TLS** |
| Services $VA_d$ | 0.904*** | 0.553*** | 0.932*** | 0.998*** | 0.999*** | 0.978*** |
| | [0.027] | [0.027] | [0.027] | [0.032] | [0.025] | [0.026] |
| Services $VA_f$ | 0.797*** | 0.492*** | 0.786*** | 0.849*** | 0.830*** | 0.817*** |
| | [0.031] | [0.026] | [0.031] | [0.027] | [0.026] | [0.027] |
| Distance | -0.288*** | -0.482*** | -0.310*** | -0.675*** | -0.705*** | -0.618*** |
| | [0.049] | [0.068] | [0.052] | [0.057] | [0.056] | [0.055] |
| Contiguity | 0.414*** | 0.528*** | 0.317** | 0.266** | 0.276** | 0.446*** |
| | [0.137] | [0.164] | [0.141] | [0.135] | [0.135] | [0.138] |
| Common language | 0.466*** | 0.444*** | 0.445*** | 0.276** | 0.230* | 0.171 |
| | [0.132] | [0.158] | [0.131] | [0.128] | [0.127] | [0.127] |
| FTA | 1.190*** | 0.700*** | 1.159*** | 0.141 | 0.04 | 0.219 |
| | [0.111] | [0.157] | [0.122] | [0.143] | [0.139] | [0.133] |
| $Wage_d$ | -0.750*** | | -0.837*** | -0.892*** | -0.888*** | -0.880*** |
| | [0.037] | | [0.038] | [0.046] | [0.035] | [0.035] |
| $Wage_f$ | -0.574*** | | -0.619*** | -0.777*** | -0.777*** | -0.750*** |
| | [0.043] | | [0.042] | [0.039] | [0.037] | [0.037] |
| Human $capital_d$ | 2.301*** | 0.769* | 2.323*** | 1.868*** | 1.919*** | 1.620*** |
| | [0.311] | [0.462] | [0.313] | [0.281] | [0.276] | [0.290] |
| Human $capital_f$ | 2.621*** | 2.047*** | 2.943*** | 2.353*** | 2.177*** | 2.222*** |
| | [0.348] | [0.458] | [0.343] | [0.295] | [0.286] | [0.285] |
| Labor tax $wedge_d$ | | -1.304*** | | 0.181** | 0.213*** | 0.206*** |
| | | [0.209] | | [0.088] | [0.051] | [0.053] |
| Labor tax $wedge_f$ | | -0.703*** | | 0.291*** | 0.213*** | 0.206*** |
| | | [0.222] | | [0.063] | [0.051] | [0.053] |
| Trans. $Infra._d$ | | | | 0.181** | 0.213*** | 0.206*** |
| | | | | [0.088] | [0.051] | [0.053] |

**TABLE II.** — CONTINUED

| | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|
| **Specification:** | | **SUR-TLS** | | | | **3SLS-TLS** |
| Trans. Infra.$_f$ | | | | 0.291*** | 0.213*** | 0.206*** |
| | | | | [0.063] | [0.051] | [0.053] |
| Tel. Infra.$_d$ | | | | 2.388*** | 2.229*** | 2.393*** |
| | | | | [0.546] | [0.321] | [0.312] |
| Tel. Infra.$_f$ | | | | 2.534*** | 2.229*** | 2.393*** |
| | | | | [0.397] | [0.321] | [0.312] |
| Entry barriers$_d$ | | | | | -0.045 | |
| | | | | | [0.091] | |
| Entry barriers$_f$ | | | | | -0.508*** | |
| | | | | | [0.108] | |
| Overall regulation$_d$ | | | | | | -0.436*** |
| | | | | | | [0.134] |
| Overall regulation$_f$ | | | | | | -0.587*** |
| | | | | | | [0.120] |
| Observations | 395 | 336 | 374 | 374 | 374 | 374 |
| R-sq Importer | | | 0.66 | 0.72 | 0.73 | 0.73 |
| R-sq Exporter | | | 0.72 | 0.75 | 0.75 | 0.75 |

Dependent variable: bilateral services exports. Coeff. on exporting $z_d$ and importing $z_f$ country specific characteristics come from TLS$_d$ and TLS$_f$ regressions, respectively. All models include country and partner fixed effects. Constant variables estimated but not reported. Coefficients on *Distance*, *Contiguity*, *Common language* and *FTA* are constrained to be the same for TLS$_d$ and TLS$_f$ regressions. Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All variables in logs except for *FTA*, *Common Language* and *Contiguity*. Wages are proxied by the average of labour compensation, and Human capital variables by the average years of education. *transport* and *telecom Infra.* indicators are increasing in the quality of infrastructure (see GOLUB (2003)). *Entry barriers* and *Overall regulation* indicators summarise restrictions and regulations of non-manufacturing industries (services) and increase with the level of restrictiveness.

Columns 9 and 10 in TABLE II look at the effects of two alternative product market regulation variables on bilateral services exports. In column 9, we restrict the focus to 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. Conversely, restrictions on access to the host country's markets 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, restrictive regulations appear 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 suffers in both countries from exceedingly stringent measures to regulate services markets.

III.*4.1.* Comparison with goods

In services, production occurs when it meets consumption. This, as shown above, leads to a coproduction process among exporters and importers of services when studying trade in services. As mentioned in the introduction however, this characteristic might not hold for goods in the production process. At the shipping and marketing stages process however (after goods have been produced), cross-country interaction of inputs should arise because the sole activity of trading the good should involve services such as transport, retail or financial activities.

Hence, we expect the cost and/or supply of production factors in the import (host) country to matter *a priori* at the shipping stage of trading the goods, not at their production stage. We do not have access to data on the amount of services associated to trading the goods. However, we expect that the proportion of services in the total value of the traded good is sufficiently small so that inputs from the importer would matter less. Do the data validate our expectation? We gather data on bilateral trade in goods on the same period and for the same sample of countries from the OECD. We perform exactly the same type of equation on goods. Beforehand, we have replaced service-specific variables like services value added, wages and regulation in services by their counterpart data related to the manufacturing sector.[16]

Equation 11 in TABLE III applied to bilateral goods trade is the counterpart of services trade equation 10 (in TABLE II). By simply comparing both equations, one notices that three out of four variables related to production factors in the importing country (human capital, telecom and transport infrastructure) appear to matter less for goods than for services. Especially, the effect of human capital in the importing country is 3.5 times lower for goods than for services. On the other hand, telecommunication infrastructure in the importing country does not appear to facilitate foreign goods entry as it seemed to be facilitating entry of foreign services. One argument is that a well endowed telecommunication infrastructure in one country's manufacturing sector may be a cost advantage for its domestic firms at the expense of foreign ones.

The only non-expected result is related to the effect of wages in the import country, however. While we expect it to matter less, the value of the wage parameter in the goods equation appears to have the same magnitude if not even higher, in absolute terms, than its counterpart in the services equation. One possible explanation is related to the fragmentation of production between partner countries, so that wages in both countries matter for producing the final good. This result asks however for further investigations.

As mentioned earlier, trade in goods has two components: a production component and a shipping component. We have conjectured so far that inputs in the host (importing) country should not play a determinant role at the production process that takes place in the source country. One way to let the RHS variables, introduced so far, capture the production and not the shipping process is to add a services trade variable to the trade in goods equations. By doing that, we expect inputs or their cost, in the host country not to matter anymore, because their effect on trade in

16. Manufacturing wages (compensation per employee) and value added variables are extracted from the STAN-OECD database. The regulation variable in manufacturing comes from the OECD' Product Market Regulation database.

**TABLE III.** — DETERMINANTS OF TRADE IN GOODS

| | (11) | (12) |
|---|---|---|
| **Specification:** | **3SLS-TLS** | |
| Distance | -0.730*** [0.057] | -0.519*** [0.058] |
| Contiguity | 0.541*** [0.110] | 0.473*** [0.101] |
| Common language | 0 [0.110] | 0.009 [0.101] |
| FTA | 0.790*** [0.155] | 0.776*** [0.143] |
| Goods $VA_d$ | 0.922*** [0.029] | 0.667*** [0.041] |
| Goods $VA_f$ | 0.856*** [0.029] | 0.653*** [0.038] |
| Manufacturing $wage_d$ | -0.629*** [0.041] | -0.383*** [0.049] |
| Manufacturing $wage_f$ | -0.753*** [0.037] | -0.554*** [0.046] |
| Human $capital_d$ | 1.759*** [0.267] | 1.356*** [0.261] |
| Human $capital_f$ | 0.804*** [0.248] | 0.435* [0.263] |
| Transport $Infrastructure_d$ | -0.219*** [0.068] | -0.301*** [0.066] |
| Transport $Infrastructure_f$ | 0.150** [0.065] | 0.11 [0.069] |
| Telecom $Infrastructure_d$ | 1.705*** [0.433] | 1.605*** [0.415] |
| Telecom $Infrastructure_f$ | -1.738*** [0.412] | -2.094*** [0.439] |
| Regulations in exporter's goods markets | -0.039 [0.075] | 0.119 [0.074] |
| Regulations in importer's goods markets | -0.686*** [0.085] | -0.426*** [0.093] |
| Bilateral services exports | | 0.250*** [0.028] |
| Observations | 306 | 306 |
| R-sq Importer | 0.8 | 0.81 |
| R-sq Exporter | 0.85 | 0.88 |
| Chi-test Transport Infraestructure exp=imp | 17.11 | 20.74 |
| Chi-test Telecom Infraestructure exp=imp | 34.83 | 39.53 |

Dependent variable: bilateral goods exports. All models include country and partner fixed effects. Constant variables estimated but not reported. Coefficients on *Distance*, *Contiguity*, *Common language* and *FTA* are constrained to be the same for $TLS_d$ and $TLS_f$ regressions. Standard errors in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%. All variables in logs except for *FTA*, *Common Language* and *Contiguity*. Wages are proxied by the average of labour compensation, and Human capital variables by the average years of education. *transport* and *telecom Infra*. indicators are increasing in the quality of infrastructure (see GOLUB 2003). Regulation indicators are increasing with the level of restrictiveness.

goods would translate through their impact on services. The results are presented in Equation 12 (TABLE III). By controlling for services trade activity, human capital in the import country appears to be insignificant and transport infrastructure in the importer is less statistically significant (only at the 10% level) with a parameter that has a much smaller magnitude. Besides, telecommunication infrastructure is even more negative in magnitude. Nevertheless, the wage parameter is still negative and statistically significant, although now its magnitude has been reduced. In sum, one can deduce that the interaction of production factors among trading partners seems to play a more crucial role for trade in services than for trade in goods.

### III.5 *Empirical implementation on air transport of passengers*

In the preceding section, we have used aggregate data to show how factors from both countries can affect symmetrically services flows. In this section, we use instead industry level data on the air passenger transportation industry.[17]

By nature, international air transport is a service which process of production ends in the host country. We would like to study here whether factors from both countries are, again, affecting international traffic of passengers. As the dependent variable we consider the log of bilateral traffic of passengers for 100 air routes connecting 27 OECD countries, in the 1996-97 travel season.[18] The number of passengers carried is obtained by counting each passenger on a particular flight.

Concerning the explanatory variables, we include again variables accounting for input prices and the quality of performance, along with gravity type variables (GDPs and the distance between airports).[19] Regarding input prices, we use alternatively two cost variables from ICAO: 1/ the average wage compensation and 2/ the operating average unit cost, both variables being computed using data from the main national companies.[20] Assuming competitive factor markets in a given location, the cost of factors tend to be equal, which is why we have approached factor prices in a typical destination or a typical departure by observable costs of the main national companies.

As for the quality of performance factors, we use three types of variables. The first variable concerns the average aggregate load factor at departure and arrival. The load factor of an airline carrier is the share of seats occupied by passengers in total capacity seats. When aggregated over the whole domestic carriers, the average load factor provides information on the average efficiency of the airline industry in the country. At similar costs, one expects that a higher efficiency in providing the service at departure (resp. at arrival) would increase exports from (resp. to) that location.

The second proxy of performance concentrates on the quality of infrastructure at the two extremes of the transaction. We use a dummy variable indicating the presence of congestion in traffic at departure and arrival airports. The third variable is related to the extent of competition and regulation on the route. It is represented here by three alternative measures: (1) a dummy

17. We make use of the data set employed by the authors Rauf Gonenc and Giuseppe Nicoletti in "Regulation, Market Structure And Performance In Air Passenger Transportation", OCDE 2000.

18. A very large majority of connexions is made between city hubs.

19. We would have preferred to use country or city fixed effects in order to take into account unobserved country specific characteristics. Unfortunately, the pure cross-section nature of the data did not allow us to do so.

20. The unit costs of different carriers were weighted by the air company traffic in order to obtain a nationwide specific variable.

variable indicating whether some air companies dominate most of the slots at departure and arrival airports; (2) an on-route regulation indicator and (3) a national market structure indicator. Higher levels of all these indicators inform respectively about lack of competition either on the bilateral route or at the national level. Detailed information on data sources and the construction of these variables is provided in the ANNEX B.

As a benchmark, equation 13 reports the results for the basic gravity-type regression including distance between airports and GDPs. The passenger traffic seems to respond to these variables in the same way as in the aggregate-data based regressions. By including wages into the regression (column 14) gives exactly the same negative effects at both ends of the transaction. Further, the average load factor variable at departure and arrival, introduced in column 15, have a positive and significant effect on bilateral air traffic. However, because of the lack of wage and load factor data (only 54 observations used in regression) we have withdrawn the two variables from the rest of the table, replacing the average wages indicator by operating average unit costs, which are more available across departure and destination countries. Notice that in the great majority of the following regressions, unit costs appear with a robust negative and significant sign. In some minority of cases however (see equations 18 and 22), unit costs become weakly significant or insignificant due to insufficient degrees of freedom that end-up producing multicollinearity problems.[21] That is the main reason why we have chosen to enter many variables alternatively (not together) into the equation to test.

Columns 17 and 18 in TABLE IV add alternatively dummy indicators of congestion and slot concentration at departure and arrival. Although it appears with a negative sign, congestion does not seem to be significantly affecting transport. However, column 18 shows that slot concentration has a negative and significant effect at departure, which almost doubles in the presence of slot concentration at both ends of the transaction (column 19).[22] Column 20 introduces a regulation indicator on the route constructed by the OECD (see the ANNEX), which appears as expected, with a statistically significant negative sign. Column 21 includes alternatively an indicator of market structure in the countries of departure and arrival also constructed by the OECD. The indicator takes into account, among other variables, national concentration and market shares of the largest national carrier, where higher figures reveal a decrease in competition. Again, uncompetitive markets at departure and arrivals affect significantly and negatively air transport. Besides, the last column 22 shows that the presence of uncompetitive markets at both route ends doubles the negative impact on air travels.[23]

## IV. Conclusions and discussion

This article has argued that trade in most 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.

21. The same applies to GDP in columns 18 and 21.
22. We have constructed a dummy variable taking on 1 when slot concentration prevailed at both departure and arrival; 0.5 when slot concentration prevailed in only one location and 0 otherwise.
23. We have constructed a dummy variable taking on 1 when uncompetitive markets prevailed at both departure and arrival; 0.5 when uncompetitive markets prevailed in only one location and 0 otherwise.

**TABLE IV. — DETERMINANTS IF AIR PASSENGERS TRAVEL**

| | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ln km | -0.427*** | -0.768*** | -0.689*** | -0.653*** | -0.660*** | -0.401*** | -0.430*** | -0.489*** | -0.604*** | -0.620*** |
| | [0.073] | [0.189] | [0.177] | [0.123] | [0.122] | [0.071] | [0.050] | [0.115] | [0.109] | [0.118] |
| Ln $gdp_p$ | 0.198*** | 0.566*** | 0.485*** | 0.539*** | 0.544*** | 0.117 | 0.173* | 0.548*** | 0.171 | 0.281** |
| | [0.075] | [0.149] | [0.145] | [0.117] | [0.129] | [0.132] | [0.086] | [0.111] | [0.117] | [0.115] |
| Ln $gdp_a$ | 0.197** | 0.561*** | 0.475*** | 0.538*** | 0.561*** | 0.266* | 0.186** | 0.547*** | 0.172 | 0.280** |
| | [0.077] | [0.144] | [0.144] | [0.112] | [0.125] | [0.149] | [0.087] | [0.105] | [0.116] | [0.111] |
| Av $wage_d$ | | -0.013** | -0.021*** | | | | | | | |
| | | [0.005] | [0.007] | | | | | | | |
| Av $wage_a$ | | -0.013*** | -0.021*** | | | | | | | |
| | | [0.005] | [0.007] | | | | | | | |
| Load $factor_d$ | | | 24.565** | | | | | | | |
| | | | [10.498] | | | | | | | |
| Load $factor_a$ | | | 25.057** | | | | | | | |
| | | | [10.691] | | | | | | | |
| Unit $cost_d$ | | | | -0.025** | -0.024* | 0.005 | | -0.028** | -0.020* | -0.019 |
| | | | | [0.012] | [0.013] | [0.008] | | [0.013] | [0.011] | [0.012] |
| Unit $cost_a$ | | | | -0.026** | -0.023* | 0 | | -0.028** | -0.020* | -0.020* |
| | | | | [0.012] | [0.013] | [0.009] | | [0.012] | [0.011] | [0.012] |
| $Congestion_d$ | | | | | -0.065 | | | | | |
| | | | | | [0.249] | | | | | |
| $Congestion_a$ | | | | | -0.155 | | | | | |
| | | | | | [0.243] | | | | | |

**TABLE IV.** — CONTINUED

| | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) |
|---|---|---|---|---|---|---|---|---|---|---|
| Slot concentration$_d$ | | | | | | -2.165** | | | | |
| | | | | | | [0.834] | | | | |
| Slot concentration$_a$ | | | | | | -1.214 | | | | |
| | | | | | | [0.976] | | | | |
| Slot conc. at both ends | | | | | | | -3.891*** | | | |
| | | | | | | | [0.874] | | | |
| On route Regulation | | | | | | | | -0.081* | | |
| | | | | | | | | [0.048] | | |
| Uncompetitive market$_d$ | | | | | | | | | -2.946*** | |
| | | | | | | | | | [0.645] | |
| Uncompetitive market$_a$ | | | | | | | | | -2.926*** | |
| | | | | | | | | | [0.642] | |
| Uncomp. MK at both ends | | | | | | | | | | -5.856*** |
| | | | | | | | | | | [1.050] |
| Constant | 4.952 | -10.149** | -40.312*** | -9.792** | -10.553*** | 6.431 | 6.82 | -11.029*** | 11.795** | 4.393 |
| | [3.402] | [4.902] | [13.249] | [3.929] | [3.611] | [4.978] | [4.431] | [3.722] | [4.475] | [4.132] |
| Observations | 102 | 54 | 54 | 82 | 82 | 62 | 62 | 82 | 82 | 82 |
| Adjusted R-squared | 0.22 | 0.33 | 0.45 | 0.38 | 0.36 | 0.51 | 0.55 | 0.39 | 0.49 | 0.44 |

Dependent variable: the log of bilateral passenger traffic. Suffixes *d* denote departure and suffixes *a* arrival. Constant variables estimated but not reported.
Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

On the supply side, we have modelled this specificity of traded services by a production function, that arises from a set of interacting tasks performed in the exporting and importing country. 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 less intensive than goods trade. We have shown that this proposition is consistent with two types of data provided by the OECD and ICAO, respectively at the aggregate level and for the typical Air transportation industry. 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 in general and air transport in particular. Moreover, using alternative OECD indicators of product market regulations, we also show that restrictive regulations in importing and exporting countries have symmetric negative effects on bilateral services exports and Air travel.

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 supply of crucial infrastructure and easing services regulation at both ends of transactions.

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 some traded services, imports of services might perfectly be consistent with higher employment. Besides, another intuition that follows our findings is that tests, based on differences in endowments, might be difficult to apply to this particular type of services trade where the process of production ends only when it is delivered in the destination country. In these trades, under the hypothesis of co-production of services in partner countries, endowments are no more country specific. Independent of its location, each resource is needed to perform the export and import transaction of services. Further research in these areas could be useful to clarify these intuitions.

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## Appendix

### A. *Composition of services trade in the OECD area, 1999, OECD average*

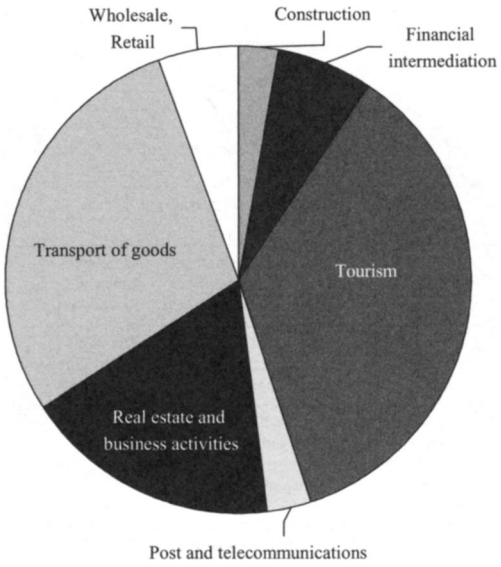


FIGURE A.*A*

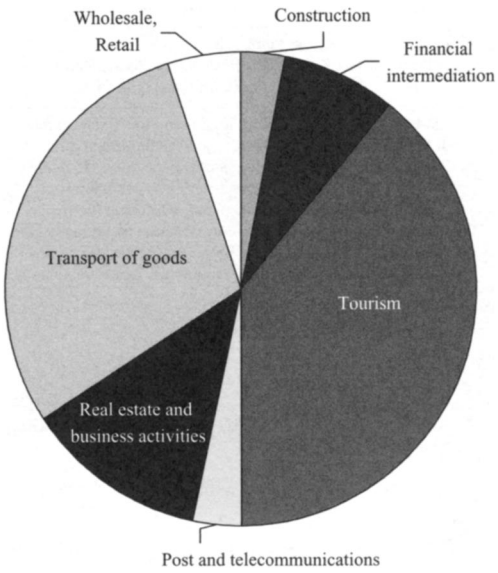


FIGURE A.*B*

*Note* : Services trade reported by balance of payments statistics includes only cross-border supply and consumption abroad. Services supplied through commercial presence or movement of individuals are excluded. *Source*: OECD.

## B. *Data Sources for Air Transport.*

TABLE B. — DESCRIPTION OF DATA SOURCES FOR AIR TRANSPORT

| Name of variables | Description | Source |
|---|---|---|
| Ln of bilateral passenger traffic | The log of bilateral scheduled passenger traffic. | ICAO (International Civil Aviation Organisation) and OCDE's estimates |
| Ln distance between airports (in Km) | The log of distance traveled by an aircraft from takeoff to landing. | OECD |
| Ln gdp at departure (resp. arrival) | GDP at constant prices for the departure (resp. arrival) country. | WDI |
| Average wage at departure (resp. arrival) | Gross average wages paid by national companies (gross wage including payroll taxes, employee benefits and pension contributions) for departure and arrival countries. | ICAO |
| Unit cost departure (resp. arrival) | Average operating unit cost of air carriers, The unit costs of different carries were weighted by the air company traffic in order to obtain a nationwide variable. | ICAO |
| Congestion at departure (resp. arrival) | A dummy variable indicating whether there exists congestion traffic at departure and arrival airports. The list of airports reported as "congested" to the International air Transport Association. | IATA (International air Transport Association) |
| Slot concentration at departure (resp. arrival) | Data on slot concentration have been extracted from multiple country-specific and international sources. They refer to the share of the largest carrier in the total number of departure flights from an airport. There are differences in definition and in some periods - in certain airports only the concentration of international flights are reported. Slot share may be underestimated in certain airports when there is double-counting due to code-share flights. | OECD |
| On route regulation | Regulation restrictions at the route level based on: 1/ Designation of authorised carriers capacity regulations. 2/ Fare regulations. 3/ Authorisation of charter flights. | OECD |
| Uncompetitive market at departure (resp. arrival) | Market environment indicator accounting for: 1/ The number of registered (ICAO-reporting) scheduled passenger airlines. 2/ Market share of the largest carrier in the domestic market. 3/ Market share of the largest carrier in the international market. 4/ Carrier concentration on domestic market (Herfindahl index). 5/ Carrier concentration on international market (Herfindahl index). 6/ Proportion of the 100 busiest international routes serviced by more than 2 carriers. | OCDE; GONENC and NICOLETTI (2000) |

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