Assessment of Restrictions in Trade in Services: a Critical view with application to the Telecommunication Sector in MENA Countries

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Résumé :

Les négociateurs commerciaux de l'OMC ont identifié quatre modes d'échange de services : l'échange transfrontière, la consommation à l'étranger, la présence commerciale et la présence de personnes physiques. Les entraves aux échanges de services s'étendent donc aux réglementations domestiques, aux quotas et interdictions, même non discriminatoires.
Le papier vise à recenser les diverses méthodes de mesures des barrières aux échanges de services, avec une illustration relative aux télécommunications dans les pays méditerranéens et à présenter une analyse critique de leur utilisation dans les équations de gravité. Les résultats de gains impressionnants issus de la libéralisation des échanges de services reposent sur trois hypothèses fortes. Premièrement, les élasticitiés de substitutions doivent être élevées, ce qui n'est pas le cas pour les données sectorielles de services qui restent très agrégées. Deuxièmement, la répartition de l'écart de prix entre la rente et la technologie inefficiente reste inconnue. Troisièmement, l'éloignement de l'ensemble des partenaires commerciaux doit être pris en compte comme l'ont montré Anderson et Van Wincoop (2003). Nous en concluons que les hypothèses fortes posées tendent à surestimer les gains attendus de la libéralisation des échanges de services. En outre, l'application d'une méthode développée pour les pays de l'OCDE pour mesurer des équivalents tarifaires et évaluer les effets de la libéralisation dans les PSEM, pour les télécommunications, pose la question de la pertinence de l'utilisation d'une même référence et méthode pour tous les pays quelles que soient leurs institutions.

Abstract

Theoretically, welfare gains from liberalisation of trade in services arise from falling prices and technology transfers from foreign firms. Empirically, due to the role of the regulatory framework in barriers to trade in services ('behind-the-border' laws), substantial gains are only reached when entry of foreign firms is widened. The aim of the paper is to resent the different methods used to measure impediments to trade in services, with an application to the telecommunication sector in MENA countries, and to present a critical view of their use in gravity equation. The results of huge gains from liberalisation of trade in services rest on three strong hypotheses. First, substitution elasticities need to be important, which is not the case empirically for aggregated service data. Second, information is required on the breakdown of the initial price-wedge between rent and inefficient technology. Third, remoteness has to be taken into account. Therefore, we argue that such strong hypotheses tend to over-estimate the gains expected from liberalising trade in services. Moreover, applying the framework developed for OECD economies to MENA countries to assess tariff equivalents and impact of liberalisation in telecommunications does not consider the relevance of the benchmark and the methodology for all countries whatever the nature of their institutions

Keywords: Trade restrictions, Commercial presence, Liberalisation of trade in services, Gravity equations

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1. Introduction

Compared with goods, services possess two special features. They have to be customised to the needs of individual purchasers (consumers or firms). Therefore, firms incur fixed costs to learn about either the regional characteristics of individuals they are servicing or the regional regulatory framework in which they are operating. Moreover, some service activities require a direct contact between user and producer (Dee, 2003). Aware of this particularity, WTO (World Trade Organisation) negotiators have recognised commercial presence (mode 3) and the temporary movement of people (mode 4) as methods by which services are traded[3] aside of traditional cross-border trade (mode 1) and movement of consumer abroad (mode 2).

Owing to the small room of manoeuvre remaining for relaxing barriers to commodity trade, most economists expect stronger trade creation and welfare improvements from liberalisation of trade in services than from further openness of good trade. The productivity improvement in forward user industries awaited for from cheaper backward service inputs also plays its role in this conviction. But, measuring the effect of the removal of barriers to services trade on their prices is difficult. In fact, restrictiveness index, which syntheses impediments to trade, such as estimations through gravity equations, have major loopholes and rely on strong approximates.

However, major shortcomings still prevail in measuring services activities. International services transactions are more complex to analyse because of the need to consider different modes of supply, which limits and reduces the information on policies restricting international trade in services; conceptual problems haunt the basic definitions on which such measures are based; insofar as services do not cross borders; information on foreign transactions in services remains very poor. Moreover, it makes little sense to speak collectively of "the service sector" because different services play different roles in the economy, have very different market structures, and rely on different modes of supply in contesting foreign markets. Finally, if modes are substitutes, a particular policy restriction may be redundant or less restrictive than it would appear to be when considered in isolation (Whalley, 2004; Francois and Hoekman, 2009).

The idea of the paper comes from the paradox between the huge and precise results of trade creation and welfare gains obtained from the equations and the important shortcomings in measuring impediments to trade in services (section 2) and modelling them through gravity equations (section 3). This question is illustrated by the telecommunication sector in the MENA countries (section 4).

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[3] The impact of commercial presence, when the firm is implemented in the foreign market and contributes to foreign GDP is, of course, sensibly different from that of usual cross-border trade, in which the service is still produced in the home country and contributes to domestic GDP. Nevertheless, in 1994, the GATS has included commercial presence into the four modes of trade in services and we adopt that extensive definition.

2. Evaluation of actual impediments to trade in services

Three different methods have mainly been used to estimate barriers to trade in services. In the late 1990's, barriers were measured by commitments to the GATS (General Agreement on Tariff and Trade). Then in the early 2000's, restrictiveness indexes have been calculated based on assessment of the degree of restrictiveness of services regulations. Finally, impediments to trade are measured indirectly by the gap between actual trade and predicted trade if a given set of countries incurs the same barriers as the least regulated country of the sample. After a brief presentation of the main barriers to trade in services, section 2 is devoted to the analysis of the first two approaches, while the latter is presented in section 3 along with gravity equations, measuring it.

2.1. Assessment of impediments to trade in services

Free trade in goods focuses mainly on tariffs and quantitative barriers to trade. Since there is no custom clearance, no national borders apply for services. Thus, commercial policy instruments are more numerous and complex than for goods trade as they all concern the regulatory framework ("behind-the-border" laws). Trade barriers take the form of prohibitions, quotas and government regulations (Whalley, 2004 and Dee, 2005).

According to Francois and Hoekman (2009), major barriers to services trade split into three headings. First, limitations are enforced on the ability of services suppliers to establish physical outlets in a country and then to supply services through those outlets. Impediments to trade in services differ whether they create an artificial scarcity, so that incumbent firms benefit from economic rents (similar to a tariff) or increase production and transaction costs (similar to low productivity or inefficient technology). The first ones have a *competition effect*; local firms charge a price mark-up (v_i) over marginal cost (c_i) when they fix their price ($p_i = c_i(1 + v_i)$). Openness to trade genders the usual 'triangle gains': barriers are rent-creating account should be taken of the price impact. As for the second ones, a *cost inefficiency effect* occurs; excluding foreign suppliers, possessing a more advanced technology with lower costs, coupled with absorption of resource-using service barriers λ_i, induces costs that exceed global 'best pratice' (cost-increasing barriers): $c_i = c_i*(1 + \lambda_i)$. Free trade would then have similar effects as productivity enhancement or upper shift in the supply curve and lead to 'rectangle gains' (Francois and Hoekman, 2009). Second, impediments and control on ongoing operations affect variable cost. Third, restrictions are imposed on the price of some services, when government-appointed industry regulators impose controls on prices differentiating between firms depending on their origin. The first two constraints can be either discriminatory, imposed only to foreigners, or applied equally to all suppliers (see appendix 1). Therefore, "*assessing the interaction between domestic (non discriminatory) regulation and*

discriminatory (trade) policies' also matters (Dee, 2005 and Hoekman, 2006), insofar as domestic policy reforms are needed.

However, not all regulations of services should be viewed as protectionist; many regulations serve legitimate purposes, such as protecting health and safety or preventing fraud and other misconduct. On the one hand, such regulation, if applied in a non-discriminatory manner, is not protectionist and should not be viewed as a barrier to service trade, even though it may maintain a higher standard than prevails abroad and thus reduce imports compared to what they would be without regulation (Deardorff and Stern, 2008; Walsh, 2006 and Matoo, 2005). It is the case of prudential regulation in financial services and security regulation in air passenger transport. On the other hand, non-discriminatory barriers, that is limits on the number of providers in a market regardless of nationality, are not absolved from being protectionist if they enforce a standard that has no legitimate purpose but happens to be met by domestic providers and not by foreign ones (Deardorff and Stern, 2008 and Dee, 2005).

However, in order to distinguish between legitimate and illegitimate regulations, a detailed knowledge of a given sector is needed. Only professionals of the very activity possess the necessary information and their objectivity and disinterestedness can be questioned (Deardorff and Stern, 2008). Moreover, despite the specific difficulties of discussion of and classification of barriers to service trade, trade economists are usually drawn back to analogies with restrictions on goods flows, and look for tariff-like measures of barriers (Dee, 2005). Many analogies can be misleading and even ultimately uninformative insofar as market access and regulation are closely linked (Whalley, 2004 and Hoekman, 2006). '*In many markets the key need is to address regulatory policies that impede contestability.*' (Hoekman, 2006).

Finally, services are highly differentiated among and within activities. The sector by sector approach reveals the most relevant one (Dee, 2005).

2.2. Measurements of NTBs (Non Tariff Barriers) in services

Those measures are based on the assumption that all service trade restrictions can be converted into tariff equivalents, evaluating a wedge between actual price and the price that would prevail without barriers to trade in services, even though no customs clearance applies (Whalley, 2004). We will present the methodology of the three sources the most frequently quoted: Hoekman (1996)' indicator, work of Australian teams at the dawn of the 2000's, then OECD's analyses. The latter two combine two types of impediments to trade in services: direct measures other than GATS commitments (observance of a practice or an explicit policy), and indirect measures. Barriers are

quantified as the difference between trade flows expected under free trade and their effective level, when assessing the latter.

2.2.1. Frequency index of commitments to the GATS: the pioneer price-based measure

When it comes to trade in services, the most used frequency index was developed by Hoekman (1996). He derived impediments to trade from a country's GATS commitments schedule, for the four modes of trade in services. No restrictions to market access or national treatment for a given mode or activity correspond to a score of one; commitment toward partial liberalisation counts as one-half, and absence of commitment as zero. This method presents some weaknesses. The absence of commitment does not always indicate the presence of restrictions; new industries are *a priori* considered as completely closed to entry; and actual restrictions differ from commitments. Moreover, the same weight is given to all impediments, whatever their actual degree of restrictiveness (Whalley, 2004; FEMISE, 2007; Deardorff and Stern, 2008).

Hoekman (1996) assumes that the absence of openness in a given industry is equivalent to a particular level of tariff, he chooses from his knowledge of the activity. He then applies these maximum tariffs to his frequency ratios to build tariff equivalents. Hoekman's method is limited insofar as the tariff equivalent of the most protectionist country is estimated arbitrarily (Walsh, 2006 and FEMISE, 2007). Therefore, Deardorff and Stern (2008) refer to Hoekman's measurements as "guestimates" and only use them as indications of the relative degree of restriction.

After Hoekman, subsequent authors (in particular the Australian Productivity Commission and the OECD) have constructed more elaborate frequency measures, based on specific surveys, which we will label as synthetic trade restrictiveness indices (STRI).

2.2.2. The Australian restrictiveness indexes

The Australian Productivity Commission (APC) and the Australian National University (ANU) have carried-out a three-year joint research leading to measurement of restrictions to trade in services and their price-impact. This work has resulted in a series of augmented frequency indexes for six service industries: banking, telecommunications, maritime transport, education, professional services and foreign direct investment (FDI) in services. Their methodology follows three steps. First, for each country, using improved data sources (mostly based on surveys) allowing a better distinction of different types of barriers to trade, the APC and the ANU researchers have scored actual restrictions on commercial presence and current activities according to their perception of their degree of restrictiveness. Then, an average of the score has been calculated, using the relative

economic significance of each restriction for weights, and converted into a quantitative synthetic "restrictiveness index". Second, for each service industry, they have entered the restrictiveness index into an econometric model of economic performance (price, quantity, price/cost margin above productivity) along with the other important determinants. Third, using their sectoral restrictiveness index, the effects of current restrictions on economic performance relative to a free-trade benchmark have been converted into a percentage "tax equivalent" and thus the "first round" effects of liberalisation can be predicted.

This method genders estimates of the trade impact, which are explicitly linked to the restrictions' characteristics. The gap between countries in terms of barriers to trade and its impact on performance of a given service activity permits then to measure an 'average relation among countries' between barriers and performance (Dee, 2003 and 2005). The latter can then be used to project the impacts on a given country, as soon as its current level of restriction can be estimated by a STRI; the econometric model has thus been used to estimate barriers in third countries, for 'out-of-sample' forecasting, (see applications to MENA countries, in section 4).

2.2.3. Product market regulations' indexes of the OECD

In the mid 2000's, the OECD has built summary indicators of the strictness of economic and administrative regulation based on a database on indicators of product market regulations (PMR), which focuses exclusively on the likely influence of regulations on the intensity of product market competition. The non-manufacturing industry's regulation indexes cover energy, transportation and communication between 1975 and 2003, and distributional and professional services in 1998 and 2003. These indicators explicitly and objectively measure market conditions, formal rules and regulations without using a 'subjective' estimate of participants (opinion surveys, as the Australians did). They include state control, barriers to entry, government involvement in economic business, and sometimes market structure. They are approved by officials from State members and OECD experts. They are calculated with a *bottom-up* approach: basic information is translated into a score increasing with restrictions; this mark is aggregated in an index relative to a given regulatory field (barriers to entry or state control); in the end, the indicator of regulation in the sector is obtained by a last aggregation. The weights are chosen on a discretionary manner, except when information is so comprehensive (retail trade, for instance) as to use data analysis. Statistics on market structure are included to measure the impact of regulation on competition. Certainly, weights are subjective, but they are transparent, like rankings. They rely on a measure of theoretical 'good practices' and are invariant with the number of countries concerned. The indicators for communication, energy and transport activities are highly correlated with regulation indicators on product markets (PMR)

covering the overall economy, as well as other indices such as the Economic Freedom of the World index, which the authors interpret as a sign of good approximation of global regulatory conditions among OECD countries. Some direct tests of the relation between regulatory indicators in non-manufacturing industries (NMR) and measures of competition on the markets have shown a negative correlation with firms' rate of entry and margin rates (Conway and Nicoletti, 2006; Kozluk et al., 2009).

2.2.4. Limits of restrictiveness indexes

Price-based measures of impediments to trade in services can be misleading, since prices differences across markets may merely reflect either differences in domestic regulatory environments and or quality differentials across countries rather than formal barriers such as impediments to entry for foreign services providers. Thus, prices differences need to be connected to barriers. Moreover, econometric models not control enough for quantity effects gendered by an impediment so that price-elasticity estimates of supply and demand would be necessary to move easily from observed price difference to *ad valorem* barriers which models implicitly assume generated them (Whalley, 2004 ; Deardorff and Stern, 2008 ; Francois and Hoekman, 2009).

Moreover, given fragmentation of production and trade of intermediate services, even masked by in aggregate data categories like "business services", price comparisons may not indicate which markets are actually restricted. Therefore, price-based measurements of trade barriers used for goods may be inappropriate to assess which markets are actually restrained (Francois and Hoekman, 2009).

Price based measurement of impediments to trade are thus not very appropriate to evaluate the impacts of barriers to entry and to competition in services.

3. Measuring the economic consequences of liberalisation of services

3.1 The method

Based on past episodes of liberalisation and deregulation (retrospective view), the gravity approach aims at estimating a 'normal' bilateral trade pattern. The few attempts to explain exports and imports of services by gravity equations prove meaningful, with determinants similar to those used for commodity trade. Those estimates are then sometime used to assess barriers to trade in services, measured as the difference between actual trade flows and what they should be under a "theoretical" free trade situation. The latter is generally estimated with the level of regulation of a liberal benchmark country (Hong-Kong, Singapore or the UK).

After a first generation of naive estimates of gravity equations, testing international trade analysis in monopolistic competition, various tentative derivation of structural gravity equations based on the theory of international trade have seen the light. Recent works take into account product differentiation by country of origin (Anderson and Van Wincoop, 2003), as well as Krugman's monopolistic competition or either models with homogeneous product and heterogeneity of productivity.

We draw on the formalisation proposed by Deardorff (1998) and applied to trade in services by Park (2002) taking stock of the work of Anderson and van Wincoop (2003). We use Armington preferences (all goods are differentiated by country of origin), and assume each country is specialised in the production of only one good, and there are trade costs. The gravity equation can be expressed as follows (see appendix 2 for the derivation):

$$T_{ij} = \frac{Y_i \, Y_j}{Y^w} \frac{\tau_{ij}^{-\sigma}}{P_j^{1-\sigma} \, \varphi}, \qquad\qquad \varphi = \sum_k \theta_k \tau_{ik} P_k^{\sigma-1} \qquad\qquad (1)$$

$$P_j = \left(\sum_i \alpha_i (p_i \tau_{ij})^{1-\sigma} \right)^{1/(1-\sigma)} \qquad\qquad (2)$$

where, P_j is the Dixit-Stiglitz price index of country j, φ is the income weighted average Dixit-Stiglitz price index of export countries, p_i denotes the exporter's supply price, and σ is the constant elasticity of substitution. Thus the gravity equation relates nominal bilateral trade in services from country i to country j (T_{ij}) to the exporting and importing GDP (Y_i and Y_j respectively), the bilateral trade costs (τ_{ij}) and price indexes. This gravity equation indicates that bilateral trade is positively related to the product of economic size of the two countries' incomes, and, when $\sigma > 1$, inversely related to trade costs between then. We follow Park (2002) and suppose that each importing country has a single trade barrier imposed on all trade partners, that is $t_{ij} = t_j$.

Finally, following Anderson and van Wincoop (2003), we assume that unobservable trade costs τ_{ij} are a loglinear function of bilateral distance d_{ij} and trade barriers t_j:

$$\ln \tau_{ij}^{\sigma} = \sigma . k_{ij} \ln t_j + \sigma . \rho \, \ln d_{ij} \qquad\qquad (3)$$

where, t_j is equal to one plus j's tariff equivalent to trade in services and k_{ij} is the dummy variable equal to 0 if i and j are in the same country and 1 otherwise.

The price index φ, reflecting the multilateral resistance in Anderson and van Wincoop (2003)'s model : the fact that two countries far away from the rest of the world should trade more together than two countries separated by the same distance but closer to third parties. Park (2002) uses aggregate wholesale price indexes to proxy the exporter's price index, which should include the price level of all trading partners. Then, equation (1) with (3) implies that:

$$\ln T_{ij} = \ln Y_i + \ln Y_j - \sigma.\rho \ln d_{ij} - \sigma.k_{ij}\ln t_j - \ln P_j^{1-\sigma} - \ln\varphi \qquad (4)$$

Measurement of barriers to trade in services t_j is an issue since they cannot be directly observed and identified (see previous section). Therefore, an indirect method consists of taking the difference between actual trade flows and what they should be under free trade circumstances as an indication of trade barriers. Frictionless trade is generally measured by a gravity equation in which a synthetic trade restrictiveness index (STRI, see previous section) is fixed at the level of the most liberal country.

3.2. Gravity equation applied to trade in services: a good fit

The analyses applying gravity equations to trade in services follow two directions. Some search to measure expected gains from trade in services liberalisation. Others look at explanations of cross-border trade in services, with a focus on complementarity between trade in services and either trade in goods or FDI in services. Inside those two groups, the first generation of studies is based on GTAP[4] (Global Trade Analysis Project) data and does not control for the omitted variable bias due to unobserved variables specific to exporting and importing countries (remoteness or multilateral resistance terms), in opposite to the second generation of analyses, which mainly uses OECD or Eurostat statistics.

All studies underline huge gains from greater openness to trade in services. Thus, among the first generation of studies, Gilbert et al. (2001) find identical coefficients for GDP, but smaller ones for distance for services compared with goods. Defining free trade as the fall in Autralian STRI to the minimum of their sample of OECD countries, Grünfeld and Moxnes (2003) show that liberalisation induce a significant increase in services exports in all countries, between 35% and 50%, and particularly sensible in Germany and the UK. They find the same result for FDI in services. Willing to measure the level of restrictions in trade in services and introducing a multilateral resistance term, Park (2002) identifies the amount of free trade transactions taking operations of the country with the smallest actual imports relative to expected imports for each service industry, as a benchmark. Comparing these results to actual trade, he finds tariff equivalents varying from 15% to 36% for France and from 6% to 36% for all OECD countries, depending on activities. Convinced that the real impediment to trade in services is not so much the level of regulation than their heterogeneity among the EU, from OECD data and a transformed least square equation, Kox and Lejour (2006) estimate that the adoption of the Service Directive in its first version of 2004 would

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[4] The *Global Trade Analysis Project* aims at gathering social accounting and trade policy for a benchmark year (1997 or 2004) for a global cooperation on general calculable equilibrium models.

Table 1: Main outcomes from gravity models assessing the impact of liberalisation of trade in services

Authors	Modes of trade in services	Type of data	Type of trade restrictiveness index	Unobserved terms specific to origin and destination countries	Significant independent variables	Tests, results specific to the model
Gilbert, Scollay and Bora (2001)	Bilateral trade in goods and services	GTAP version 5, 1997			(+) GDP and GDP/capita (-) Distance (+) EU et Asian RTA only	Income and income/capita idem. Distance effect weaker for trade in services
Park (2002)	Bilateral exports and imports (same estimate for trade in goods)	GTAP version 5, 1997 52 countries; trade, construction, transport, communication, finance, business services and others; cross-section analysis	Benchmark = trade of the country for which gaps between actual and expected exports are the highest	Multilateral export prices proxied by wholesale price indexes	(+) GDP 2 partners (-) distance (+) common language	Weaker effect of distance for services
Grünfeld and Moxnes (2003)	Exports of services and bilateral outward FDI stocks	OECD data, 1999, for 22 countries and their partners, OLS and fixed effect model	Non weighted average of countries' STRI (APC), corruption index (Transparency International)		(+) GDP 2 partners; higher home market effect (+) similarity variables, GDP proximity (-) STRI (fixed effects, exports only) (-) Corruption index (-) Distance	Sensible ↑ of exports and FDI with minimum STRI Residual of FDI explained by exports residual (complementarity)
Ceglowski (2006)	Sum of exports and imports for each couple of partners	OECD, 28 countries in 1999 and 2000 OLS and fixed effects panel		Included in countries' fixed effect of panel model; Higher fixed effect for goods than for services	(+) GDP 2 partners (-) Distance (+) Common language and border (+) membership to common RTA	Greater economic size and smaller distance impact for trade in services, which ↑ with trade in goods
Kimura and Lee (2006)	Bilateral exports and imports of services, then of goods	OECD data for 10 countries having between 27 and 47 partners in 1999 and 2000; OLS and panel with fixed effects	Economic Freedom of the World (EFW), index developed by the Fraser Institute in Canada	Relative distance from a country i: inverse of the sum of its partners j market shares in global GDP reported to distance between countries i and j	(+) GDP 2 partners (-) distance (+) common langage, border (weakly significant) (+) membership in a common RTA (+) EFW index (+) relative distance ('*remoteness*')	Adjusted R^2, distance, EFW index higher for trade in services than for trade in goods; inverse for common langage and border Residual good exports depends on residual of services imports (non reciprocal)

Authors	Modes of trade in services	Type of data	Type of trade restrictiveness index	Unobserved terms specific to origin and destination countries	Significant independent variables	Tests, results specific to the model
Kox and Lejour (2006)	Exports and bilateral inward FDI stocks of, respectively commercial and total services	Exports: OECD from 1999 to 2001, 9 EU15 countries; total bilateral FDI stocks in 1999, EU-15+3 EU-NMC; 1998 PMR; gravity equation, cross-section analysis with fixed effects, TLS			(+) origin country GDP (exports), of the 2 partners (FDI) (-) distance (EX and IDE), langage (FDI only) (-) origin country PMR (-) PMR heterogeneity on exports (+) Origin country labour productivity (FDI)	Measurement of PMR heterogeneity = comparing regulation of European countries pairs for PMR components and aggregation of differences
Schwellnus (2007)	Bilateral service exports (ratio of imports used by default)	Eurostat ITS data without transport and travel; 1999-2004 ; Panel controlling for country heterogeneity	OECD aggregated PMR index	Multilateral openness controlled by included origin and destination countries fixed effects, in panel	(+) GDP 2 partners (-) PMR index, ↓ of ½ (exporter) and ↓ 1/3 (importer), in panel (-) distance	
Fillat Castejon, Francois and Woerz (2008)	Imports and inward FDI stocks of services (non bilateral data)	IMF, OECD and OECD for FDI 1994-2004, 24 OECD countries, fixed effect model	PMR indicators	Average distance weighted by destination country's GDP reported to all its potential partners ; country fixed effects	(+) Commercial presence on imports (-) Direct effect, trade and FDI barriers (+) Indirect effect by cross-price effects of domestic market restrictions	
Head, Mayer and Ries (2009)	Good and commercial services exports	OECD data for 1992-2006 ; Fixed effect panel		Time-variable fixes effects for importer and exporter		
Lemon, Mirza and Nicoletti (2009)	Goods, services, air transport exports and imports	OECD date for 17 countries and their partners, 1999-2000 ICAO for transport, OLS, TLS, instrumental variables	PMR index, aggregation for the OECD and related to non-manufacturing activities	Country fixed effects	(+) Added Value 2 countries (+) human capital 2 countries (+) RTA, common language and border, transport and telecommunication infrastructure (-) distance (-) wages 2 partners (-) importer entry barriers	Good exports, importing country: human capital 3.5 time smaller; telecommunication infrastructure non significant; controlled by trade => human capital non significant

(Source: Synthesis by the authors from quoted papers)
RTA: Regional trade agreement; TLS : *Transformed Least Squares*

have permitted an increase between 30% and 62% of commercial services trade and between 18% and 26% of FDI stocks of services in the EU-15. Interested by offshoring in services, Head and al. (2009) show that OECD service users are ready to pay four times more for close suppliers (100 km) than for remote suppliers (10 000 km), even though distance effect is time-decreasing. Finally, from Eurostat statistics, introducing importing and exporting country fixed effects in a panel analysis, Schwellnus (2007) shows that, if between 1998 and 2003, France PMR index has passed from 2.5 to 1.1, that is the UK level, exports would have raised by 52% instead of the 16% observed, impact sensibly smaller than the 62% found in a cross-section analysis without any fixed effect (see table 2).

Despite the few progress in terms of liberalisation of trade in services included in regional trade agreements (RTA), these arrangements have a positive impact on international transactions in services, attributed to complemtarity between trade in services and trade in goods, by Cegloswski (2006) and Kimura and Lee (2006). The residual of the good exports' equation is explained by services imports, while reciprocity does not hold. Kimura and Lee (2006) see in that result the confirmation of the role of services purchases in the growth of good trade that is their complementarity. The positive impact of Economic Freedom of the World index both for exports and imports in Kimura and Lee (2006), with greater effects on good trade, echoes the result of Lennon, Mirza and Nicoletti (2007) and their outcome that regulatory environment in services in the buying country also matters, while, for goods, it only plays a role in exports. As for them, Fillat Castejòn and al. (2008) highlight a complementarity between commercial presence and trade in services, from OECD date (see table 2).

3.3 Drawbacks of gravity equations applied to trade in services

Trade in services data cruelly lack of consistency and homogeneity between countries and industries, because they are disseminated in balance of payments, macroeconomic indicators, not sectoral ones. This induces a higher variance of the dependant variable, which could explain better performance of the gravity equation to handle trade in services compared with trade in goods, when using the same explanatory variables[5]. Moreover, with indirect approaches, price-cost margins or differences in the amount traded cannot be attributed to specific policies (Francois and Hoekman, 2009). At the end, works occulting impediments to trade with all trade partners induce an omitted variable bias and tend to overestimate barriers to trade (frontier effect) and thus the impact of liberalisation of trade in services (Ceglowski (2006) and Gilbert et al. (2001), respectively, with OECD and GTAP data). For their part, Kox and Lejour (2006) use a 'transformed least squares'

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[5] See table 3, the results found both by Ceglowski, 2006, and Kimura and Lee 2006.

estimation, method which control for unobserved heterogeneity between countries when it is not correlated with observed explanatory variables, which is not the case for the degree of multilateral openness. Thus, the omitted variable bias is not corrected and their outcome of huge increase in trade in the UE is overestimated. Among the analyses correcting for bilateral country heterogeneity, the panel analysis with exporting and importing countries' fixed effects undertaken by Schwellnus (2007) and Head et al. (2009) seems the more promising one, insofar as multilateral openness first depends on geography, which is time invariant or on technological progress, which is common to all OECD countries. However, using aggregate wholesale price indexes to compensate for the absence of export prices indexes (including prices indexes of all trading partners) and to correct for omitted variable bias, Park (2002) draws on a controversial method considering the thin link between those kind of prices and traded services. Besides, he finds a negative coefficient, smaller for bilateral distance in trade in services than in trade in goods. In opposite, introducing a relative distance variable (*remoteness*), from OECD statistics, Kimura and Lee (2006) obtain a higher distance effect for services. As for Head et al. (2009), despite a more pronounced initial impact, the decreasing trend of distance effect lead to a similar impact to that observed for goods at the end of the period (2002). Park's results are surprising; a higher distance effects is expected for trade in services than for trade in goods, in line with the particular importance of proximity between suppliers and users of services (see table 2).

Gilbert et al. (2001) and Park (2002) use GTAP 1997 data, which have been compiled for CGE models, that is, to build a detailed structure on the interactions between trade, production and consumption. Early versions were themselves based on a reverse gravity-type balancing to estimate trade by sector (Francois and Hoekman, 2009). Therefore, they are not the best database from which testing a gravity equation.

Otherwise, for studies relying on synthetic trade restrictiveness indexes (STRI), the choice of benchmark country reveals presupposition that a country regulation can be adapted to any other, within OECD or even outside. In practice, institutions differ between Continental Europe and Anglo-Saxon countries (less regulated according to the Australian trade restrictiveness index). In the same way, measurement of heterogeneity of barriers by Kox and Lejour (2006) is not convincing because a given regulation, a licence requirement for instance, can be sensibly different from a country to another (Schwellnus, 2007). In the end, to deduce the level of barriers t_j, from the estimate of $-\sigma \ln t_j$, Park (2002) makes the hypothesis of a substitution elasticity of 5.6, that is the average elasticity for manufacturing in 2-digits, which corresponds to 67 types of goods, while his data only include seven traded service industries. The value of the 1-digit breakdown, 4.8, would have been a more relevant choice since it is split into ten activities. Facing the same problem, their

distance coefficient depend on the product of the elasticity of bilateral costs to distance and an inverse measure of productivity $\theta = \sigma - 1$, Head et al. (2009) also rely on estimates calculated for goods and find deplorable the lack of estimates of distance and substitution elasticities for services industries.

4. Assessment of gains from trade in telecommunication in MENA countries

In 2005, the FEMISE (Forum Euroméditerréen des Instituts de Sciences Economiques) has applied the Australian methodology to telecommunications, in some Middle East and North Africa (MENA) countries, namely Egypt, Morocco, Tunisia and Turkey. These four countries have undertaken a survey on the regulatory environment affecting market access and national treatment, in fixed lines and mobile phones and the Internet. Based on the Australian researchers' work, these studies assess indexes of discriminatory and non-discriminatory restrictions. Quantity effects of impediments have been transformed in price effects using a demand price-elasticitiy of -1.2 (estimated from a 1997 analysis and used by Warren (2000) in the course of the Australian research).

This index has been introduced in performance equations, which take back the coefficient estimated by Warren (2000) for fixed lines and mobile phones, and explained by the GDP per capita, household density, percentage of mainlines connected to digital exchange, waiting list as percentage of mainlines. Finally, those tariff equivalents' estimates are coupled with input-output tables, describing the use of services as intermediate consumption, to evaluate the impact of liberalisation of trade in services on economies' welfare. The regulation generally seems less restrictive in Egypt and Turkey than in the two Maghreb countries and softer in mobile phone than for the Internet and *a fortiori* fixed lines, except for Turkey. Welfare gains remain limited (FEMISE, 2005).

Marouani and Munro (2009) rely on the synthetic trade restrictiveness index (STRI) methodology developed by the Australian team to assess modal *de facto* restrictions in fixed and mobile telecommunications in Egypt, Jordan and Morocco. The impediments to trade are evaluated through a survey of expert opinion (government agencies, trade experts in the MENA regions) based on the questionnaire of Dihel and Shepherd (2007). The results of the latter for non-MENA countries are used to increase the number of countries in order to perform a component analysis to determine the weights of each restriction by its contribution to the whole variance (principal component analysis), method which limits the degree of subjectivity of such synthetic indexes. While MENA countries rank among the most restrictive for trade in fixed telecom services (in emerging economies), their aggregate scores have decreased between 2004 (analysis of Dihel and Shepherd, 2007) and 2007 (study of Marouani and Munro, 2009). In all investigations (including FEMISE, 2005) and for all

countries, the mobile sector is less regulated than fixed lines. In the telecommunication sector, information concerns mainly restrictions on cross-border trade and commercial presence. Compared to other modes, restrictions on mode 1 are low. Mode 2 refers to call-back services, which are permitted in Jordan, but still not in Egypt and Morocco. The three countries have very close levels of restrictions for mode 3, which are again lower for mobile phones. As for Mode 4, Jordan records the highest restriction levels as it imposes particularly short limitations on the time allowed in the temporary movement of long stay employees, while Morocco is the most liberal (see table 2; Marouani and Munro, 2009).

Table 2: Synthetic trade restrictiveness indexes (STRI, in fixed and mobile telecommunications, for three MENA countries, in 2007 (%)

| | Fixed Telecommunications | | | | |
	Aggregate	Mode 1	Mode 2	Mode 3	Mode 4
Egypt	122.00	64.00	205.00	136.00	181.00
Jordan	85.00	2.00	0.00	108.00	223.00
Morocco	80.00	64.00	205.00	81.00	73.00
	Mobile Telecommunications				
	Aggregate	Mode 1	Mode 2	Mode 3	Mode 4
Egypt	99.00	0.00	0.00	77.00	224.00
Jordan	78.00	0.00	0.00	67.00	266.00
Morocco	59.00	0.00	0.00	67.00	116.00

(Source: Marouani and Munro, 2009).
Lecture: Higher levels of STIR correspond to stricter restrictions.

In reality, services barriers are simultaneously rent-creating and cost-increasing, but without information on cost and price at firm level, these effects cannot be analysed separately. Thus, firm price-cost margin, that is the sum of earnings before interest, taxes and depreciation divided by net sales, is used as exogenous variable in performance equations. When the coefficient of STRI variable is positive, it is interpreted as rent-creating barriers, whereas if negative, it is taken as cost increasing impediments to trade. As stated by Dihel and Shepherd (2007), in order to avoid statistical inference due to the presence of firm and country level explaining variables, in presence of country-level fixed effects, a two-stage approach estimation is frequently used. First, "adjusted" price-cost are estimated as country-level fixed effects, after controlling for firm level differences, while the second stage regression seeks to explain the adjusted margins from the first stage in terms of the STRI and country-level control variables. For Dihel and Shepherd (2007), barriers (STRI) are cost-increasing for fixed and mobile telecommunication in the aggregate and for Mode 1, which seems in contradiction with previous results, whereas they are rent-creating for Mode 2, 3 and 4, which make interpretation delicate.

Bottini and Marouani (2009) choose the same type of econometric estimation as Dihel and Shepherd (2007). They use the UK as the benchmark country, having the lowest STRI. In both fixed and mobile telecom, the price-cost margin is the highest in MENA countries, compared to non-MENA developing and developed countries (Dihel and Shepherd, 2007). For fixed telecommunication, in the first stage, firm capital intensity and market share have a positive impact on price-cost margin, while the effect of net sales is negligible and that of sales growth is not significant. In the second stage, a 1% increase in the aggregate STRI induces a 0.33% increase in the country level before-tax profit, whereas, for Mode 3, it induces a 0.34% rise. Thus, restrictions in the fixed telecommunications STRI have mainly rent-creating effects. Prudential regulation and the share of mobile subscribers over the population have a positive impact on price-cost margin in fixed telecommunication. When it comes to mobile phone, firm sales growth has a positive impact on before-tax profit while capital intensity is not significant. A 1% increase in the aggregate STRI induces a 0.59% decrease in the country level price-cost margin on average, whereas a 1% increase in the Mode 3 STRI induces a 0.50% increase in the country level price-cost margin. Regulations are cost-increasing in the mobile phone sector, which, according to the authors, suggest higher gains from liberalisation due to the removal of market inefficiency. Despite higher restrictions in fixed telecommunications, tariff equivalents are higher in mobile phone in line with a greater impact of restriction in the latter activity (see table 3). Mode 3 seems thus the most critical to liberalise in order to improve firm's performance and income redistribution (Bottini and Marouani, 2009).

Table 3: Tax equivalents of restrictions, fixed-line and mobile telecommunications, for three MENA countries, in 2007 (%)

	Fixed-line Telecommunications									
	Aggregate		Mode 1		Mode 2		Mode 3		Mode 4	
	2004	2007	2004	2007	2004	2007	2004	2007	2004	2007
Egypt	9.36	54.00	7.43	15.00	36.11	2.00	132.24	67.00	8.77	68.00
Jordan		35.00		0.00		0.00		50.00		89.00
Morocco	10.19	33.00	20.71	15.00	36.11	2.00	132.24	35.00	33.4	23.00
Tunisia	10.54		20.71		36.11		132.24		110.07	
	Mobile Telecommunications									
	Aggregate		Mode 1		Mode 2		Mode 3		Mode 4	
	2004	2007	2004	2007	2004	2007	2004	2007	2004	2007
Egypt	5.73	101.00	13.43	0.00	0.00	0.00	2.34	51.00	32.47	356.00
Jordan	3.88	73.00	0	0.00	0.00	0.00	2.34	43.00	56.56	506.00
Morocco	7.61	52.00	28.66	0.00	0.00	0.00	1.46	43.00	17.14	119.00
Tunisia	5.57		13.43		0.00		1.18		106.31	

 (Source: Dihel and Shepherd, 2007 for 2004 results; Bottoni and Marouani, 2009, for 2007 estimates).

Dihel and Shepherd (2007) have calculated estimated 70% confidence intervals for the tax equivalents, relying on a bootstrap technique. Those intervals are larger for fixed-line telecommunications than for mobile-phone and for commercial presence, than for cross-border

trade (see table 4). Nevertheless, they highlight the small degree of confidence, the high variation of such tariff or tax equivalent, applied to trade in services.

Table 4: Estimated tax equivalents of restrictions - 70% confidence interval for fixed-line and mobile telecommunications, for three MENA countries, in 2004 (% on cost)

	Fixed-line telecommunications									
	Aggregate		Mode 1		Mode 2		Mode 3		Mode 4	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Egypt	0.00	180.85	0.00	27.29	7.77	71.69	35.42	311.53	7.44	66.80
Jordan	0.00	113.69	0.00	54.87	0.00	0.00	23.14	164.10	12.12	126.08
Morocco	0.00	206.65	0.00	88.42	7.77	71.69	35.42	311.53	4.12	33.36
Tunisia	0.00	217.97	0.00	88.42	7.77	71.69	35.42	311.53	20.30	273.53
	Mobile telecommunications									
	Aggregate		Mode 1		Mode 2		Mode 3		Mode 4	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Egypt	0.00	32.16	0.00	39.14	0.00	0.00	0.00	7.97	9.34	58.62
Jordan	0.00	20.99	0.00	0.00	0.00	0.00	0.00	7.97	15.30	108.67
Morocco	0.00	44.37	0.00	93.61	0.00	0.00	0.00	4.93	5.15	29.64
Tunisia	0.00	31.20	0.00	39.14	0.00	0.00	0.00	3.96	25.85	228.16

(Source: Dihel and Shepherd, 2007).

Drawing on Dihel and Shepherd (2007) and Bottini and Marouani, 2009, Fontagné and Mitaritonna (2009) build a STRI for fixed and mobile telecom for eleven emerging countries including Egypt, Morocco and Tunisia. The qualitative information on regulation comes from a survey conducted by Queen Mary University. The regulations are scored depending on their degree of restrictiveness. Then, the scores are aggregated into a weighted average, relying on principal component analysis to calculate the weights. In a second stage, the authors measure the impact of STRI on price-cost margin after controlling for its usual determinants for each sector. The combined presence of firm and country level variable leading to incorrect statistical interference is handled by clustering the error terms at country level. In fixed telecommunications, while firm' productivity is not significant, price-cost margin is positively related to firm's market share, the growth of firm sales, the capital intensity. The STRI alone has no impact, but when interacting with RTA or MFN (Most Favoured Nation) exception, the STRI have a significant negative, cost-increasing, effect on before-tax profit, suggesting that discriminatory regulations and treatment of trade partners impede incumbent firms to accede to world leading technology rather than creating rents. In mobile telecom, sales growth and MFN exceptions are not significant, while market share has a very significant and positive effect on price-cost margins. Morocco has one of the largest rent in fixed telecom accruing to domestic provider of services (33.7%), similar to that of India (33.4%), while Morocco appears less restricted (30%) and Tunisia performs even better (18.4%) (Fontagné and Mitaritonna, 2009).

These analyses suffer from some drawbacks. Using coefficient of a regression estimated on 1997 data pour 136 countries, as the FEMISE studies did, that is at constant market structure, to analyse an 'out-of-sample' country's performance in 2005, coupled with old input-output tables (1997 for Morocco) to estimate welfare gains, this analysis is subject to Lucas's criticism (1976). In other words, these estimates only remain relevant insofar as the economy keep the same structure, but can become biased or wrong when structure changes occur, such as technological progress and openness to international competition in telecommunications in the decade 2000. Moreover, for each new estimate, the performance response to a given regulatory framework is supposed identical to the average of the countries in the initial sample. This hypothesis does not take into account of institutional specificities of the new countries tested, which differ from world average.

Divergences in prices are not just reflecting the strictness of regulations; they can be imputed to improvement in the quality of services and differences of regulatory framework. In the work of Bottoni and Marouani (2009) and Fontagné and Mitaritonna (2009), the lack of data on firm level costs and price lead the authors to measure at the same time rent-creating and cost-increasing restrictions regulations. But, the result of cost decreasing with STRI obtained by the former could also be linked to increasing competition in mobile telecommunication in a time when the people of MENA countries are acquiring their first mobile phone. To our view, the breakdown between technology inefficiency and rent in wedge-price remains unfortunately unknown, which questions the robustness of the results. Thus, these findings are imprecise and over-estimated insofar as these kinds of models are highly sensitive to initial assumptions.

In summary, due to lack of data, to the small effective sample in the second-stage regression in Dihel and Shepherd (2007) and Bottoni and Marouani (2009), and the huge interval of confidence of tax equivalent estimates (see table 4), these results need to be considered with great caution, in particular before being generalised to other countries, sectors and/or time periods.

5. Conclusion

Considering the importance of proximity between supplier and client, heterogeneity and differentiation of services industries, measurement of flows and impediments to services trade reveals fussy. In fact, barriers to trade in services include domestic regulations, or non-discriminatory quotas and prohibitions. We have resent the various methods used to assess impediments to trade in services. These measures present some limitations, due to the difficulty to quantify qualitative elements of trade restrictiveness indexes and to the subjectivity of judgmental choices of weights.

The outcomes of huge gains from liberalisation of trade in services arising from gravity models relying on those measures are fragile. Moreover, those studies rely on three strong hypotheses. First, substitution elasticities need to be high, which is not the case empirically for aggregated service data. Second, information is required on the breakdown of the initial price-wedge between rent and inefficient technology. Third, remoteness has to be taken into account, as stated by Anderson and Van Wincoop (2003). Therefore, we argue that such strong hypotheses tend to over-estimate the gains expected from liberalising trade in services.

As illustrated in the case of MENA countries, due to huge interval of confidence for tax equivalents, the important and precise quantitative results of those analyses should be regarded with caution. They only represent the best attempt of the various authors at drawing appropriate conclusions given the current level of data. Therefore, rather than drawing detailed policy conclusions based on point estimates, it would be more appropriate to opt for a flexible, qualitative interpretation of the quantitative results and rank ordering of countries.

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Appendix 1: Typology of trade barriers in services by modes, based on examples for financial services and telecommunications*

Mode of supply	Nature of the restriction	General type of restriction	Restrictions specific to the sector
Mode 1	National treatment	Barriers to trade: discriminatory procedures	Car and fire insurance supplied by domestic companies only, telecommunications
Mode 2	National treatment	Barriers to trade: discriminatory procedures	Life insurance contracts bought abroad subject to a x% tax
Mode 3	Discriminatory entry limitations	Barriers to entrepreneurship: regulatory and administrative opacity	Policy score for competition in the provision of the relevant telecommunication services
		Barriers to entrepreneurship: quotas, economic tests	Number of banking agencies
		Barriers to entrepreneurship: utility tests, screening	Requirement to desmonstrate the economic interest of the investment for approbation
		Barriers to entrepreneurship: number of competitors on the market	Limitation of the number of foreign mobile suppliers at 2
		Barriers to entrepreneurship: percentage of incumbents privatised	Telecommunications
		FDI barriers: foreign participations, *joint ventures*	Entry of new banks only in joint-venture with a domestic bank; limitation at 25% (49%) of foreign ownership; Requirement to transfer part of ownership to local partners at a given time horizon
		FDI barriers: equity participation, FDI	Limitation to ten of the number of foreign non-life insurers; no more than five affiliates per company
		FDI barriers: allowing third party access	New telecommunication suppliers entering into the market
	Discriminatory limitations on entry and on-going operations	Barriers to entrepreneurship - regulatory and administrative opacity: Licences (number, requirement)	Number of bank licenses ; Number of bank outlets
	Discriminatory limitations on ongoing operations	Barriers to entrepreneurship - Administrative burden	Restrictions on public deposits or raising funds from domestic capital markets
			Restrictions on the type and amount of loans, directed towards real estate and small and medium enterprise loans
			Restrictions on local content
		Barriers to entrepreneurship - barriers to competition: performance requirements	Export requirements
			Restrictions on profit and capital repatriation (financial services)

Mode of supply	Nature of the restriction	General type of restriction	Restrictions specific to the sector
Mode 3	Non discriminatory entry barriers	Barriers to entrepreneurship - number of competitors in the market	Limitation at 2 of the number of mobile suppliers
	Non discriminatory limitations on ongoing operations	State control: introduction of an independant regulator	Telecommunications
		Barriers to entrepreneurship - regulatory and administrative opacity: Composition of the board	Limitation on the percentage of foreigners members of the board (financial services)
		Barriers to entrepreneurship - regulatory and administrative opacity: Capacity regulation	Aditionnal requirements in capital (car and fire insurance)
		Barriers to entrepreneurship - administrative burden: restrictions on mutlidisciplinary practices	Excluding banks from insurance services and share issuing
		Barriers to entrepreneurship - administrative burden	Lending and raising funds by banks
Modes 3 & 4	Discrimination on entry and on ongoing operations	Barriers to entrepreneurship - regulatory and administrative opacity: nationality, citizenship , residency, local content requirements	No more of 10% of staff as persons of foreign nationality
Mode 4	Discrimination on entry & on ongoing operations	Barriers to trade and investment: restrictions on natural person movement	Number of years (days) that executive, managers and professionals can stay
		Barriers to trade and investment:	Problems of recognition of the skill level (education and professional)
	Discrimination on ongoing operations	Barriers to entrepreneurship - regulatory and administrative opacity:	Local langage knowlegde required for members of the board

(Source : Dee, 2005 ; Dihel and Shepherd, 2007; Kozluk, et al., 2009)

* Barriers classifcation draws on regulations' tree on which the PMR indicator is based (see Kozluk et al., 2009)

Appendix 2: The gravity equation

For deriving the gravity equation, we follow Deardorff (1998), Park (2002), and Anderson and van Wincoop (2003). Assuming that all goods are differentiated by country of origin, each country specialised in the production of only one good. In each country j, all consumers are assumed to share the following CES utility function defined on the services of all countries i:

$$U_j = \left(\sum_i \alpha_i^{1/\sigma} c_{ij}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} , \qquad \sigma > 1 \qquad (A-1)$$

where c_{ij} is consumption by country *j* consumers of goods from country *i*, α_i is a positive distribution parameter and σ is the elasticity of substitution between any pair of services. The price received by exporters for their services is p_i, assuming no discrimination between countries. Let τ_{ij} (≥ 1) be unobservable trade costs of Samuelson "iceberg" form, that is: a function (τ_{ij} - 1) of the good shipped from country *i* used up in trade costs (information, transport, legal and regulatory costs) to deserve country j. Then the consumer's price is $p_i.\tau_{ij}$. Consumers in country *j* maximise the utility function a subject to budget restrictions

$$Y_j = \sum_i p_i \tau_{ij} c_{ij} \qquad (A-2)$$

The demand for country *i* services satisfying maximisation of (A-1) subject to (A-2) is

$$c_{ij} = \alpha_i.(p_j \tau_{ij})^{-\sigma}(P_j)^{\sigma-1}Y_j, \qquad (A-3)$$

The value of exports of services (as FOB price) from country *i* to country *j* is then

$$T_{ij} = \alpha_i.(\tau_{ij})^{-\sigma}(p_i)^{1-\sigma}(P_j)^{\sigma-1}Y_j \qquad (A-4)$$

In order to express exports in the gravity equation, we follow Deardorff (1998) and denote county *i*'s share of world income as θ_j.

$$\theta_i = \frac{Y_i}{Y^w} = \frac{1}{Y^w} \sum_j T_{ij}$$

$$\theta_i = \alpha_i \sum_j \theta_j (\tau_{ij})^{-\sigma}(p_i)^{1-\sigma}(P_j)^{\sigma-1}Y_j) \qquad (A-6)$$

Solving (A-5) for α_i and substituting that in (2), then we get the gravity equation (1) in the text.