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Keywords

International trade, Telecommunications

Cover Page Footnote

I would like to thank Aaron Popp, for his valuable feedback and comments regarding this paper.

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Cross-Sectional Gravity Regression

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International Trade in Telecommunication Services: Cross-Sectional Gravity Regression

Introduction

Basic telecommunication services consists of several fixed and mobile services defined by the United Nations Central Product Classification as the following:

- Provision of access to the public switched telephone network for the transmission and switching of voice, data and video where the call is made from a fixed customer location
- Provision of access to, and use of, switched or non-switched networks for the transmission of voice, data, and video where the call originates from or terminates in a portable handset or device

The global market for telecommunication services is worth over US \$1.5 trillion in revenue (WTO 2014). A robust market for these services provides positive externalities and growth for the world economy. Firms rely on communication links to coordinate with suppliers and customers.

Consumers also gain utility from using networks when more people are connected. Therefore, it is necessary that these links be accessible at a low-cost. These services can be made accessible through trade negotiations which guarantee increased market access to services through competition (Cowhey & Aronson, 2008). This is the cornerstone of The General Agreement for Trade in Services (GATS) which was created with the intention to negotiate limits on market access to many basic services by mode of supply:

- *Mode 1 Cross-Border Supply:* Supply of a service from the territory of one Member into that of another Member
- *Mode 2 Consumption Abroad:* Consumption of a service by consumers of one Member who have moved into the territory of the supplying member.
- *Mode 3 Commercial Presence:* Services are provided by foreign suppliers that are commercially established in the territory of another Member, often as foreign direct investment
- *Mode 4 Presence of Natural Persons:* Services are supplied by foreign natural persons, either employed or self-employed, who currently stay in the territory of another Member.

For clarity, the above modes of supply will be translated and defined for all telecommunications sub-sectors (Nordås *et al.*, 2014):

- *Mode 1:* Revenues from international calls or transmitted through the country and interconnection with foreign networks.
- *Mode 2:* Revenue from tourists using the local network, international roaming charges, and local internet services
- *Mode 3:* Revenues from foreign branches, affiliates, and joint ventures
- *Mode 4:* Income earned by telecommunication experts providing services abroad on a temporary basis

Negotiations for services trade entail each WTO Member to submit commitments for market access. Simply, a statement that the Member will provide access and reduce entry barriers to specific sectors. The telecommunication services market is a successful example of the progress in market access commitments and has proven that liberalization has benefited both firms and consumers.

Throughout this paper, we will be examining Mode 1 and Mode 2 supply of telecommunication service imports of OECD members and a few selected countries using an Anderson & van Wincoop (2003) cross-sectional gravity regression model. Mode 1 supply is defined as revenues from international calls and interconnection with foreign networks while Mode 2 supply is defined as revenue from tourists using the local network or revenue from international roaming charges. This paper is an extension of the 2005 study by the OECD Experts in Service Trade Restrictiveness (2009a), using recent data with a larger amount of reporting countries for the year 2011. These findings will provide a robustness check to the 2009 paper and examine possible explanations for the estimated parameters.

Service Trade Gravity Regression

The purpose of a basic gravity model of international trade is to explain bilateral trade flows in goods using factors such as GDP and distance. Similar studies have used gravity regressions for services trade using bilateral aggregated trade data. Often, researchers want to capture the effects of geographical distance, language, output, and tariff-equivalents on services trade (Walsh, 2006). Grunfeld and Moxnes (2003) were one of the first to apply most of these regressors to service trade. In their paper, they include the level of GDP, GDP per capita, distance, and a dummy variable for whether partner countries are members of a free trade area and a trade restrictiveness index. Other gravity models were studied by Kimura and Lee (2004) who use a standard gravity model to assess the differences between trade in goods and trade in services. They conclude that the gravity equation performs better for trade in services than with trade in goods. However, their data involves aggregated service trade data; the results may differ when investigating disaggregate service trade data. Therefore, we are estimating the gravity model for telecommunication services as:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \beta_3 lang_{ij} + \beta_4 EU_{ij} + \beta_5 y_i + \beta_6 y_j + \beta_7 \ln STRI_i + \varepsilon_{ij}$$

Where $\ln X_{ij}$ represents the natural logarithm of telecommunication service imports between importer i and partner country j . $\ln dist_{ij}$ is the natural logarithm of geographical distance between country i and country j (CEPII, 2011). $border_{ij}$, $lang_{ij}$, EU_{ij} are dummy variables for 1 = the country share a similar border 0 = the countries do not share a similar border a 1 = the countries share a common language and 0 = the countries do not share a similar language, 1 = the countries share EU membership and 0 = the countries do not share EU membership. y_i represents the gross domestic product (GDP) for the importing country and y_j is the GDP for the partner country. $\ln STRI_i$ is the natural logarithm of a service trade restrictiveness index for telecommunications provided by the OECD (2014a) and ε_{ij} is our error term.

Service trade imports are taken from the Extended Balance of Payment Statistics (EBOPS) and are provided by United Nations Service Trade Statistics (2014). There are complications when measuring service imports using EBOPS for it does not reveal which telecommunication revenue is being reported. Most telecommunication services cover Mode 1 and Mode 2 supply, while the UN service trade database covers these, it is impossible to differentiate the two. This leads to some bias in the OLS estimate because Mode 1 and Mode 2 supply can be more or less sensitive to the chosen regressors. There can also be a mismatch between the industries classified in the EBOPS compared to the STRI sector defined by the OECD (2009a). For this paper, we will be using the EBOPS classification 245 which includes post and telecommunications. The STRI measures the sector level of restrictiveness in the telecommunications services which might not be a perfect representation the restrictiveness in both postal and telecommunications.

The disadvantage of using a cross-sectional gravity regression for this study is that there are a smaller number of observations versus using a panel data regression. A panel data regression would also be more suitable to measure trade restrictiveness over time as it accounts for multilateral

resistance and price variations (OECD, 2009a). It would also allow us to observe the effects of previous service trade agreements. However, it has its disadvantages. The STRI is only a recent development in measuring service trade barriers and only available for the year 2014. Using this in a panel data regression would lead to some bias. It would be appropriate to use the STRI in a cross-sectional regression despite the service imports being recorded for the year 2011. Regulation in services tends to happen slower than trade in goods, therefore the STRI for 2014 and service imports for 2011 are an approximate match. This is a similar issue encountered in the OECD (2009a) study and uses this similar reasoning.

The dataset used for this study contains 1064 observations or records of international service transactions. However, few reporting countries do not have disaggregated data for each partner, instead reporting their total imports from the world. With this large of a sample, the missing data might not be critical, but is important to recognize.

Table 1. Cross-section regression for year 2011

	(1)	(2)	(3)
(Constant)	-20.909 [-13.923]	-21.391 [-14.045]	-20.673 (-12.516)
Distance	-1.177*** [-15.245]	-1.196*** [-15.181]	-1.101*** (-12.593)
Common border	0.024 [0.112]	-0.009 [-0.043]	-0.288 (-1.219)
Common language	1.450*** [5.401]	1.365*** [5.126]	1.262*** (4.779)
EU membership	0.474*** [3.100]	0.729*** [4.770]	0.474*** (2.751)
GDP in country <i>i</i>	.842*** [20.315]	.843*** [20.390]	.861*** (21.377)
GDP in country <i>j</i>	.792*** [20.743]	.852*** [22.111]	.745*** (17.159)
STRI index	-.602*** [-6.563]		-0.292*** (-2.648)
Partner STRI index			-0.372*** (-3.074)
Number of observations	1064	1064	1064
R squared	.625	.613	.633

$$(1) \ln X_{ij} = \beta_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \beta_3 lang_{ij} + \beta_4 EU_{ij} + \beta_5 y_i + \beta_6 y_j + \beta_7 \ln STRI_i + \varepsilon_{ij}$$

$$(2) \ln X_{ij} = \beta_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \beta_3 lang_{ij} + \beta_4 EU_{ij} + \beta_5 y_i + \beta_6 y_j + \varepsilon_{ij}$$

$$(3) \ln X_{ij} = \beta_0 + \beta_1 \ln dist_{ij} + \beta_2 border_{ij} + \beta_3 lang_{ij} + \beta_4 EU_{ij} + \beta_5 y_i + \beta_6 y_j + \beta_7 \ln STRI_i + \beta_7 \ln STRI_j + \varepsilon_{ij}$$

Robust standard errors in brackets

* significant at 10%, **significant at 5%, ***significant at 1%

Gravity Regression Results

All estimated parameters contain the expected sign. The coefficient for distance is highly significant and negatively correlated with telecommunication service imports. Precisely, a 10 percent increase in the distance between the importing country and the partner country will decrease imports by 11.77 percent. The importance of proximity between the importer and partner country is hard to dismiss, but whether this proximity is more or less significant compared to other services is debatable. Generally, we would expect this correlation to be less significant for communication services due to lower transportation costs (Kimura & Lee, 2004).

At any significance level, the correlation between service imports and sharing a common border is zero. Previous gravity model studies for services trade have shown that there is minimal to zero relationship between common borders and bilateral services trade. Kimura and Lee (2004) use an OLS estimation and conclude that the border dummy is positive and significant at the 10 percent level for bilateral service trade, but insignificant for service imports. Walsh (2003) also concludes that a common border has no impact on services trade, reflecting that services trade are not affected by physical borders unlike trade in goods. Hoekman and Braga (1997) argue that borders do not matter because customs agents cannot observe services as they cross the border. This is especially true for the telecommunication sector whose trade in Mode 1 occur through networks and spectrums that do not need to pass through a physical border.

The coefficient for common language is significant at the 1 percent level. That is, country i will import more services if it shares a common language as country j . This result is intuitive, as consumers are more likely to originate and terminate calls in the same language.

The coefficient for both countries sharing membership in the European Union is highly significant and is positively correlated with service trade imports. In 2009, the EU adopted comprehensive regulatory framework to address market imperfections in the telecommunications market. Among these are significant investments in broadband and transparent spectrum policy. More recent policies address high international roaming charges by introducing price caps, also called the “Euro tariff.” These policies have the theoretical effect of increasing the total volume of international calls, however, the results have not yet been estimated. To further examine a trade bloc’s impact on service trade imports, it would again be more practical to use a panel data regression.

Both coefficients for GDP in each country are highly significant. The coefficient is larger in the importing country than the partner country, but not significantly larger. A 1% increase in the

importing country's GDP will increase telecommunication service imports by .842 percent while a 1 percent increase in the partner country's GDP will increase imports by .792 percent.

Service Trade Restrictiveness Index (STRI)

An analysis of the STRI parameter is worth a separate section in this study as it has important contributions to the gravity model and contains attributes for the barriers affecting imports of telecommunication services. Econometricians have sought and developed several methods of capturing tariff-equivalents in service trade models. Hoekman (1995, 1996) constructs a frequency ratio calculated by dividing the actual number of a country's service trade commitments by the maximum possible number of commitments. A trade restrictiveness index equals 1 minus the frequency ratio.

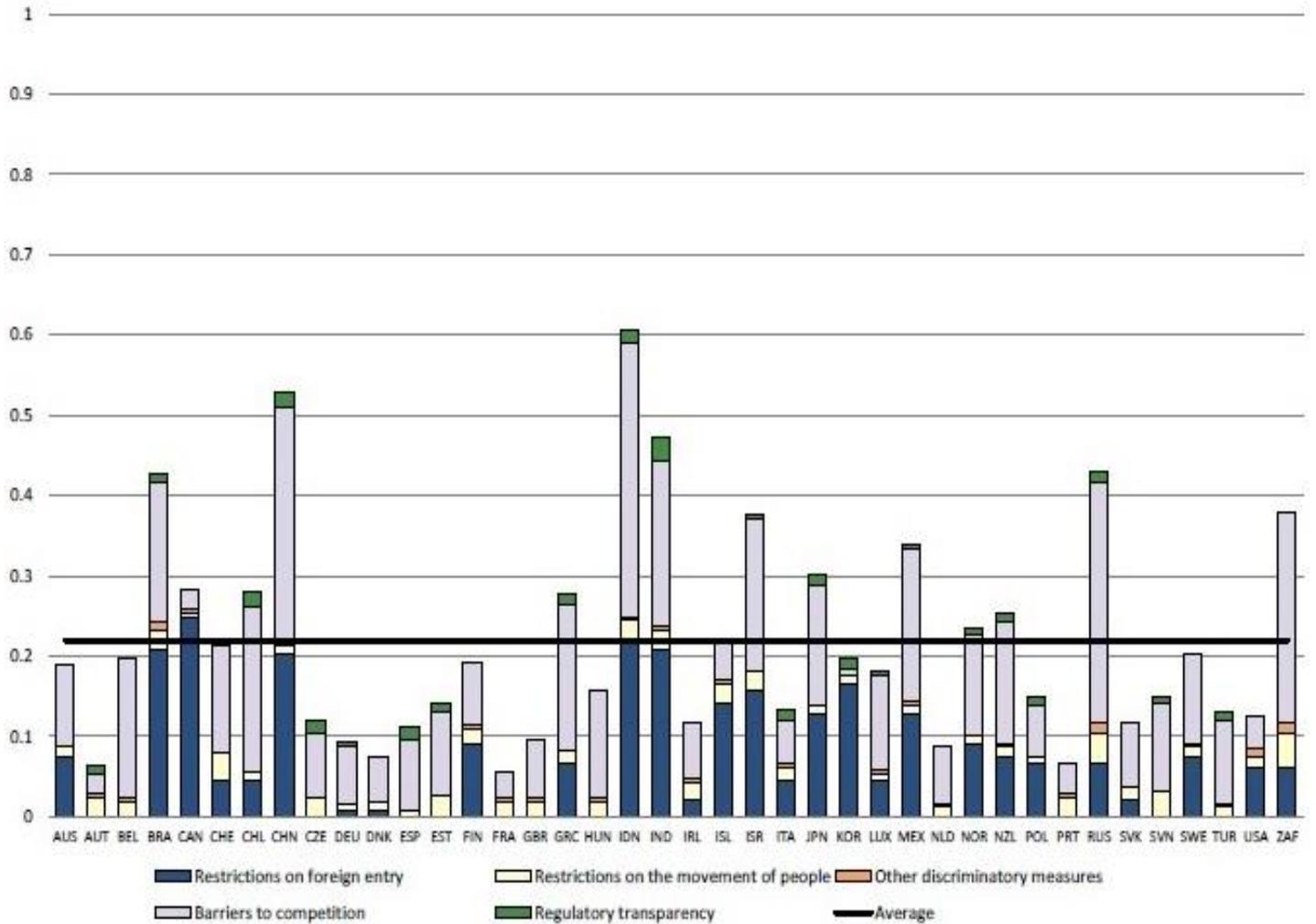
Hardin and Holmes (1997, 2000) improve this methodology by creating a weighting scheme for Mode 3 supply; restrictions on foreign direct investment. FDI restrictions can affect services such as communications more than other sectors such as business and distribution services. His results show that countries such as Korea, Indonesia, China, Thailand, and the Philippines have higher restrictiveness indexes compared to the United States and Hong Kong (Deardorff & Stern, 2008). Other methods have used price-impact measurements (Bosworth et al., 2000) and quantity-impact measurements (Warren, 2000) to econometrically estimate the effects of service trade barriers.

The OECD Service Trade Restrictiveness Index (STRI) was launched by the Trade Committee in June 2007. Barriers to service can be divided into restrictions on foreign entry and the movement of people, barriers to competition, regulatory transparency, and other discriminatory measures.

For the telecommunication sector, the most common regulatory barriers are barriers to competition which effect Mode 1 supply while restrictions on foreign entry effect Mode 3 supply. Among these are high mobile termination rates, interconnection barriers such as blocking access to essential

facilities and local loop unbundling, and high wholesale international roaming fees. The distribution of these barriers are illustrated in the figure below (OECD, 2014b).

Figure 1. STRI by Policy Area: Telecommunications



The regression results show that telecommunication services imports are highly significant and negatively correlated with the services trade restrictiveness index. More precisely, a 10 percent increase in the restrictiveness level will decrease service imports by 6.02 percent.

Extension of Findings

In the second regression, the most significant change occurs in the EU membership parameter which increases by 54 percent. According to this regression, it indicates that EU members engage in more service trade possibly because of stronger regulations and for reasons mentioned in the regression results. Once controlled for the STRI, the importance of being an EU member declines.

In the third regression, the estimated parameters of the STRI for the importing country and the exporting country provides an interesting conclusion. For this model, the partner STRI is negatively correlated with the reporting country's imports. Perhaps even more interesting, is that the partner STRI has a slightly stronger correlation than the importer's STRI. The STRI reveals domestic market conditions such as lack of competition and the high cost of interconnection. This would make it more costly for outgoing calls to be received in the importing country. For mode 2 supply, high downstream retail roaming rates also reduce the volume of outgoing calls. Most importantly, we observe that both the partner country and importing country negotiate on mobile termination rates. A mobile network operator that earns significant revenue from terminating calls might also be more inclined to originate less calls (Cowhey & Aronson, 2008). The main contribution of this paper compared to that of the OECD is that we focus on both Member's rules and regulations for telecommunication services, rather than that of the importer's.

International Trade in Telecommunication Services and the WTO

The most significant achievement in pro-competitive regulatory principles for telecommunications was the WTO "Reference Paper" (Cowhey & Aronson, 2008). The reference paper was a result of the negotiations in the Basic Telecommunication Agreement (BTA) and was accepted by 67 participating countries. The paper provides guidance about how telecommunication competition should be governed and obligates governments to create interconnection policy to address market

imperfections. These policies are designed to limit the market power of incumbents such as state-owned monopolies. Traditionally, the incumbent would attempt to block rival access to essential facilities such as telephone local loops. Interconnection attempts to solve this by requiring incumbents to share network economies with new entrants (Noam, 2001).

Network economies (or network externalities) are a source for regulator's concern. A network has higher value when there are more people (subscribers) connected. These externalities can lead to start-up problems and underinvestment (Nordås *et al.*, 2014). The remedy for this is price regulation or subsidies until the company has attracted more subscribers. Even though the intentions of interconnection are pro-competitive, there are arguments against the regulator controlling usage of facilities. For example, interconnection can discourage the incumbent from making further investment in new technologies.

Interconnection was an ideal solution to resolving service trade competition barriers. At the time of the Uruguay Round, what was understood about the telecommunication market has significantly changed. How can current trade policy adequately address a rapidly developing market using outdated market commitments found in the reference paper? For example, developments in mobile data services lead to new mobile services that may not fit any current sector classifications. Not being able to adequately define the sector can impede trade negotiations (Peng, 2007). It is also important that new regulations in the telecommunication industry remain technology-neutral. Meaning that the regulator cannot create policy in such a way that favors one technology over another. For example, in wireless spectrum licensing, a mobile network operator could either use a spectrum license for voice or data, but the regulator should not define which. To address a dynamic market for telecommunication services, transparent, forward-looking policies should be crafted that discourage anti-competitive practices yet encourage technological innovation.

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Appendix A: Summary of Statistics Variables Used in the Analysis

	Mean	Median	Standard Deviation
Log (Imports)	14.578	15.054	3.106
Log (Distance)	7.951	7.871	1.120
Log (GDP in Country i)	26.927	26.964	1.440
Log (GDP in Country j)	26.328	26.393	1.967
Log (STRI in Country i)	-1.773	-1.890	0.636
Log (STRI in Country j)	-1.726	-1.704	0.603