Distance in International Service Trade

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(Abstract)

This paper identifies the determinants of service trade with gravity model using the most recent bilateral service trade dataset. It is found that distance has significant trade-inhibiting effects on service trade flow as well as on merchandise trade. To understand the driving force behind the negative coefficient of distance variable in the service trade, we investigate the relationship between service and merchandise trade. The complementary relationship reveals that more than half of the negative coefficient in service trade is driven by merchandise trade pattern and the complementarity is found to be stronger in high income group and weaker in low income group.

1. Introduction

Modeling the pattern of international trade flow has been one of the main foci in international economics and at the center of these studies lies the gravity model. The gravity model has been widely applied in various settings but previous studies left some uncharted territories. Though applicable to all tradables, the model has been mostly used for merchandise trade. Possibly due to the conventional association of trade with physical movement of cargoes, service trade has been paid relatively less attention to by researchers. Another is the exclusive use of aggregate data that can possibly hide the sectoral heterogeneities. (Harrigan, 2002) Breaking free from these traditions would push forward the frontiers of international trade studies as well as instill novelty in the existing literature. Here lie the aims of this paper.

The first goal is to investigate the international service trade flow by sectors using gravity model. Specifically, the improvement of this paper upon previous studies is the usage of a more detailed and comprehensive dataset. Previous studies, though few in number, mostly utilized aggregated dataset of few countries over short time span.[1] The dataset used in this paper presents sectoral data and covers 188 countries over more than 20 years period. The detailed classification of service sectors is beneficial for the analysis since it allows examining the presumably different features of each sector. Furthermore, the large dataset of more countries and longer time period enables production of more representative and generalizable result.

The second aim is to understand the role of distance in depth. Previous findings tend to show inconclusive effect of distance factor. With different distance estimates, they fail to offer neither unambiguous predictions nor justifications for the effect of distance on service trade. This paper, in addition to offering a more realistic estimate with wide-ranging dataset, tries to explain the rationales behind the estimates. By

[1] Most of the previous service trade studies used OECD statistics composed of 26 OECD home countries and slightly more partner countries for only 2 years, 1999 and 2000. Examples are Kimura and Lee (2006), Ceglowski (2006), Walsh (2006) and Grünfeld and Moxnes (2003).

investigating the relationship between service and merchandise trade, the paper sheds light on the driving forces behind the role the distance plays in service trade.

The rest of the paper is organized as follows. At the second chapter, the existing literature on the gravity model is presented with specific focus on service trade and distance. Next, the data and methodology used are discussed with expected results from theory. Then, the results of analyses are presented. Lastly, we conclude.

2. Literature Review

2.1. The outset of gravity model

Gravity model refers to the law that the volume of trade between two countries is proportional to the size of the two economies and inversely proportional to the transportation costs, proxied by distance. Borrowed from physics, it is interesting to note that the model began to be used empirically by Tinbergen (1962) and Pöyhönen (1963) without theoretical justification. Despite its high empirical fit, the model was criticized for the lack of theoretical foundation. This gave rise to several attempts to link the highly successful empirical model with neoclassical international trade theories. Anderson (1979) and Bergstrand (1985a, 1989b) showed that the volume of bilateral trade is a multiplicative function of incomes and transportation costs by assuming differentiated products by their places of origin, namely, Armington assumption (1969). Other studies presented derivations of the gravity model from well-known theories of international trade, thereby proving that the model is nothing more than different presentations of the following theories. Helpman and Krugman (1985) proved that the gravity equation can be derived from monopolistic competition model with increasing returns to scale. Deardorff (1998) showed that Heckscher-Ohlin model can be transformed to yield gravity equation without assuming product differentiation. Ricardian model of trade was also found to imply gravity equation for homogeneous goods by Eaton and Kortum (2002). The comprehensive review of the theoretical foundations is well presented in Harrigan (2002).

2.2. Gravity model in service trade and distance

The gravity model has been mostly applied to analyze merchandise trade and its application to service sectors has been severely restricted due to data availability issue. Early studies had to resort to crude dataset with limited generalizability. Francois (1993) and Fieleke (1995) used the service trade data of the United States to find out that the same model design in merchandise trade could be used to analyze the service trade pattern as well. The data of Germany were used by Langhammer (1989) for the same analysis. Fortunately, to keep up with rapidly growing service trade, international rules of recording service transactions have been established and more data became gradually available. It was the OECD service trade dataset released in 2002 that gave rise to a number of systematic studies.

A number of papers employed the same gravity model setting to analyze the service trade pattern with OECD dataset. To compare the findings with the pattern of merchandise trade, a method proposed by Graham (1996) was frequently utilized in which the residuals from gravity equations are analyzed. Di Mauro (2000) used the method to investigate the relationship between merchandise exports and foreign direct investment, while Grünfeld and Moxnes (2003) looked at the relationship between service exports and foreign affiliate sales. Kimura and Lee (2006) was the first one to directly use the method to examine the relationship between service and merchandise trade. The authors separately used export and import values of both service and merchandise trade. The 4 measures, that is service exports and imports and merchandise exports and imports, were individually analyzed and it was found that merchandise exports are complementary to service imports while merchandise imports are not complementary to service exports. This reflects the service trade pattern as a contributing factor in merchandise exports. Ceglowski (2006), using the standard statistical analysis, proved that merchandise trade facilitates service trade and the two sectors are intricately connected through gravity equation.

Among several differences between service and merchandise trade flow, the role of distance has been particularly controversial. So far, the evidence provided by former

studies is inconclusive and theories do not offer a clear prediction either. The weightless and formless nature of service could render the distance factor irrelevant by making it unnecessary for buyers and sellers to be present at the same place. On the other hand, certain types of service, such as haircut or catering, do require simultaneous presence of both the buyers and the sellers. A couple of studies (Tharakan *et al.* 2005) found distance influence to be negligible in a restricted setting, but the majority of papers do show the significantly negative effect of distance in service trade environment. This was also true of international equity flow whose product is definitely weightless. (Portes and Rey, 2005) The authors, Portes and Rey, link the distance with information asymmetry which could also be a reason why service trade is subject to distance factor given inherent asymmetric information in service consumption. (Tirole, 1988) The remaining question is whether the distance is more or less important in determining actual trade flow in service versus merchandise trade. Surely, the intangibility and no physical movement of products would help overcome the physical barriers to trade and it would result in smaller coefficients for the distance variable.[2] Lennon (2006) finds this intuition to be true in OECD dataset as well. Ceglowski (2006) use the model of time and country fixed effects on OECD dataset to find that indeed the trade elasticity of distance is smaller for service trade. According to Baier and Bergstrand (2001) that used Schuknecht 1999 estimate, about 30% of the world service trade does not require buyer or seller to travel to deliver service. However, the evidence is rather mixed and there are studies that point the other direction as well. Fieleke (1995) posits that distance factor is more important in service trade than in goods trade. Grünfeld and Moxnes (2003), in the course of analyzing service trade and FDI, cite Melchior (2002) and Di Mauro (2000) to conclude that physical proximity has a greater impact on service trade.

3. Data and Methodology

[2] Since the distance coefficient is negative, 'smaller' coefficient used in this paper means smaller number in absolute value.

3.1. Model specifications

The most rudimentary form of gravity model relates the bilateral trade flow with the gross domestic products of the two countries and the distance between them. Thus, the standard gravity model takes the following form.

$$M_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \varepsilon_{ij}$$

Country *i* is the exporting country and country *j* is the importing country. M_{ij} is an import value of country *j* from country *i*; $Y_{i(j)}$ is an income of country *i(j),* and D_{ij} is the distance between the two countries. Import volume and GDP is denominated in current US dollar. The distance is defined as the geodesic distance between the capital cities of the two countries. Since trade is proportional to the size of economies but inversely proportional to distance, the expected coefficients would be $\beta_1 > 0$, $\beta_2 > 0$ and $\beta_3 < 0$. ε_{ij} is a lognormally distributed error term such that $E(\ln \varepsilon_{ij}) = 0$. The model can be extended to incorporate other trade-related variables that work either as a catalyst or a barrier to trade. Then, the extended model would estimate the sensitivity of the bilateral trade volume to each determinant. The gravity model specification used in this paper is presented as follows.

$$\ln M_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ij} + \gamma_{ijt} + \delta_{it} + \delta_{jt} + \epsilon_{ijt}$$

The model was transformed from the standard model by taking the log. γ_{ijt} is a vector of control variables that will be discussed below. δ_{it} and δ_{jt} refer to country-year fixed effects of both the exporting and importing countries. ϵ_{ijt} is an error term.

3.2. Control variables

A number of trade-boosting and trade-inhibiting factors were incorporated into the model. The vector of control variables, γ_{ijt}, includes the followings.

$$\ln\left(Y_{it}/P_{it}\right), \ln\left(Y_{jt}/P_{jt}\right) \text{and } \ln(Y_{it}/P_{it} - Y_{jt}/P_{jt})$$

The GDP per capita of both countries and the GDP per capita difference were included in the model. All the variables are denominated in current US dollar. The GDP per capita, in addition to GDP itself, captures the development level of a country and a consequent level of innovation and consumer tastes. Bergstrand (1989) included the per capita GDP in his theoretical proof of gravity model. The coefficients, though generally positive, could vary depending on how the population variable affects the trade level. The per capita income difference is often included to test the Linder hypothesis which states that the more similar the countries are in per capita income, the more they will consume similar products and end up trading more. (Linder, 1961) If true, the difference term should have negative coefficient.

$ln(area_i)$, $ln(area_j)$, $landlocked_{ij}$, $island_{ij}$, and $border_{ij}$

Despite technological progress, geographic characteristics still remain highly relevant in international trade. *Area* refers to the surface area of a country in square kilometers. Previous studies that employ large gravity dataset suggest that area has a negative effect on trade volume probably due to increased transportation costs of moving goods. *landlocked (island)* variable indicates the number of landlocked (island) countries in the bilateral trade setting. Thus, the possible value should be either 0, 1 or 2. The definition is borrowed from Rose (2004) and it captures the effect of these geographical characteristics on the trade volume. Island countries tend to engage more in international trade possibly due to easy access to seaports. For the opposite reason, landlocked countries tend to be discouraged from international trade. *border* indicates the contiguity of the countries. Countries *i* and *j* that share a border will show a value 1. Numerous studies show that sharing border boosts trade significantly, even after controlling for the short distance.

$comlang_{ij}$, $colony_{ij}$, $comcol_{ij}$, rta_{ij}, cu_{ij} and $comctry_{ij}$

Cultural similarities, shared history and membership in the same economic organizations are likely to foster the trade as well. *comlang* refers to the usage of same language. Speaking same language would definitely facilitate trade and thus the coefficient will likely be positive. *colony* and *comcol* reflect the colonial history of the countries concerned. *colony* is 1 if one country was ever a colony of the other country. On the other hand, *comcol* is unity if both countries were ever colonized by the same country. Despite the tragic colonial history, similar economic structures that remain as a result of colonial period tend to increase the trade between the involved countries. Thus, the expected coefficients would be positive. *rta* and *cu* each represent shared membership in the same regional trade agreement or currency union. Thus, the variable would be unity if both countries are a member of the same organization. Different kinds of trade agreements or currency unions were not distinguished here since it is not the main goal of this paper to estimate their individual effectiveness. Given the objectives of the organizations are to foster economic integration, the expected coefficients should be positive indicating trade-boosting effect. Lastly, *comctry* means common country and it is unity when the two countries form one nation.[3]

3.3. Dataset

The bilateral service trade data are from World Bank Trade in Services Database. The dataset was last updated in 2015 and it includes 2013-released OECD TiVA trade in service data, UNCTAD data and EuroStat data. So, it is one of the most recent and comprehensive service trade data of the world. The dataset shows the sectoral service imports value in million US dollars. Among 11 service sectors, 5 specific sectors were chosen for analysis based on their size and usage in former literature, namely, transportation, travel, communication, financial services and other business services. The coverage is the whole world of 188 countries from 1985 to 2011.[4] Some

[3] Like in Glick and Rose (2016), the word 'country' does not necessarily refer to an entire nation with sovereignty. The dataset includes overseas territories (Gibraltar), island territories (Guam) and so forth.

[4] Some of the 'countries' in the original dataset, such as 'World', 'World(residual)' and

observations in which year it was impossible to find the relevant data for GDP were dropped from the dataset. It was mainly due to international conflicts, like in Syria, political upheavals, such as Eastern European countries before democratization, or small island countries, like New Caledonia.

For the sake of data consistency, World Bank *World Development Indicators* dataset was used to retrieve the GDP, GDP per capita, population and surface area data. For Taiwan, the relevant data could not be found. Hence, they were acquired from National Statistics of Republic of China website. The CEPII (*Centre d'Études Prospectives et d'Informations Internationales*) dataset was extensively used to obtain the data for control variables as well. Both the geographical variables such as distance, contiguity and island, and the cultural variables such as language and colonial history came from CEPII GeoDist dataset. Only when the CEPII dataset did not include the necessary data was CIA Factbook referred to. Variables for which the author's discretion was needed include the regional trade agreement and currency union. Since not all the current or past agreements could be included, a subset of them were picked for analysis. The regional trade agreements data came from the WTO RTA database (Acharya, 2016) and the ones reflected in the dataset include EEC/EC/EU, US-Israel FTA, NAFTA, CARICOM, PATCRA, ANZCERTA, MERCOSUR, ASEAN, CACM and SPARTECA. They were selected on the basis of their wide usage in the previous literature, such as in Rose (2004). Each country's year of joining and canceling membership were taken into account to allow accurate estimations. In some cases, such as in CARICOM and CACM, there was no observation of bilateral service trade between the member countries probably because the trade volume is miniscule and thus not recorded. The currency unions included in the dataset are the followings; ECCU, UEMOA, CEMAC, Australia Zone, EMU, Dollarized countries, Indian Rupee Zone and Danish Krone Zone. Whitten (2016) was used to determine which currency unions to include. Similar to regional trade agreements, some currency unions consist of small countries between which bilateral service trade data is not present. In such cases, they could not be included in

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'Benelux' have been dropped, since they are just a group of countries that are already individually included in the dataset.

the dataset.[5]

4. Results

4.1. The gravity model of service trade

The first baseline model is shown in Table 1. This model is the simplest gravity model estimation without any fixed effects. As for the dependent variable, the entire service trade and 5 specially chosen sectors are presented. One can see that most of the coefficients are significant and have the expected signs, but they show slight variations in magnitude across sectors. Since the model without any fixed effects results in biased estimates, we move on to models with more elaborate fixed effects. Table 2 presents the same model with country and year fixed effects. The country and year fixed effects mean that dummy variables for each exporting country, importing country and year are created and thus control variables that are specific to a country or a year, such as *area, island and landlocked*, are dropped. Next, Table 4 shows the gravity model with country-year fixed effects. These fixed effects are different from the former in the sense that the latter looks at the combination of country and year rather than country and year individually. Since the dummy variables for each exporting country-year pair and importing country-year pair are created, all variables defined for country-year pair, such as GDP and GDP per capita, are dropped and only the ones that are characteristic of an origin-destination pair remain. This is ideal for the distance variable, the focus of this paper, since we maximize the degree to which the fixed effect terms eliminate the unobservable influences that lead to biased regression results.

Since many variables are dropped with fixed effects estimation, we analyze the variables in the latest model before they are dropped. As presented in the first column of Table 2, it is the per capita income, not the GDP itself, that increases the service trade. However, it does not mean that the increase in GDP decreases trade, since given no

[5] The detailed lists of countries in each trade agreement and currency union are presented in the data appendix.

population growth, the sum of the *GDP* and *GDPpc* coefficients are indeed positive. Another way to interpret the income coefficients is to use population variables instead of *GDPpc*. From Table 3, it can be seen that the increase in national income boosts the service trade, whereas the population growth without economic growth would diminish the trade volume.[6] This shows that countries with larger population tend to engage less in international service trade presumably because there are more domestic services available and more domestic service demand. The comparison of *GDP* coefficients between the exporting and importing countries merits interpretation as well. The fact that the *GDP* coefficient for importing countries is significantly larger than the one for exporting countries except in transportation sector is in contrast to the findings of Grünfeld and Moxnes (2003) that service trade shows home market effects. (Feenstra, Markusen and Rose, 2001)[7] Different dataset could be the reason but the more plausible one is the use of fixed effects estimation. Table 1 that does not incorporate the fixed effects supports Grünfeld and Moxnes discovery which lacked fixed estimates as well.

The difference in income is found to have a positive effect on trade volume from Table 4. This contradicts the Linder hypothesis that countries similar in their standard of living tends to share similar product preferences and trade more. (Linder, 1961) In the service sector, different countries tend to trade more except in travel and financial sectors that exhibit negative coefficients.

The geographical characteristics have distinctive influence on service trade as well. As shown in Table 1, the surface area tends to have a negative effect on the service trade. This is true of both exporting and importing countries and all the sectors except travel. Table 1 shows that countries being landlocked or island affects the service trade in an opposite way. As is usually the case in merchandise trade, being landlocked discourages service trade as well as merchandise trade, whereas island countries tend to engage more in international service trade. Sharing borders also boosts the bilateral service trade. Even after controlling for the small distance between

[6] Only per capita GDP has been replaced with population variable and everything else was unchanged. All the other coefficients remained the same.

[7] The difference in coefficients were significant at 1% level except in transportation.

contiguous countries, sharing borders increases the bilateral trade significantly in all sectors.

From Table 4, it can be seen that the effect of cultural, historical and economic ties is mostly consistent with the theoretical prediction except the trade agreement. Speaking common language significantly increases the trade except in communication sector. Being part of a common country generally boosts the bilateral service trade, but fails to attract travelers. Colonial history, of all the factors, contribute to bilateral service trade the most across sectors. As for economic ties, belonging to a common currency zone tends to raise the service trade, while regional trade agreements hardly have any positive effect on the trade volume.

The distance is one of the most heavily influenced variable by incorporating fixed effects. Since the distance analysis will be the focus of this paper which requires utmost precision, only the coefficients with country-year fixed effects estimation in Table 4 will be used. Distance, as is the case in merchandise trade, significantly decrease the bilateral service trade across all the sectors. The coefficient revolves approximately around -1.03 while travel sector shows significantly smaller coefficient of -0.205. It is worth mentioning the significant negative coefficient for the transportation sector. Walsh (2006) presented significantly positive coefficient for distance in transportation sector and justified the finding with the unique characteristic of transportation service that the price rises as distance gets larger. Though partially true, this argument does not consider the quantity or number of transactions that drops as distance increases. The World Bank dataset which is comparatively bigger and more comprehensive than OECD dataset used in Walsh shows a negative coefficient which indicates that the quantity effect is bigger than the price effect.

4.2. Comparison with merchandise trade

For the sake of comparison, the merchandise trade data were introduced and analyzed using the same gravity model specification. The data were taken from Glick

and Rose (2016) dataset for the overlapping period 1995 - 2010.[8] It consists of 199 countries and there are significantly more frequent trades among countries compared to service trade dataset. The total number of observations that fall on the mentioned period is 149,137. The result of applying gravity model with country-year fixed effects is presented in Table 5. The comparison between service and merchandise trade makes it easier to see the unique characteristics of service trade.

Most of the variables remain significant with expected signs. One interesting difference is that merchandise trade exhibits a negative coefficient for the difference in per capita GDP. This is an evidence that, in contrast to service trade, merchandise trade does support the Linder hypothesis and countries that are similar in their national per capita income tend to share similar economic structures and trade more with each other. Contrary to service trade which showed trade-inhibiting effects of regional trade agreement, the variable turns out to have positive effects on merchandise trade. Common country, on the other hand, shows negligible effects on merchandise trade, while it shows significant positive effects for service trade. Linguistic tie gives a significant positive boost to both bilateral trade flows. However, in contrast to the findings based on OECD data (Lennon, 2006), shared language is found to have bigger impacts on merchandise than on service trade.

The comparison of distance factor between merchandise and service trade is the core of this paper and the regression result of this paper supports the argument made by Lennon and Ceglowski. From Table 4 and 5, it is clear that the distance coefficient is bigger in merchandise trade than in total and 5 service sectors. The trade elasticity of distance is 1.03 in total service and at best 1.13 in communication sector, while the counterpart in merchandise trade is 1.501. This means that when distance increases by 1%, the bilateral service trade, on average, decreases by 1.03%, whereas the merchandise trade falls by 1.501%. However, the reasons behind the negative distance coefficients in service trade are not easily understandable. Service, in essence, is formless and does not incur transportation costs. Even accounting for asymmetric

[8] Both the exports and imports data were taken from the Glick and Rose (2016) dataset. Table 5 shows the result of using the imports data.

information or occasional travelling of people to deliver services, it is unclear what gives rise to the significantly negative coefficient of -1.03. Thus, as a next step, this paper investigates the driving force behind the negative distance elasticity. Among many others, special attention is given to the relationship between service and merchandise trade.

Table 1: Baseline model

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
$\ln(GDP_i)$	0.833***	0.828***	0.608***	0.620***	0.645***	0.893***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\ln(GDP_j)$	0.790***	0.764***	0.685***	0.640***	0.552***	0.847***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\ln(GDPpc_i)$	0.109***	0.027	0.131***	0.063***	0.258***	0.119***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
$\ln(GDPpc_j)$	0.124***	0.065***	0.291***	0.110***	0.154***	0.059***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
$\ln(area_i)$	-0.132***	-0.157***	0.001	-0.066***	-0.176***	-0.170***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\ln(area_j)$	-0.067***	-0.130***	0.027***	-0.034***	-0.115***	-0.075***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln(distance)	-0.682***	-0.579***	-0.404***	-0.732***	-0.178***	-0.755***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
ln(d_GDPpc)	0.128***	0.038**	-0.177***	-0.009	0.054***	0.050***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
landlocked	-0.057***	-0.302***	-0.136***	-0.262***	0.584***	-0.124***
	(0.01)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
island	0.241***	0.124***	0.164***	0.037	0.394***	0.282***
	(0.01)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
border	0.968***	1.073***	0.481***	0.671***	0.395***	0.599***
	(0.04)	(0.06)	(0.07)	(0.04)	(0.06)	(0.05)
common language	0.883***	0.689***	0.617***	0.958***	1.579***	0.844***
	(0.02)	(0.04)	(0.05)	(0.05)	(0.05)	(0.04)
currency union	0.161***	-0.249***	0.035	0.013	0.830***	0.155**
	(0.03)	(0.06)	(0.08)	(0.06)	(0.09)	(0.06)
colony	1.009***	0.943***	0.393***	0.962***	0.549***	0.502***
	(0.03)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)
common colony	0.627***	0.952***	-0.477***	0.820***	0.462***	0.291***
	(0.05)	(0.07)	(0.10)	(0.08)	(0.08)	(0.07)
trade agreement	0.339***	0.508***	0.326***	0.558***	0.269***	0.354***
	(0.02)	(0.05)	(0.06)	(0.04)	(0.07)	(0.05)
common country	0.072	-0.106	-1.193***	-0.033	0.079	0.124
	(0.06)	(0.12)	(0.12)	(0.07)	(0.09)	(0.07)
Fixed effects	No	No	No	No	No	No
Observations	54656	15575	26982	17032	15858	30092
Adjusted R^2	0.69	0.62	0.49	0.57	0.45	0.61

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Service trade FE model 1 - country and year

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
$\ln(GDP_i)$	-0.665***	-0.100	-0.476	-0.086	1.229***	-1.239***
	(0.16)	(0.14)	(0.30)	(0.28)	(0.37)	(0.27)
$\ln(GDP_j)$	-0.165*	-0.021	-0.312**	-0.340***	-0.269*	-0.172
	(0.08)	(0.14)	(0.12)	(0.10)	(0.13)	(0.11)
$\ln(GDPpc_i)$	0.784***	0.193	0.682*	0.330	-0.903*	1.473***
	(0.15)	(0.15)	(0.29)	(0.27)	(0.36)	(0.26)
$\ln(GDPpc_j)$	0.611***	0.205	0.758***	0.863***	0.999***	0.647***
	(0.09)	(0.15)	(0.14)	(0.12)	(0.15)	(0.12)
ln(distance)	-1.002***	-1.025***	-0.224***	-1.148***	-0.850***	-1.034***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)
ln(d_GDPpc)	0.036***	0.054***	-0.039***	0.058***	-0.058***	0.016*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
border	0.584***	0.595***	0.403***	0.601***	0.154**	0.303***
	(0.03)	(0.06)	(0.05)	(0.04)	(0.05)	(0.04)
common language	0.372***	0.248***	0.219***	0.040	0.410***	0.255***
	(0.02)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
currency union	0.112***	0.290***	0.077	-0.034	0.421***	0.325***
	(0.03)	(0.08)	(0.08)	(0.06)	(0.08)	(0.07)
colony	1.024***	0.855***	0.145**	0.746***	0.251***	0.478***
	(0.03)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)
common colony	0.862***	0.806***	-0.004	0.654***	0.259**	0.574***
	(0.03)	(0.06)	(0.07)	(0.07)	(0.08)	(0.06)
trade agreement	0.105***	-0.096	0.046	0.014	-0.155*	-0.372***
	(0.03)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)
common country	0.225***	-0.036	-0.395***	-0.067	0.293***	0.350***
	(0.05)	(0.10)	(0.08)	(0.06)	(0.08)	(0.07)
Fixed effects	country, year	country, year	country, year	country, year	country, year	country, year
Observations	54656	15557	26973	17017	15838	30069
Adjusted R^2	0.80	0.78	0.67	0.73	0.68	0.73

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Service trade FE model 2 - country and year

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(GDP_i)	0.119***	0.091	0.205***	0.244***	0.326***	0.233***
	(0.03)	(0.05)	(0.06)	(0.05)	(0.07)	(0.05)
ln(GDP_j)	0.441***	0.182***	0.442***	0.521***	0.728***	0.467***
	(0.03)	(0.05)	(0.05)	(0.05)	(0.07)	(0.05)
ln(pop_i)	-0.844***	-0.164	-0.711*	-0.301	0.821*	-1.533***
	(0.16)	(0.15)	(0.30)	(0.28)	(0.37)	(0.27)
ln(pop_j)	-0.583***	-0.176	-0.738***	-0.859***	-0.998***	-0.614***
	(0.09)	(0.15)	(0.14)	(0.12)	(0.16)	(0.13)
Fixed effects	country, year	country, year	country, year	country, year	country, year	country, year
Observations	54656	15557	26973	17017	15838	30069
Adjusted R^2	0.80	0.78	0.67	0.73	0.68	0.73

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Service trade FE model 3 - country-year

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-1.030***	-1.006***	-0.205***	-1.130***	-0.903***	-1.015***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)
ln(d_GDPpc)	0.037***	0.050***	-0.048***	0.031***	-0.064***	0.021**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
border	0.551***	0.576***	0.422***	0.581***	0.205***	0.255***
	(0.03)	(0.06)	(0.05)	(0.04)	(0.05)	(0.04)
common language	0.396***	0.269***	0.197***	0.081	0.354***	0.259***
	(0.02)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)
currency union	0.121***	0.286***	0.012	-0.098	0.404***	0.296***
	(0.03)	(0.08)	(0.08)	(0.06)	(0.08)	(0.06)
colony	0.983***	0.856***	0.120*	0.712***	0.248***	0.492***
	(0.03)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)
common colony	0.901***	0.792***	-0.005	0.659***	0.244**	0.547***
	(0.03)	(0.07)	(0.08)	(0.07)	(0.09)	(0.06)
trade agreement	-0.062*	0.054	0.063	-0.038	-0.250***	-0.419***
	(0.03)	(0.07)	(0.05)	(0.05)	(0.06)	(0.05)
common country	0.236***	-0.072	-0.392***	-0.035	0.267**	0.344***
	(0.05)	(0.11)	(0.08)	(0.07)	(0.09)	(0.07)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	54003	14599	26172	16367	15269	29232
Adjusted R^2	0.81	0.78	0.67	0.74	0.69	0.76

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Merchandise trade FE model - country-year

	(1) merchandise
ln(distance)	-1.501***
	(0.01)
ln(d_GDPpc)	-0.045***
	(0.01)
border	0.409***
	(0.03)
common language	0.520***
	(0.02)
currency union	0.165***
	(0.03)
colony	1.144***
	(0.05)
common colony	0.732***
	(0.02)
trade agreement	0.525***
	(0.02)
common country	0.311
	(0.47)
Fixed effects	country-year
Observations	149137
Adjusted R^2	0.77

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3. Relationship between service and merchandise trade

Many aforementioned studies that drew upon bilateral service data tried to understand the relationship between the merchandise and service trade. The methodology was introduced by Graham (1996) to investigate the relationship of two different types of trades taking into account the correlations between them. This paper also utilizes the same methodology and tests the relationship between service trade and merchandise trade. While only the service imports data are available, for merchandise trade, both the exports and imports data can be obtained from Glick and Rose dataset. Thus, for merchandise trade, we use both the merchandise exports and imports data. This is for the purpose of accounting for possibly different characteristics of exports and imports, which was shown in Kimura and Lee (2006).

The methodology that will be used is as follows. First, three dependent variables, merchandise exports, imports and service imports are regressed on gravity explanatory variables, such as *GDP, area, border* and so on. We use the country-year fixed effects model. From the three gravity equations, the residuals of each equation can be obtained. Then, the residual from service imports equation is regressed on both the residuals from merchandise exports and imports.

$$u_{ijt} = \alpha + \rho\, v_{ijt} + \tau\, w_{ijt}$$

u_{ijt} is the residual term of service imports equation while v_{ijt} and w_{ijt} are the residual terms from merchandise exports and imports equation respectively. A positive ρ or τ signifies a complementary relationship, since the trade volumes tend to increase or decrease together. On the other hand, a negative ρ or τ signifies a substitute relationship, because an increase in one trade volume leads to a decrease in the other.

Estimating the relationship with merchandise exports, imports and service imports value themselves is ineffective and the usage of residuals is the key here. The reason that residuals are used is to take away the common determinants of each trade volume. Due to the use of identical variables in each gravity equation, all the explanatory

variables in gravity models, such as national income and geographical features, simultaneously affect the three trade volumes, namely, merchandise exports, imports and service imports. Thus, these explanatory variables are, by definition, omitted variables that can lead to spurious relationship. Thus, we make an assumption that gravity model includes all the factors that simultaneously determine the merchandise exports, imports and service imports. Then, the residuals from three gravity equations are uncorrelated to one another through the explanatory variables in the gravity models. Now, we can examine the relationship between service and merchandise trade.

Table 6 presents the results. It can be seen that, through all the sectors, service imports have complementary relationship with both the merchandise exports and imports to a similar degree.[9] This means that when there is a larger amount of merchandise export or import than what the model predicts, then the service imports increase as well above the level predicted by the gravity model. The complementary relationship holds for all sectors which indicates that all the five service sectors' imports tend to increase and decrease together with the merchandise trade. This relationship can shed light on the understanding of distance factor in service trade. The complementary relationship between service and merchandise trade could mean that the service trade patterns, even after controlling for all the gravity variables, are not randomly determined, but rather they tend to accompany the merchandise trade pattern. When a country engages in international service trade more with a particular country than with others that are same in all aspects except distance, this could be attributable to not only the difference in distance but also to the pattern of merchandise trade. Hence, the significantly negative coefficient of distance in service trade could, in theory, be a result of simply following the merchandise trade pattern that are negatively related to distance.

This result implies that the merchandise trade pattern itself is one of the determinants of service trade. Thus, to infer the distance effect on service trade that is

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[9] From this point, only the merchandise trade data for which corresponding service data exist were used so that the merchandise trade volumes can be used as control variables. This will be discussed in the next chapter. However, it should be noted that this could possibly bias the complementarity coefficient upward due to selection issue.

void of merchandise influence, the merchandise trade flow is controlled for in the gravity equation. If the effect of distance on service trade distribution is largely driven by merchandise trade, the resulting coefficient should get smaller as merchandise trade is controlled for. Table 7 shows the regression result after incorporating merchandise export and import into the original gravity equation with country-year fixed effects. The coefficients across the sectors get halved as the merchandise trade flow is controlled for.[10] The result indicates that about half of the negative distance coefficient was a result of accompanying merchandise trade flow. The negative coefficient of -0.566 implies that the service trade that are unrelated to merchandise trade still decreases with distance, but at a much smaller rate. This indeed shows that intangible and weightless service trade is significantly less constrained by physical distance. Upon comparison of Table 4 with Table 7, the result also holds valid for *border, colony, common colony,* and *trade agreement* variables. Their coefficients drastically decrease after the inclusion of merchandise trade variables, as opposed to *common language* or *currency union* variables. This indicates the high correlation of former variables with merchandise trade pattern.

However, it should be noted that the complementary relationship does not imply any causal link between two types of trades. The fact that merchandise trade and service trade is complementary indicates that service trade flow also affects the merchandise trade. Thus, for the sake of comparison, we also see how service trade affects merchandise trade in terms of distance coefficient. The merchandise import was regressed on explanatory variables in the gravity model with service imports as an additional control variable. Similarly, country-year fixed effects were used. As it turned out, the distance coefficient decreases as well, but to a smaller extent, by 27%. The result shows that the service trade pattern is more heavily influenced by the merchandise trade pattern in terms of distance effect.

[10] The coefficient in total service decreases by 53%.

Table 6 : Service and merchandise trade relationship

	(1) total service residual	(2) transport residual	(3) travel residual	(4) communicate residual	(5) financial residual	(6) other business residual
merchandise export residual	0.179***	0.203***	0.458***	0.258***	0.185***	0.252***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
merchandise import residual	0.221***	0.282***	0.371***	0.209***	0.214***	0.237***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Constant	0.001	-0.004	0.005	-0.001	0.001	0.000
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	44958	12188	22179	14401	12284	24767
Adjusted R^2	0.12	0.11	0.43	0.09	0.05	0.10

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Service trade FE model 4 - Controlling for merchandise trade

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-0.566***	-0.544***	-0.047***	-0.594***	-0.516***	-0.398***
	(0.01)	(0.03)	(0.01)	(0.02)	(0.03)	(0.02)
ln(d_GDPpc)	0.050***	0.066***	0.050***	0.071***	-0.038**	0.037***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
border	0.344***	0.196***	0.257***	0.323***	-0.051	0.054
	(0.03)	(0.06)	(0.04)	(0.04)	(0.06)	(0.04)
common language	0.397***	0.121*	0.019	0.070	0.433***	0.186***
	(0.03)	(0.05)	(0.04)	(0.05)	(0.06)	(0.04)
currency union	0.250***	0.353***	-0.011	0.024	0.600***	0.356***
	(0.04)	(0.08)	(0.07)	(0.07)	(0.09)	(0.07)
colony	0.586***	0.645***	0.154***	0.566***	0.163**	0.237***
	(0.03)	(0.06)	(0.04)	(0.05)	(0.06)	(0.05)
common colony	0.386***	0.353***	-0.252***	0.252***	-0.100	0.112
	(0.04)	(0.07)	(0.06)	(0.07)	(0.09)	(0.06)
trade agreement	-0.247***	0.017	-0.129**	0.199***	-0.195**	-0.324***
	(0.03)	(0.06)	(0.04)	(0.05)	(0.07)	(0.05)
common country	0.365***	0.130	-0.317***	0.167*	0.261**	0.476***
	(0.05)	(0.11)	(0.07)	(0.07)	(0.10)	(0.07)
ln(merchandise export)	0.180***	0.204***	0.458***	0.258***	0.184***	0.252***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
ln(merchandise import)	0.222***	0.281***	0.371***	0.209***	0.216***	0.236***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	44958	12187	22179	14401	12284	24767
Adjusted R^2	0.83	0.81	0.80	0.77	0.70	0.79

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.4. Interaction with income

As a robustness check, the same analysis is carried out across different income groups. Specifically, due to the frequent uses of OECD countries dataset by previous studies, the OECD countries are separately analyzed. Since the OECD countries, in some sense, represent rich countries, corresponding poor countries have also become matching subject of analysis. The countries were lined by their 2010 per capita national income and the bottom and middle tercile have been defined as the poor countries.[11]

[11] The distribution of per capita GDP is highly skewed to the right and thus the bottom and middle tercile countries are quite homogeneous in their income level. Moreover,

The same analysis conducted on the entire countries was applied to trades in each group and their results were analyzed. As it turned out, the result holds valid across the different income groups. Both groups show complementary relationship between the service and merchandise trade, and their distance coefficients decrease significantly after controlling for merchandise trade. However, the extent to which their coefficients change differs in an opposite way which we attribute to the effect of income.

This paper specifically concentrates on the trade between OECD countries. Before looking at the gravity model, Graham (1996) analysis is conducted to see the relationship between service and merchandise trade. The resulting coefficients are presented in Table 8. Positive coefficients in every sector signify the complementary relationship between service imports and merchandise exports and imports. However, upon careful comparison with Table 6 which shows the same analysis but on the entire sample, it can be seen that the complementary relationship is stronger in intra-OECD trade. The service imports are more strongly correlated with both the merchandise exports and imports across all the sectors for OECD countries. Since the service trade is more heavily driven by merchandise trade flow for OECD countries, it can be predicted that the distance coefficient, once the merchandise trade is controlled for, should decrease by more than in previous analysis based on the entire countries. Table 9 and Table 10 indeed confirms this conjecture. Table 9 presents the country-year fixed effects estimation of intra-OECD service trade, while Table 10 shows the same model with additional control variables, merchandise export and import. The distance coefficients are found to drop by more than half. For total service, the coefficient drops by about 80%, whereas in travel sector, the distance coefficient becomes not significantly different from zero. Compared to about 50% decrease in coefficients for the entire data analysis, the intra-OECD analysis indeed shows bigger decrease in distance coefficients which means that the service trade is more strongly driven by merchandise trade flow.

This result intuitively makes sense given usual process of economic development. Only after countries go through development in agricultural or

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poor countries do not frequently trade with each other and thus, the single use of bottom tercile did not contain enough observations to draw significant results.

manufacturing sectors do they see the growth in service sectors. The producer services, which take up most of the shares of tradable services, especially grow later in the development stage. Therefore, rich countries are more likely to develop bigger service sectors than manufacturing or agricultural sector, and thus engage more actively in international service trade. Poor countries, if any, are apt to have comparatively small tradable service sectors and the share of producer services that are more closely connected with merchandise trade flow takes up smaller portion of traded service. This can be proven empirically in the next analysis which was conducted on the group of poor countries.

Table 11 shows the strength of complementarity for poor countries and they show weaker complementary relationship compared to the entire sample. The change in distance coefficient is smaller as well. Comparison of Table 12 with Table 13 reveals that the total service distance coefficient decreases by 42%, which is smaller relative to entire dataset, let alone OECD countries estimates. This empirical evidence does show that poor countries have weaker link between merchandise and service trade and thus the distance coefficient is less driven by merchandise trade flow.

Table 8: OECD service and merchandise trade relationship

	(1) total service residual	(2) transport residual	(3) travel residual	(4) communicate residual	(5) financial residual	(6) other business residual
merchandise export residual	0.317***	0.348***	0.447***	0.273***	0.342***	0.312***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)
merchandise import residual	0.330***	0.296***	0.391***	0.312***	0.292***	0.257***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	0.02
Constant	0.003	0.001	0.010	-0.001	-0.002	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	12274	4354	10118	6683	5856	9544
Adjusted R^2	0.20	0.13	0.49	0.10	0.06	0.10

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: OECD service trade FE model 1 - country-year

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-0.884***	-0.911***	-0.111***	-1.091***	-0.896***	-0.919***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
ln(d_GDPpc)	0.059***	0.025	-0.011	0.017	-0.074***	-0.028**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
border	0.112**	0.081	0.453***	0.514***	0.393***	0.050
	(0.04)	(0.08)	(0.06)	(0.05)	(0.07)	(0.05)
common language	0.340***	0.420***	0.226***	-0.079	0.083	0.223***
	(0.03)	(0.06)	(0.05)	(0.06)	(0.07)	(0.05)
currency union	0.181***	0.270***	-0.034	0.113	0.213*	0.218***
	(0.03)	(0.08)	(0.08)	(0.06)	(0.08)	(0.06)
colony	0.324***	0.114	-0.155**	0.262***	0.112	0.146**
	(0.04)	(0.07)	(0.06)	(0.06)	(0.08)	(0.06)
common colony	3.089***	2.288***	0.183	2.509***	2.297***	3.239***
	(0.19)	(0.43)	(0.18)	(0.26)	(0.35)	(0.26)
trade agreement	0.050	0.076	0.297***	-0.018	-0.188**	-0.226***
	(0.04)	(0.07)	(0.06)	(0.05)	(0.07)	(0.05)
common country	1.024***	1.190***	-0.165	0.122	0.432***	0.835***
	(0.06)	(0.14)	(0.10)	(0.08)	(0.11)	(0.08)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	14519	5383	12154	7727	7297	11257
Adjusted R^2	0.88	0.83	0.72	0.79	0.72	0.83

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: OECD service trade FE model 2 - Controlling for merchandise trade

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-0.178***	-0.258***	-0.015	-0.432***	-0.201***	-0.191***
	(0.02)	(0.04)	(0.01)	(0.04)	(0.05)	(0.03)
ln(d_GDPpc)	0.066***	0.035*	0.077***	0.085***	-0.016	0.003
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
border	0.056	-0.164*	0.091	0.364***	0.240**	0.049
	(0.04)	(0.08)	(0.05)	(0.05)	(0.07)	(0.05)
common language	0.178***	0.047	0.046	-0.215***	0.019	0.111*
	(0.04)	(0.07)	(0.04)	(0.06)	(0.08)	(0.05)
currency union	0.249***	0.252**	0.073	0.127*	0.363***	0.227***
	(0.03)	(0.08)	(0.07)	(0.06)	(0.10)	(0.06)
colony	0.154***	0.159*	0.027	0.322***	0.080	0.056
	(0.04)	(0.07)	(0.04)	(0.06)	(0.08)	(0.06)
common colony	1.038***	0.798*	0.332*	1.106***	0.575	1.515***
	(0.17)	(0.40)	(0.14)	(0.25)	(0.36)	(0.26)
trade agreement	-0.227***	-0.006	-0.063	0.206***	-0.162*	-0.099*
	(0.03)	(0.06)	(0.05)	(0.05)	(0.08)	(0.05)
common country	0.758***	1.278***	0.103	0.065	0.461***	0.759***
	(0.06)	(0.15)	(0.08)	(0.09)	(0.13)	(0.09)
ln(merchandise export)	0.317***	0.348***	0.445***	0.273***	0.341***	0.312***
	(0.01)	(0.03)	(0.01)	(0.02)	(0.03)	(0.02)
ln(merchandise import)	0.330***	0.296***	0.393***	0.312***	0.292***	0.257***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	12274	4354	10118	6683	5856	9544
Adjusted R^2	0.90	0.86	0.85	0.82	0.73	0.85

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: POOR service and merchandise trade relationship

	(1) total service residual	(2) transport residual	(3) travel residual	(4) communicate residual	(5) financial residual	(6) other business residual
merchandise export residual	0.172***	0.212***	0.449***	0.242***	0.418***	0.155***
	(0.02)	(0.04)	(0.04)	(0.05)	(0.08)	(0.03)
merchandise import residual	0.187***	0.264***	0.263***	0.355***	0.262**	0.223***
	(0.02)	(0.04)	(0.03)	(0.05)	(0.10)	(0.04)
Constant	-0.001	-0.009	0.006	-0.002	-0.000	-0.008
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)	(0.03)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	3709	1134	1250	727	318	1771
Adjusted R^2	0.08	0.12	0.31	0.11	0.11	0.05

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: POOR service trade FE model 1 - country-year

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-1.020***	-1.062***	-0.815***	-1.093***	-0.192	-0.985***
	(0.05)	(0.13)	(0.09)	(0.16)	(0.26)	(0.09)
ln(d_GDPpc)	-0.001	0.110*	0.040	0.156**	-0.280**	0.014
	(0.02)	(0.05)	(0.05)	(0.06)	(0.10)	(0.04)
border	0.676***	0.546**	0.158	0.238	0.245	0.260
	(0.10)	(0.19)	(0.21)	(0.20)	(0.35)	(0.16)
common language	0.952***	0.551*	0.998***	1.356***	0.291	0.837***
	(0.12)	(0.23)	(0.27)	(0.26)	(0.42)	(0.17)
currency union	-0.337	0.000	0.349	0.000	0.000	0.000
	(1.54)	(.)	(1.65)	(.)	(.)	(.)
colony	1.383***	2.335***	0.468	0.940***	0.895**	0.995***
	(0.13)	(0.27)	(0.27)	(0.19)	(0.31)	(0.18)
common colony	1.137***	0.986***	-0.408*	-0.086	-0.293	1.150***
	(0.10)	(0.20)	(0.20)	(0.24)	(0.43)	(0.18)
trade agreement	-0.577***	0.000	0.000	0.000	0.000	-0.633*
	(0.17)	(.)	(.)	(.)	(.)	(0.26)
common country	-0.849***	-0.847*	0.489	-1.508***	-1.632	-1.823***
	(0.21)	(0.35)	(0.45)	(0.38)	(0.88)	(0.34)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	4222	1282	1307	747	350	1925
Adjusted R^2	0.72	0.56	0.66	0.57	0.32	0.69

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: POOR service trade FE model 2 - Controlling for merchandise trade

	(1) total service	(2) transport	(3) travel	(4) communicate	(5) financial	(6) other business
ln(distance)	-0.592***	-0.591***	-0.485***	-0.214	0.702*	-0.467***
	(0.06)	(0.15)	(0.08)	(0.20)	(0.32)	(0.10)
ln(d_GDPpc)	-0.033	0.073	0.021	0.110	-0.410***	-0.026
	(0.02)	(0.05)	(0.04)	(0.06)	(0.10)	(0.04)
border	0.411***	0.145	-0.354	0.195	0.006	0.094
	(0.10)	(0.19)	(0.18)	(0.20)	(0.36)	(0.16)
common language	0.641***	0.157	0.676**	1.180***	-0.049	0.547**
	(0.12)	(0.22)	(0.23)	(0.25)	(0.44)	(0.18)
currency union	0.000	0.000	2.135	0.000	0.000	0.000
	(.)	(.)	(1.38)	(.)	(.)	(.)
colony	0.982***	1.801***	0.660**	0.558**	0.283	0.471*
	(0.13)	(0.26)	(0.23)	(0.19)	(0.33)	(0.19)
common colony	0.629***	0.470*	-0.562**	-0.364	-1.342**	0.585**
	(0.11)	(0.20)	(0.17)	(0.24)	(0.50)	(0.21)
trade agreement	-0.795***	0.000	0.000	0.000	0.000	-0.754**
	(0.17)	(.)	(.)	(.)	(.)	(0.27)
common country	-0.756***	-0.696*	-0.045	-1.021**	-0.634	-1.534***
	(0.21)	(0.33)	(0.38)	(0.37)	(0.95)	(0.34)
ln(merchandise export)	0.174***	0.206***	0.455***	0.242***	0.424**	0.161***
	(0.02)	(0.04)	(0.04)	(0.06)	(0.13)	(0.04)
ln(merchandise import)	0.189***	0.277***	0.257***	0.354***	0.256	0.222***
	(0.02)	(0.04)	(0.04)	(0.07)	(0.14)	(0.04)
Fixed effects	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)	(country-year)
Observations	3708	1132	1250	727	318	1771
Adjusted R^2	0.74	0.61	0.76	0.61	0.41	0.71

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Conclusion

This paper analyzes the bilateral service trade flow and its relationship with traditional merchandise trade flow. The main goals presented in the beginning are twofold; the use of extensive service data and the focus on distance variable. First, the findings suggest that the gravity model shows high empirical fit in explaining the service trade flow. It confirms the claims of early studies, Francois (1993), Hoekman and Stern (1991), Sapir and Winter (1994) and Fieleke (1995), that service trade should be a function of the same variables as merchandise trade. Indeed, most of the trade determinants showed significant influence consistent with merchandise trade model as well as theoretical foundation. Sectoral analysis shows some heterogeneities across 5 different service sectors, but it is revealed that though each sector differs in their magnitude of coefficients, they mostly show same signs and synchronized movements that are consistent with overall pattern. Second, for the sake of comparing merchandise and service trade, special attention was given to distance variable. Through residual analysis, it was revealed that service and merchandise trade maintain complementary relationship across all the sectors. This gave rise to an idea of controlling for merchandise exports and imports to estimate the extent to which service distance variable is driven by merchandise trade flow. The analysis showed some remarkable results that more than half of distance effect on service trade is due to merchandise trade flow. National income was also found to play a role here in the sense that higher income countries show higher complementarity and stronger influence of merchandise trade pattern on service distance factor.

Increasing developments and liberalizing trade in service sectors call for a great deal of studies on service trade and its determinants. As more data become available through international coordination, more detailed analysis with various empirical designs will be made for better understanding of international trade flow and its drivers. This paper, to my knowledge, is the first study that utilized the recent comprehensive dataset of bilateral service trade. It should be viewed as an attempt to understand the international trade flow from one angle and to attract more attention to the topic.

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7. Data appendix

7.1. Country coverage

Germany	United Arab Emirates	Comoros
Spain	Bahamas, The	Cape Verde
France	Bosnia and Herzegovina	Djibouti
United Kingdom	Barbados	Dominica
Italy	Brunei	Dominican Republic
Japan	China	Ecuador
Portugal	Cote d'Ivoire	Eritrea
United States	Costa Rica	Ethiopia
Argentina	Fiji	Gabon
Australia	Guatemala	Ghana
Brazil	Honduras	Guinea
Canada	Jamaica	Gambia, The
India	Moldova	Guinea-Bissau
Morocco	Nicaragua	Equatorial Guinea
Mexico	Pakistan	Grenada
New Zealand	Peru	Greenland
Turkey	Papua New Guinea	Guam
Russian Federation	Saudi Arabia	Guyana
Poland	Senegal	Haiti
Hungary	El Salvador	Jordan

Austria
Czech Republic
Netherlands
Finland
Albania
Belgium
Bulgaria
Belarus
Switzerland
Chile
Cyprus
Denmark
Egypt, Arab Rep.
Estonia
Greece
Hong Kong, China
Croatia
Indonesia
Ireland
Iran, Islamic Rep.
Iceland
Israel
Korea, Rep.
Liechtenstein
Lithuania
Luxembourg
Malta
Malaysia
Nigeria
Norway
Philippines
Trinidad and Tobago
Vietnam
Armenia
Azerbaijan
Bangladesh
Bahrain
Bhutan
Cuba
Algeria
Georgia
Kazakhstan
Kyrgyz Republic
Cambodia
Lao PDR
Liberia
Libya
Sri Lanka
Macao
Myanmar
Mongolia
Panama
Swaziland
Syrian Arab Republic
Tajikistan
Turkmenistan
Tunisia
Uzbekistan
Angola
Tanzania
Aruba
Afghanistan
Kenya
Kuwait
Lebanon
Lesotho
Madagascar
Maldives
Mali
Mozambique
Mauritania
Mauritius
Malawi
Namibia
Niger
Nepal
Oman
Paraguay
Qatar
Rwanda
Sudan
Sierra Leone
San Marino
Sao Tome and Principe
Suriname
Seychelles
Chad
Togo
Uganda
Vanuatu
Samoa
Yemen, Rep.
Zambia

Romania	Andorra	Zimbabwe
Singapore	Antigua and Barbuda	Tonga
Slovak Republic	Burundi	Micronesia, Fed. Sts.
Slovenia	Benin	Iraq
Sweden	Burkina Faso	Kiribati
Thailand	Belize	East Timor
Ukraine	Bolivia	Puerto Rico
Uruguay	Botswana	Cayman Islands
Venezuela	Central African Republic	Palau
South Africa	Cameroon	Montenegro
Colombia	Congo, Dem. Rep.	Taiwan
Latvia	Congo, Rep.	

7.2. Regional trade agreements

In parentheses is the day of accession. Countries that are not in the dataset are omitted.

(1) EEC/EC/EU (European Economic Community / European Communities / European Union)

Belgium (1957)	United Kingdom (1973)	Bulgaria (2007)
France (1957)	Portugal (1986)	Czech Republic (2004)
(West) Germany (1957)	Spain (1986)	Hungary (2004)
Italy (1957)	Greece (1981)	Slovakia (2004)
Luxembourg (1957)	Austria (1995)	Croatia (2013)
Netherlands (1957)	Cyprus (2004)	Estonia (2004)
Denmark (1973)	Finland (1995)	Latvia (2004)
Ireland (1973)	Romania (2007)	Slovenia (2004)
Malta (2004)	Poland (2004)	Lithuania (2004)

Sweden (1995)

(2) US – Israel FTA

United States (1985) Israel (1985)

(3) NAFTA (North America Free Trade Agreement)

United States (1994) Canada (1994) Mexico (1994)

(4) CARICOM (Caribbean Community)

Antigua and Barbuda (1974)	The Bahamas (1983)	Barbados (1973)
Belize (1974)	Dominica (1974)	Grenada (1974)
Guyana (1973)	Haiti (2002)	Jamaica (1973)
Suriname (1995)	Trinidad and Tobago (1973)	

(5) PATCRA (Papua New Guinea – Australia Trade and Commercial Region)

Australia (1991) Papua New Guinea (1991)

(6) ANZCERTA (Australia – New Zealand Closer Economic Relations Trade Agreement)

Australia (1990) New Zealand (1990)

(7) MERCOSUR (Mercado Común del Sur)

Argentina (1991)	Uruguay (1991)	Brazil (1991)
Venezuela (2012-2016)	Paraguay (1991 – 2012)	Bolivia (2015)

(8) ASEAN (Association of Southeast Asian Nations)

Brunei (1984)	Malaysia (1967)	Thailand (1967)
Cambodia (1999)	Myanmar (1997)	Vietnam (1995)
Indonesia (1967)	Philippines (1967)	Laos (1997)
Singapore (1967)		

(9) CACM (Central American Common Market)

Guatemala (1960)	El Salvador (1960)	Costa Rica (1962)
Honduras (1960)	Nicaragua (1960)	

(10) SPARTECA (South Pacific Regional Trade and Economic Cooperation Agreement)

Fiji (1981)	New Zealand (1981)	Papua New Guinea (1981)
Australia (1981)	Micronesia (1981)	Samoa (1981)
Kiribati (1981)	Tonga (1981)	Vanuatu (1981)

8.3. Currency Union

(1) ECCU (Eastern Caribbean Currency Union)

Antigua and Barbuda (1965)	Barbados (1965-1972)	Dominica (1965)

(2) UEMOA (Western African Economic and Monetary Union)

Benin (1994)	Burkina Faso (1994)	Côte d'Ivoire (1994)
Guinea-Bissau (1997)	Mali (1994)	Togo (1994)
Niger (1994)	Senegal (1994)	

(3) CEMAC (Communauté Économique et Monétaire de l'Afrique Centrale)

Cameroon(1958)	Chad (1958)	Equatorial Guinea (1985)
Madagascar (1960-1972)	Central African Republic (1958)	Congo, Rep.(1958)
Gabon(1958)		

(4) Australia Zone

Australia (1966)	Kiribati (1966)	Tonga (1967-1990)

(5) EMU (Economic and Monetary Union of European Union)

In parentheses is the day of adopting euro currency not entering ERM II.

Austria (1999)	Belgium (1999)	Cyprus (2008)
Estonia (2011)	France (1999)	Finland (1999)
Germany (1999)	Greece (2001)	Ireland (1999)
Italy (1999)	Latvia (2014)	Luxembourg (1999)
Lithuania (2015)	Malta (2008)	Netherlands (1999)
Portugal (1999)	Slovak Republic (2009)	Slovenia (2007)
Spain (1999)		

(6) Dollarized countries

Panama (1904)	The Bahamas (1966)	Puerto Rico

Ecuador (2000)	El Salvador (2001)	Guam
Liberia (1935)	Palau	Micronesia

(7) Indian Rupee Zone

Bhutan (1974)	India

(8) Danish Krone Zone

Greenland	Denmark