| | |
|---|---|
| Title | Trade in Intermediates and Final Products, Trade in Services and Goods : Implications of Differences in Their Determinants |
| Author(s) | Yane, Haruka |
| Citation | 国際公共政策研究. 23(1) P.35-P.50 |
| Issue Date | 2018-09 |
| Text Version | publisher |
| URL | https://doi.org/10.18910/70590 |
| DOI | 10.18910/70590 |
| rights | |
| Note | |

# Trade in Intermediates and Final Products, Trade in Services and Goods

## — Implications of Differences in Their Determinants —*

Haruka YANE**

**Refereed Article**

Received: 26 March 2018, Accepted: 25 June 2018

**Abstract**

With the growing integration of the world economy, there have been more and more studies looking at trade and its various effects on different aspects of the economy. Many of these studies, however, focus merely on manufacturing industries or products. This paper attempts to show how different kinds of trade other than manufacturing also matter, and reveal their distinct features. This study uses product-level international bilateral trade panel data for the period 1995 to 2009, covering 40 countries. Constructing this dataset into a gravity model, this paper aims to clarify what makes trade in intermediates different from final products, and total trade in goods different from total trade in services. This paper estimates this gravity model in its multiplicative form using the Poisson pseudo-maximum likelihood estimator. Estimation results show that the demand for intermediate inputs tend to be less subject to consumers' preferences and rather rely more on geographical proximity compared to final products. In addition, current regional trade agreements and trade partnerships still tend to be goods oriented and have scope to cover aspects of services trade. Consequently, this study illustrates the importance of distinguishing trade in different products and whether they are for intermediate use or final consumption.

**Keywords:** Trade in intermediates, services trade, gravity model, Poisson-pseudo-maximum likelihood (PPML) estimator, World Input-Output Database (WIOD)

**JEL Classification numbers:** F13, F14, F15

---

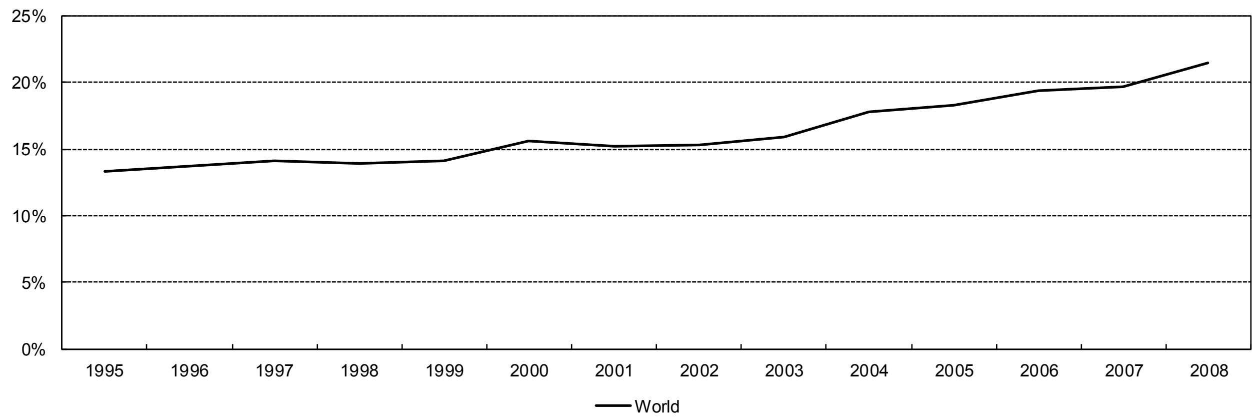
* I would like to thank Professors Hiro Lee and Tsunehiro Otsuki for their helpful comments, and Susan Stone, Senior Advisor at the Organisation for Economic Co-operation and Development (OECD), for introducing me to the World Input-Output Database. All remaining errors are my own.

** Visiting Fellow, Osaka School of International Public Policy, Osaka University, 1-31 Machikaneyama, Toyonaka, Osaka 560-0043, Japan.
Email: h-yane@osipp.osaka-u.ac.jp.

## 1. Introduction

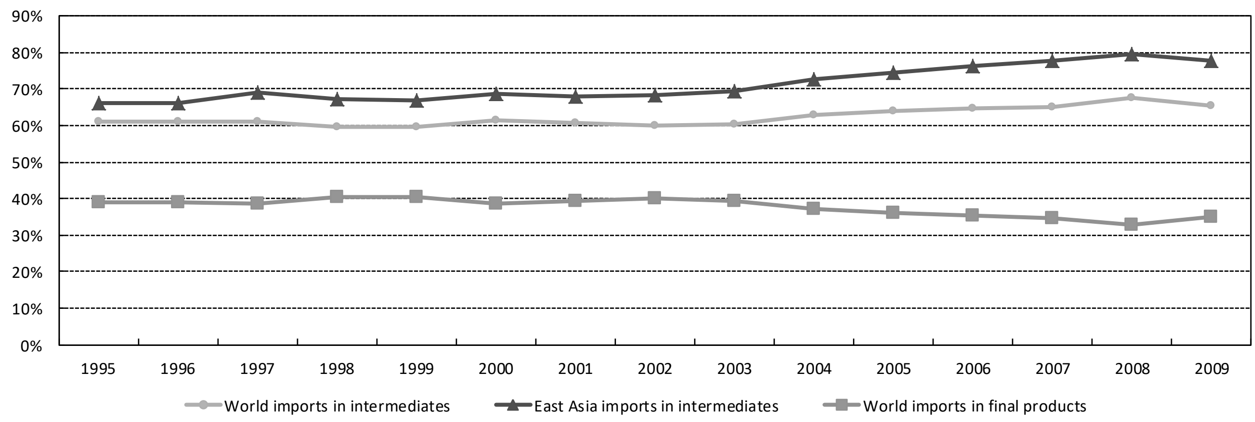
In recent years we have witnessed the world economy rapidly integrating through international trade. Behind this phenomenon is the increasing prominence of trade in intermediates and trade in services during the past two decades. The international fragmentation of production in global value chains has been motivated by sourcing intermediate inputs from more cost-efficient producers in order to enhance efficiency. As a result, domestic production has been increasingly relying on foreign intermediate inputs. Further, rapid advances in information and communications technology (ICT) and infrastructure growth have increased the tradability of many service activities, thereby facilitating the sourcing of services from abroad.

Figures 1 and 2 depict how the interconnectivity of production processes has been increasing through trade in intermediate inputs. First, Figure 1 shows the increasing trend in the world's ratio of foreign to domestic inputs. Firms are increasingly purchasing and using intermediate inputs from abroad. According to Miroudot, Lanz and Ragoussis (2009), trade in intermediates account for about 56% of world trade in case of goods and 73% in case of services. Figure 2 reveals the increasing share of world's intermediates trade in total trade, in contrast with the stagnant share of world's final products trade in total trade. In addition, you can see how intermediates trade share in total trade in East Asia is exceptionally high, leading the increasing trend in trade in intermediate products.




Source: Author's calculation based on WIOD.

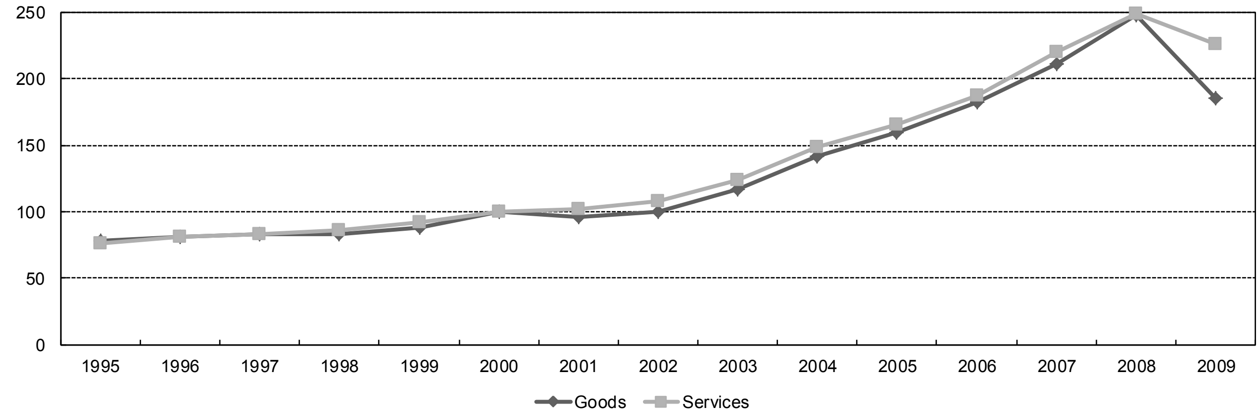
Figure 1: Trade in Intermediates – Ratio of Foreign to Domestic Intermediates




Source: Author's calculation based on WIOD.

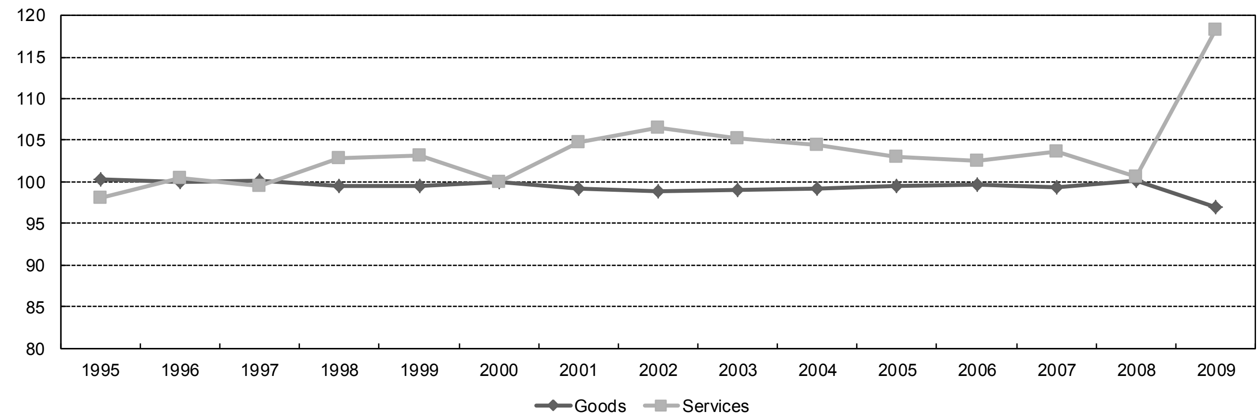
Figure 2: Trade in Intermediates and Final Products as a Share of Total Imports

Second, trade in services shows higher growth compared to trade in goods, as you can see from Figure 3. Figure 4 shows how trade in services has been representing a higher share of total trade than trade in goods. Moreover, what is striking is that both figures depict that services trade seems to have been affected much less by the financial crisis compared to goods trade.




Source: Author's calculation based on WIOD.

Figure 3: Imports of Goods and Services (year 2000=100)




Source: Author's calculation based on WIOD.

Figure 4: Trade in Goods and Services as a Share of Total Imports (year 2000=100)

Innovations such as the internet and container shipping have revolutionized trade and value chains. Thanks to these developments, we are seeing more and more of trade in intermediates and trade in total services, even seemingly overpowering the traditional trade in final products and trade in total goods. There has been, however, comparatively much less attention paid to trade in intermediates and trade in services, mostly due to the lack of statistics. Therefore, this present study will try to present new additional evidence on the different implications for different forms of trade, by using the World Input-Output Database (WIOD).

This paper's main goal is to see the differences between what determines the amount of trade in intermediate inputs and trade in final products, and between determinants of goods trade and services trade. For instance, what factors affect trade in intermediates more as opposed to trade in final products, and do trade costs have a significantly greater impact on trade in goods or trade in services? It is important to distinguish these trade flows because first, purchasers for intermediate inputs are different from those for end-use final products. It is usually the firms who buy and use intermediate inputs for further production, and final products are sold to end-users, often consumers.[1] Second, goods and services also have distinctive characteristics[2], for instance, services have an intangible nature, and production and consumption must occur simultaneously (Kimura and Lee, 2006). Therefore, although they are all international trade, their determinants should vary. This paper attempts to show the prominence of different kinds of trade in contrast with manufactured goods, and clarify their distinct characteristics.

Hence, this study uses the framework of gravity model of bilateral trade to analyze the differences in what determines the amount of trade 1) between intermediates and final products, and 2) and between goods and services. In order to account for the zero trade flows between countries, and also to control for the heteroskedasticity present in the data, this study applies the Poisson pseudo-maximum likelihood (PPML) estimator to the gravity model (see Santos Silva and Tenreyro, 2006).

The results from this study indicate how important it is to distinguish goods from services, and intermediate-use products from final-use products. More specifically, they show that trade in intermediate inputs is more sensitive to trade costs compared to trade in final products, and responds much more to regional trade agreements (RTAs). One important characteristic of services trade to note is that current regional trade agreements have not played a significant role for two countries to engage in services trade.

In this paper I will assess the differences between intermediate and final products (including both goods and services products) trade, as well as differences between trade in services and trade in goods. The rest of the paper is organized as follows. Section 2 provides background and reviews the literature. Section 3 describes the data, gravity model for international trade, and estimation techniques to account for observations with zero trade flows and to deal with the presence of heteroskedasticity under the assumption of a multiplicative error term. Section 4 discusses the estimation results of the model using the PPML estimator. Section 5 concludes.

## 2. Literature Review

### 2.1: Trade in Intermediates

'Global value chains' have rapidly emerged as production processes have become more geographically fragmented since the 1990s. International trade and production are increasingly structured around these 'global value chains'. A 'value chain' can be simply defined as the full range of activities that firms and workers carry out in order to bring a product from its conception to its end use and beyond (see Gereffi and Fernandez-Stark, 2011). The term 'global' comes from the fact that these activities are increasingly spread over multiple countries. The fragmentation of value chains has been motivated by sourcing intermediate inputs from more cost-efficient producers, foreign or domestic, in order to enhance efficiency. As a result, domestic production has been increasingly relying on foreign intermediate inputs, as shown in Figure 1.

With this increasing presence of trade in intermediates, there continues to be a rising demand for comprehensive and trustable data on the various dimensions of the internationalization of production networks. The increasing fragmentation of production across countries, however, has led current global production networks to be multi-

[1] While final products highly rely on advertisement and promotion aimed for final consumers, intermediate inputs trade could be determined more by other factors, such as preferences, customs and habits (Miroudot et al., 2009).

[2] For more on trade in services and the four modes of supply, see the document for General Agreement on Trade in Services (GATS), available on the World Trade Organization website (http://www.wto.org/english/tratop_e/serv_e/serv_e.htm).

country and back-and-forth in nature (Koopman, Powers, Wang and Wei, 2011), making it difficult to capture in statistics.

All official trade statistics are measured in gross terms, which include both intermediate inputs and final products. They record the value of intermediate inputs traded along the value chain, crossing international borders several times, back and forth, for further processing. These trade flows are thus counted multiple times. Consequently, the country of the final producer appears as creating most of the value of goods and services traded, giving the misleadingly wrong picture, overlooking the role of countries providing inputs upstream in the global value chain. For example, an exported good may require considerable intermediate inputs from domestic manufacturers, who, in turn, require considerable intermediate imports, and so, much of the revenue, or value-added, from selling the exported good may accrue abroad to reflect purchases of intermediate imports used in production.

### 2.2: Trade in Services

Globalization is no longer only about goods; it increasingly involves trade in services. Many service activities are becoming internationalized. Services trade liberalization has reduced regulatory barriers in key sectors of the global logistics chain, such as transport, finance and telecommunications. Business services, for example, are now an integral part of the global value chain. According to Johnson (2014), the ratio of value-added to gross exports for goods trade is lower compared to services trade. This is because manufacturing firms purchase services activities as part of their production processes and gross manufacturing exports include value-added from the services sector.

In spite of this increasing prominence of trade in services, however, much attention has been focused on the impact of relevant factors on trade in goods. This is partly due to the unfortunate fact that official statistical data do not provide much detailed information on services trade, compared to the goods sector, where they have detailed and timely data available for a broad range of countries. In contrast, the quality of bilateral services trade statistics by industry or product is unsurprisingly very low, with many missing observations.

### 2.3: Previous Empirical Studies

There has been a recent rise in attention to both trade in intermediate inputs and trade in services. Yet research has been hindered by the limited availability of reliable and adequate statistics. Coming up with a methodology to differentiate between intermediate and final products, as well as measuring trade in services, has been challenging.

Due to these limitations in the international trade data, there have only been a handful of empirical studies on trade in intermediate inputs or trade in services. The recent development in data quality and availability, however, have helped boost the number of studies. This is all thanks to the attempts to devise methods of measuring value-added trade in the empirical literature. Daudin, Rifflart and Schweisguth (2011) and Koopman et al. (2011) are among the first to explicitly refer to a measurement of trade in value-added using an empirical framework.

One of the recent prominent empirical works is Miroudot et al. (2009), where they analyze trade in intermediate goods and services, comparing intermediates trade and final products trade across goods and services industries, using data at four- to five-year intervals (mostly years 1995, 2000 and 2005). They use disaggregate trade data at the industry level. This present paper mainly follows their study because they also make a comparison between the goods industry and services industry.

As for research focusing on trade in services, Kimura and Lee (2006) use a standard–type gravity equation to assess the differences between trade in services and trade in goods, utilizing bilateral trade data for 26 OECD member countries for years 1999 and 2000. Fukao and Ito (2003) estimate gravity equations to test whether Japan's market for services is more closed for establishment transactions, using data on U.S. services exports, for years 1992 and 1997.

All these existing empirical studies, however, have limitations that this study seeks to overcome. Former empirical studies either used aggregate trade data, and/or data at four to five-year intervals. The present study contributes to the intermediates trade and services trade literature because unlike previous research, this study uses a panel dataset: annual data from 1995 to 2009 and trade data disaggregated at the product-level. Compared with former studies, this should reveal a more consistent and detailed picture of the recent development in different patterns of trade. This study also contributes to the literature by conducting empirical analyses for both trade in intermediates and trade in services. Moreover, this study attempts to re-examine the impact of regional trade agreements in the context of different trade flows.

## 3. Methodology

### 3.1: Data

This study uses trade data from the World Input-Output Database (WIOD)[3], which was released for the general public in April 2012. The international supply and use table covers annual time-series data from 1995 to 2009 for 40 countries. Table 1 depicts country coverage by continent. In order to maximize observations for trade in services, trade data broken down by different products were used, instead of those classified by industries[4]. For trade in services, I strictly followed and included all products covered by the General Agreement on Trade in Services[5]. As a result, this dataset provides this analysis with a good coverage balance between goods and services trade.[6] All intermediate, final and total goods and services trade data are classified into 59 products, based on Statistical Classification of Products by Activity (CPA). The classification of products into goods and services sectors is shown in Table 2.

Table 1: Country Coverage by Continent

| Continent | | | |
|---|---|---|---|
| Europe | | Americas | |
| Country | ISO | Country | ISO |
| Austria | AUT | Brazil | BRA |
| Belgium | BEL | Canada | CAN |
| Bulgaria | BGR | Mexico | MEX |
| Cyprus | CYP | United States | USA |
| Czech Republic | CZE | Obs. | 138,060 |

[3] The World Input-Output Database is available at http://www.wiod.org/database/index.htm.
The core of the database is a set of harmonized national supply and use tables, linked together with bilateral trade data in goods and services. These two sets of data are then integrated into a world input-output table. See Timmer (2012) for the detailed framework and calculations.
[4] The WIOD classifies 59 products (based on CPA) whereas for industries they only have 35 categories (based on NACE rev.1 (ISIC rev.2) classifications).
[5] The GATS services sectoral classification list is available at http://www.wto.org/english/tratop_e/serv_e/serv_e.htm or http://www.wto.org/english/tratop_e/serv_e/mtn_gns_w_120_e.doc.
[6] 52.5% of the data are on goods trade and 47.5% are on services trade.

| | | | |
|---|---|---|---|
| Germany | DEU | Percentage | 10% |
| Denmark | DNK | Asia Pacific | |
| Spain | ESP | Australia | AUS |
| Estonia | EST | China | CHN |
| Finland | FIN | Indonesia | IDN |
| France | FRA | India | IND |
| United Kingdom | GBR | Japan | JPN |
| Greece | GRC | South Korea | KOR |
| Hungary | HUN | Russia | RUS |
| Ireland | IRL | Taiwan | TWN |
| Italy | ITA | Obs. | 276,120 |
| Lithuania | LTU | Percentage | 20% |
| Luxembourg | LUX | | |
| Latvia | LVA | | |
| Malta | MLT | | |
| Netherlands | NLD | | |
| Poland | POL | | |
| Portugal | PRT | | |
| Romania | ROU | | |
| Slovak Republic | SVK | | |
| Slovenia | SVN | | |
| Sweden | SWE | | |
| Turkey | TUR | | |
| Obs. | 966,420 | | |
| Percentage | 70% | | |

Table 2: Products Description with CPA Classification

| Goods Sector | | Services Sector | |
|---|---|---|---|
| CPA | Product | CPA | Product |
| 1 | Products of agriculture, hunting and related services | 40 | Electrical energy, gas, steam and hot water |
| 2 | Products of forestry, logging and related services | 41 | Collected and purified water, distribution services of water |
| 5 | Fish and other fishing products; services incidental of fishing | 45 | Construction work |
| 10 | Coal and lignite; peat | 50 | Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of a |
| 11 | Crude petroleum and natural gas; services incidental to oil and gas extraction | 51 | Wholesale trade and commission trade services, except of motor vehicles and motorcycle |

| | | | |
|---|---|---|---|
| 12 | Uranium and thorium ores | 52 | Retail trade services, except of motor vehicles and motorcycles; repair services of person |
| 13 | Metal ores | 55 | Hotel and restaurant services |
| 14 | Other mining and quarrying products | 60 | Land transport; transport via pipeline services |
| 15 | Food products and beverages | 61 | Water transport services |
| 16 | Tobacco products | 62 | Air transport services |
| 17 | Textiles | 63 | Supporting and auxiliary transport services; travel agency services |
| 18 | Wearing apparel; furs | 64 | Post and telecommunication services |
| 19 | Leather and leather products | 65 | Financial intermediation services, except insurance and pension funding services |
| 20 | Wood and products of wood and cork (except furniture); articles of straw and plaiting mate | 66 | Insurance and pension funding services, except compulsory social security services |
| 21 | Pulp, paper and paper products | 67 | Services auxiliary to financial intermediation |
| 22 | Printed matter and recorded media | 70 | Real estate services |
| 23 | Coke, refined petroleum products and nuclear fuels | 71 | Renting services of machinery and equipment without operator and of personal and house |
| 24 | Chemicals, chemical products and man-made fibers | 72 | Computer and related services |
| 25 | Rubber and plastic products | 73 | Research and development services |
| 26 | Other non-metallic mineral products | 74 | Other business services |
| 27 | Basic metals | 75 | Public administration and defense services; compulsory social security services |
| 28 | Fabricated metal products, except machinery and equipment | 80 | Education services |
| 29 | Machinery and equipment n.e.c. | 85 | Health and social work services |
| 30 | Office machinery and computers | 90 | Sewage and refuse disposal services, sanitation and similar services |
| 31 | Electrical machinery and apparatus n.e.c. | 91 | Membership organization services n.e.c. |
| 32 | Radio, television and communication equipment and apparatus | 92 | Recreational, cultural and sporting services |
| 33 | Medical, precision and optical instruments, watches and clocks | 93 | Other services |
| 34 | Motor vehicles, trailers and semi-trailers | 95 | Private households with employed persons |
| 35 | Other transport equipment | | |
| 36 | Furniture; other manufactured goods n.e.c. | | |
| 37 | Secondary raw materials | | |
| | 52.5% | | 47.5% |

In addition to its disaggregate, product-level data characteristic, the advantage of this input-output database is that it covers a period of 15 consecutive years, whereas most former studies had to rely on data at five-year intervals more or less (Baier and Bergstrand, 2007; Johnson and Noguera, 2017).

In order to approximate non-policy trade costs in a standard gravity model, this study uses proxies discussed in Johnson and Noguera (2017), which are distance, common language, adjacency (common borders) and colonial links. These data were obtained from CEPII's database[7]. Descriptive statistics for continuous variables are shown in Table 3.

Table 3: Descriptive Statistics for Continuous Variables

| Variable | Unit of measure | Obs. | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| Total imports | in million US dollars | 1,380,600 | 65.6 | 591 | 0 | 72,300 |
| Intermediates imports | in million US dollars | 1,380,600 | 39.7 | 365 | 0 | 59,700 |
| Final products imports | in million US dollars | 1,380,600 | 25.8 | 327 | 0 | 55,100 |
| Total goods imports | in million US dollars | 725,400 | 104 | 778 | 0 | 72,300 |
| Total services imports | in million US dollars | 655,200 | 23.2 | 249 | 0 | 44,700 |
| Distance | km | 1,380,600 | 5,133 | 4,433 | 59.62 | 18,523.81 |

### 3.2: Model

This study estimates bilateral trade using a standard gravity model, initially proposed by Tinbergen (1962). Gravity equations have been favored in trade literature mainly because of their high explanatory power, empirically succeeding at predicting bilateral trade flows. However, the model has been criticized for lacking respectable theoretical foundations, causing it to suffer from incorrect specifications. Anderson and van Wincoop (2003) developed a solution by augmenting the traditional equation with multilateral resistance terms (for example, calculating remoteness indices, or adding exporter and importer fixed effects), adding strong theoretical foundations to the model. In addition, Head and Mayer (2014) state that importer and exporter fixed effects should be time varying with dataset that span many years. The combination of being consistent with theory and relatively easy to implement led to a surge in adoption in empirical work. Feenstra (2004) explains that gravity equation has finally succeeded empirically in the field of international trade.

Inspired by Sir Isaac Newton's work on *Law of Universal Gravitation*[8], for which he published a paper in 1687, Tinbergen (1962) linked the functional form to international trade flows, predicting a gravity relationship for trade flows analogous to Newton's law. It holds that the bilateral trade flows between two countries are directly proportional to the trading countries' respective economic sizes, and inversely related to trade costs. Trade costs can be proxied by the geographical distance[9] between the two trading countries, while their size of the market can be proxied using their respective GDPs. Therefore, in other words, the underlying assumption of the gravity model of bilateral trade is that trade flows should increase as a trading partner's GDP rises, and should decrease if distance

---

[7] CEPII databases are available at http://www.cepii.fr/anglaisgraph/bdd/bdd.htm.
This study uses contiguity indicator, common colonial origin indicator and common official language indicator from the CEPII Gravity Dataset. Data on distance, measured as the simple distance between the capitals in the two countries, is from CEPII GeoDist.
[8] A calculator based on this law can be found here: http://www.pythia.com.ar/?id=gravlaw.
[9] Miroudot and Ragoussis (2009) add that in addition to transport costs, distance, used as a proxy for trade costs, also captures regulatory differences as well as cultural differences between countries.

between a trading partner is farther. This study takes the fixed-effects approach; hence exporter and importer fixed effects are included in place of GDPs of importing and exporting countries, in order to account for multiple resistance.

Following Miroudot et al. (2009)'s gravity regression model, the standard gravity equation to be estimated here is as follows.[10] Let $Trade_{ijgpt}$ indicate the level of bilateral imports of intermediate or final goods and services product *p*, between country *i* and country *j* in year *t*. Subscript *g* is the indicator of whether it is intermediate or final goods and services trade:

$$Trade_{ijgpt} = \alpha_0 + \alpha_1 Dfinal_g + \mathbf{X}_{ij}\boldsymbol{\beta_1} + Dfinal_g\mathbf{X}_{ij}\boldsymbol{\beta_2} + \mu_{ipt} + \nu_{jpt} + \varepsilon_{ijgpt}.$$

$Dfinal_g$ is a dummy variable that takes the value 1 for final goods and services trade and 0 for intermediate goods and services trade. $\mu_{ipt}$ and $\nu_{jpt}$ are destination-product-time and origin-product-time fixed effects respectively, in order to account for their consumer price indices as well as their sizes of economies. $\varepsilon_{ijgpt}$ is the error term. Likewise, let $Trade_{ijpt}$ indicate the level of total goods or total services product $p$, between country *i* and country *j* in year *t*:

$$Trade_{ijpt} = \gamma_0 + \gamma_1 Dgoods_p + \mathbf{X}_{ij}\boldsymbol{\delta_1} + Dgoods_p\mathbf{X}_{ij}\boldsymbol{\delta_2} + \kappa_{ipt} + \omega_{jpt} + \xi_{ijpt}.$$

$Dgoods_p$ is a dummy variable that takes the value 1 for total goods trade and 0 for total services trade. $\kappa_{ipt}$ and $\omega_{jpt}$ are destination-product-time and origin-product-time fixed effects respectively. $\xi_{ijpt}$ is the error term.

The vector of country-pair characteristics, $\mathbf{X}_{ij}$, includes (1) the natural log of the geographic distance between the capitals of countries *i* and *j*; (2) an indicator of whether countries *i* and *j* share a common land border; (3) an indicator of whether the country pairs share a common official language; (4) an indicator of whether the country pairs ever had colonial ties; (5) an indicator of whether both countries have a regional trade agreement with each other[11]; (6) regional indicators of whether both countries are in Europe, whether both countries are members of the Association of Southeast Asian Nations (ASEAN) plus China, Japan, Korea and Taiwan, or whether both countries are members of the North American Free Trade Agreement (NAFTA).

Based on this standard gravity equation, this study will pool across products[12]. The dependent variable is bilateral trade in (1) intermediate goods and services, (2) final goods and services, (3) total goods, and (4) total services, respectively, with the same regressors. This study follows Miroudot et al. (2009) and Kimura and Lee (2006) with regard to using the same gravity equation framework as goods trade for services trade.

This paper estimates import equations because the dataset consists of the same set of home and partner countries: exports are defined as mirror flows from imports (i.e., values of exported products from country *j* to country *i* are assumed to be equal to the values of imported products of country *i* from country *j*) in the WIOD trade data this study uses (Timmer, 2012).

In addition, following Frankel (1997), I have also included regional binary variables for each year to test the effects of membership in regional trade agreements. This study also includes Europe, East Asia (ASEAN plus China, Japan, Korea and Taiwan) and NAFTA as broader trading bloc dummy variables. The regional variables

---

[10] I would like to thank my anonymous referee for suggesting to use this methodology to make a comparative analysis between different trade flows.

[11] This variable was created by using de Sousa, J. (2012)'s Regional Trade Agreements data and programs (available at http://jdesousa.univ.free.fr/data.htm).

[12] For each importer-exporter country pair in a given year, 59 products for both trade in intermediates and final products; 31 products for trade in goods, and 28 products for trade in services.

represent a country's formal membership status of a trade agreement with the other country in the corresponding year.

### 3.3: Estimation Techniques

Standard procedure to estimate multiplicative gravity models for trade is to take the logarithms so as to be able to estimate it in linear form. This study, however, uses a dataset for which around 40% of the bilateral trade data between country $i$ and country $j$ is in fact zero.[13] Zero trade flows are actually quite common in the bilateral international trade matrix (see, for example, Haveman and Hummels, 2004; Santos Silva and Tenreyro, 2006; Helpman et al., 2008). The proportion of zeros increases in line with country diversity (40*39 bilateral country pairs for this study) as well as sectoral disaggregation (59 classified products in this analysis). On the one hand, presence of zeros tends to bias estimates (especially OLS gravity model estimates), but on the other hand, disregarding the zeros means throwing away some potentially interesting information. Although the literature is still undecided as to the best way to deal with the zero trade flows, the following are among the few of the approaches commonly taken in empirical studies.

One of the approaches is to simply drop the pairs with zero bilateral trade from the dataset by estimating the log-linear form (for example, see Johnson and Noguera, 2017).[14] This means, however, that an important observation is left out of the model: the zero trade flow. This is undesirable because the omitted observations contain information as to why low levels of trade flow are observed, or why some countries trade in some products while others do not.

In order to avoid throwing away observations with zero-values, Eichengreen and Irwin (1994; 1998) estimate their model using the logarithm of (1 + Trade) as the dependent variable. However, Linders and de Groot (2006), among others, showed that this approach is prone to yield upward biased estimates.

An alternative procedure is to use the sample selection correction introduced by Heckman (1979), which corrects for this possible selection bias. Linders and de Groot (2006) make use of the Heckman selection model for a gravity equation and conclude that compared to using OLS as the estimation methodology, it is preferable to use the sample selection model. Imposing exclusion restrictions, Helpman et al. (2008) developed a model that accounts for the self-selection of firms into engaging in international trade and their impact on trade volumes. Choosing true identifying restrictions, however, is tricky. Other drawbacks of using the Heckman model is that it does not deal well with heteroskedasticity. In addition, the fixed effects probit model in the first stage suffer from the incidental parameters problem.

Lastly, the PPML estimator provides consistent estimates of the original nonlinear gravity model, since "it is exactly equivalent to running a type of nonlinear least squares on the original equation" (Shepherd, 2012), given the assumption that the gravity model contains the correct set of explanatory variables is satisfied. The PPML estimator is not only consistent in the presence of fixed effects, but also able to control for the presence of heteroskedasticity under a multiplicative error term.

Indicating that log linear models cannot be expected to provide unbiased estimates under heteroskedasticity, Santos Silva and Tenreyro (2006) proposed the PPML model as an econometric solution for the zero-value problem in count data. This model, commonly used for count data, is known for its ability to deal with occurrence of zeros

[13] 38.9%, 44% and 37% of the observations are zero, for trade in intermediates, final products, and total goods and services, respectively.

[14] Taking logarithms effectively drops such observations from the sample because log(0) is undefined.

and discrete nonnegative nature of the dependent variable (see Greene, 2008). Conveniently, it can appropriately be applied to the gravity model since it is a pseudo maximum likelihood estimator. Hence, the PPML estimator can produce unbiased and consistent estimates of the variables of interest. Consequently, this study applies the PPML estimator.

## 4. Main Results

### 4.1: Trade in Intermediates and Trade in Final Products

Table 4: Trade in Intermediates and Trade in Final Products: PPML Estimation Results

| Trade | Intermediates Imports & Final Products Imports |
|---|---|
| lnDistance | -0.945*** |
| | (0.00) |
| lnDistance×Dfinal | 0.319*** |
| | (0.00) |
| Adjacency | 1.928*** |
| | (0.00) |
| Adjacency×Dfinal | -0.914*** |
| | (0.00) |
| Common language | 0.516*** |
| | (0.00) |
| Common language×Dfinal | 0.219*** |
| | (0.00) |
| Colonial ties | 0.563*** |
| | (0.00) |
| Colonial ties×Dfinal | 0.036*** |
| | (0.00) |
| RTA dummy | 0.288*** |
| | (0.00) |
| RTA dummy×Dfinal | -0.181*** |
| | (0.00) |
| European bloc | 0.802*** |
| | (0.00) |
| European bloc×Dfinal | 0.284*** |
| | (0.00) |
| East Asian bloc | 0.761*** |
| | (0.00) |
| East Asian bloc×Dfinal | 1.391*** |
| | (0.00) |
| NAFTA bloc | 0.407*** |
| | (0.00) |
| NAFTA bloc×Dfinal | 1.613*** |
| | (0.00) |
| Dfinal | -0.727*** |
| | (0.00) |
| Constant | 17.411*** |
| | (0.00) |
| R-squared | 0.172 |
| Observations | 2,761,200 |

Notes: Estimates are made with origin-product-time and destination-product-time fixed effects. Clustered standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the results for trade in intermediates and trade in final products. First, the negative impact of distance on intermediate inputs trade is relatively higher, compared to that on final products trade. Similarly, adjacency is more important for intermediates trade compared to final products trade. These differences may be because intermediate inputs tend to be less subject to consumers' preferences and rely more on geographical proximity. Cultural ties, such as common languages and colonial ties, however, deemed to be more essential for final products trade, compared to intermediate products. This implies that smaller countries considering to open up trade may have a higher chance of succeeding in the global market by exporting intermediate inputs rather than final products, if they target countries that are near them.

Second, the RTA dummy has a positive effect that is statistically significant at the 1% level on both trade in final products and trade in intermediate inputs. This positive impact of a regional trade agreement is stronger for intermediates trade. In addition, when both countries belong to the European bloc, they tend to trade final products much more than otherwise similar countries. The same can be said for East Asian and North American countries. This may suggest that there is an increasing trend for countries to specialize in assembling final products that they export to other countries in the same regional bloc.

## 4.2: Trade in Goods and Trade in Services

Table 5: Trade in Goods and Trade in Services: PPML Estimation Results

| Trade | Goods Imports & Services Imports |
|---|---|
| lnDistance | -0.463***<br>(0.00) |
| lnDistance×Dgoods | -0.615***<br>(0.00) |
| Adjacency | 1.132***<br>(0.00) |
| Adjacency×Dgoods | -0.883***<br>(0.00) |
| Common language | 1.083***<br>(0.00) |
| Common language×Dgoods | -1.021***<br>(0.00) |
| Colonial ties | 2.025***<br>(0.00) |
| Colonial ties×Dgoods | 1.613***<br>(0.00) |
| RTA dummy | -1.292***<br>(0.00) |
| RTA dummy×Dgoods | 6.259***<br>(0.00) |
| European bloc | 3.183***<br>(0.00) |
| European bloc×Dgoods | -3.038***<br>(0.00) |
| East Asian bloc | -5.482***<br>(0.00) |
| East Asian bloc×Dgoods | 10.509***<br>(0.00) |
| NAFTA bloc | -6.998***<br>(0.00) |

| | |
|---|---|
| NAFTA bloc×Dgoods | -6.207*** |
| | (0.00) |
| Dgoods | -0.639 |
| | (0.00) |
| Constant | -26.246 |
| | (0.00) |
| R-squared | 0.345 |
| Observations | 1,380,600 |

Notes: Estimates are made with origin-product-time and destination-product-time fixed effects. Clustered standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5 shows the regression results with goods imports and services imports as dependent variables. First, trade in services is affected less by distance compared to trade in goods. Although ICT innovation has indeed reduced the role of distance for services trade, the innovation in infrastructure and container shipping have also decreased the transportation costs for goods, notwithstanding it is still more costly than services.

Second, when two countries share the same official language, they tend to trade services much more, compared to goods, than two otherwise similar countries.[15] Colonial ties, on the other hand, play a greater role for total goods trade. Third, members of the East Asian regional bloc tend to trade goods more than otherwise. This is consistent in that the East Asia region is known for its active manufacturing production processes and their fragmentation. The results for the European regional bloc reveal an opposite trend; two European countries tend to engage more in services trade compared to goods trade. In the NAFTA region, both services trade and goods trade are affected negatively when two members engage in trade. This indicates that any of the three pairs of countries trade much less than expected, given their market size, distance and such.

As for services, regional trade agreements show that they have a negative impact on services trade. This suggests that the current agreements and partnerships still tend to be goods oriented and do not cover much regarding services trade. This also means that with a little improvement, we may see a boost in services trade. The great financial crisis has affected services trade much less than goods trade, as shown in the evident resilience of services trade to the financial crisis in Figures 3 and 4, and also with Borchert and Mattoo (2009). They explain that services trade has weathered the crisis much better than goods trade for two reasons: demand for a range of traded services is less cyclical, and services trade and production are less dependent on external finance.

## 5. Concluding Remarks

This study assesses how the same factors, such as trade costs and regional trade agreements, can significantly affect intermediate, final and total goods and services trade flows differently. With technological developments in ICT and transportation, trade in intermediates and trade in services have been increasing their prominence in international trade. However, constrained by data limitations, there have not been that many empirical studies. Therefore, this paper contributes to the literature by conducting empirical analyses for both trade in intermediate inputs and trade in services. The main findings of this paper and policy implications based on them can be summarized as follows:

[15] The formula to compute this effect is $(e^{b_{ij}} - 1) * 100\%$, where $b_{ij}$ is the estimated coefficient. So here, for example, the computation will be [exp(1.083)-1.0]*100=195.4%] for services trade.

*1. Trade in intermediate inputs*

First, demand for intermediate inputs tend to be less subject to consumers' preferences and rather rely more on geographical proximity compared to final products. This implies that smaller countries considering opening up trade may have a higher chance of succeeding in the global market by exporting intermediate inputs and targeting nearby countries. Second, regional trade agreements have a more positive effect on intermediates trade than final products trade. This implies an alignment in the increase of the presence of global value chains and negotiations for trade agreements.

*2. Trade in services*

First, although ICT innovation has reduced the role of distance for services trade, the innovation in infrastructure and container shipping have also decreased the transportation costs for goods, notwithstanding it is still more costly than services. Second, services trade is much more prominent in the European region while goods trade is much more dominant in the East Asian region. Lastly, current regional trade agreements and trade partnerships still tend to be goods oriented and have scope to cover aspects of services trade. Thus, with little improvement, we may see a boost in services trade.

Through empirical analysis, this present study showed that intermediates and final products, and their trade in different sectors vary greatly in their characteristics using the gravity model. Therefore, it is necessary to distinguish trade in different products and whether they are for intermediate use or final consumption, when enforcing policies.

## References

Anderson, J. E. and van Wincoop, E. 2003. Gravity with gravitas: A solution to the border puzzle. *American Economic Review* 93(1): 170-192.

Baier, S. L. and Bergstrand, J. H. 2007. Do free trade agreements actually increase members' international trade? *Journal of International Economics* 71: 72-95.

Borchert, I. and Mattoo, A. 2009. The crisis-resilience of services trade. *World Bank Policy Research Working Paper Series* 4917.

Daudin, G., C. Rifflart and Schweisguth D. 2011. Who produces for whom in the world economy? *Canadian Journal of Economics* 44(4): 1403-1437.

Eichengreen, B. and Irwin, D. A. 1998. The role of history in bilateral trade flows. In Jeffrey A. Frankel, ed., *The Regionalization of the World Economy*, pp.33-62. Chicago, IL and London: University of Chicago Press.

Eichengreen, B. and Irwin, D. A. 1994. Trade blocs, currency blocs and the reorientation of world trade in the 1930s. *Journal of International Economics* 38: 1-24, July 1993, revised July 1994.

Feenstra, R. C. 2004. Chapter 5: Increasing returns and the gravity equation. In His *Advanced International Trade: Theory and Evidence*, Princeton University Press.

Frankel, J. A. 1997. *Regional Trading Blocs in the World Economic System.* Washington D.C.: Institute for International Economics.

Fukao, K. and Ito, K. 2003. Foreign direct investment and services trade: the case of Japan. In T. Ito and A. O. Krueger, eds., *Trade in Services in the Asia Pacific Region*, NBER East Asia Seminar on Economics (EASE), Volume 11, pp.429-480. Chicago, IL and London: University of Chicago Press.

Gereffi, G. and Fernandez-Stark, K. 2011. *Global Value Chain Analysis: A Primer*. Center on Globalization, Governance & Competitiveness (CGGC), Duke University, North Carolina, USA.

Greene, W. H. 2008. *Econometric Analysis*. New Jersey: Pearson Education, Inc.

Haveman, J. and Hummels, D. 2004. Alternative hypotheses and the volume of trade: The gravity equation and the extent of specialization. *Canadian Journal of Economics* 37(1): 199-218.

Head, K. and Mayer, T. 2014. Gravity equations: Workhorse, toolkit, and cookbook. *Handbook of International Economics*, Vol.4.

Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica* 47: 153-61.

Helpman, E., Melitz, M. and Rubinstein, Y. 2008. Estimating trade flows: Trading partners and trading volumes. *Quarterly Journal of Economics* 123: 441-487.

Johnson, R. C. 2014. Five facts about value-added exports and implications for macroeconomics and trade research. *Journal of Economic Perspectives* 28(2).

Johnson, R. C. and Noguera, G. 2017. A portrait of trade in value added over four decades. *Review of Economics and Statistics* 99(5).

Kimura, F. and Lee, H.-H. 2006. The gravity equation in international trade in services. *Review of World Economics* 142(1): 92-121.

Koopman, R., Powers, W., Wang, Z. and Wei, S.-J. 2011. Give credit where credit is due: Tracing value added in global value chains. *NBER Working Papers Series* 16426, September 2010, revised September 2011.

Linders, G. J. M. and de Groot, H. L. F. 2006. Estimation of the gravity equation in the presence of zero flows. *Tinbergen Institute Discussion Paper* No. 06-072/3.

Miroudot, S. and Ragoussis, A. 2009. Vertical trade, trade costs and FDI. *OECD Trade Policy Working Paper* No. 89.

Miroudot, S., R. Lanz and Ragoussis, A. 2009. Trade in intermediate goods and services. *OECD Trade Policy Working Paper* No. 93.

Santos Silva, J. M. C. and Tenreyro, S. 2006. The Log of Gravity. *Review of Economics and Statistics* 88(4): 641-658.

Shepherd, B. 2012. *The Gravity Model of International Trade: A User Guide*. Thailand: United Nations Publication.

de Sousa, J. 2012. The currency union effect on trade is decreasing over time. *Economics Letters* 117(3): 917-920.

Timmer, M. P. (Ed.) 2012. The World Input-Output Database (WIOD): Contents, sources and methods. *WIOD Working Paper* No. 10.

Tinbergen, J. 1962. *Shaping the World Economy*. New York: Twentieth Century Fund.