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Comparison of the Impact of Information and Communication Technology between Bilateral Trade in Goods and Services

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Abstract. This paper compares the impact of Information and Communication Technology (ICT) between bilateral service trade and goods trade. Using data from the US to 34 partnering countries from 2000-2016, we test our hypotheses that (a) ICT enhances bilateral trade in goods and services at varying levels dependent on the mode of ICT used, and (b) some trade determinants are posited to bear contradictory results from existing international trade studies. We find that (a) our models perform better on bilateral service trade than bilateral goods trade, (2) mobile phones and fixed broadband are more important than wired internet or fixed telephone line for service trade, and (3) a mix of traditional and modern forms of ICT to be critical factors in enhancing goods trade. As for the impact of trade determinants, we find wealth and market size to be significant for both service trade & goods trade. However, the impact of common language and distance on service import and goods import are diversely different from what we find for service export and goods export. We conclude that there are some similarities as well as differences between the impact of ICT on goods trade and service trade with regard to our explanatory variables.

Keywords: Internet, information and communicative technologies (ICT); wired internet, fixed broadband, mobile phones, import, export, trade, service trade, goods trade, bilateral trade

1. Introduction

The privatization and deregulation of the internet began in the 1990s. Since then, ICT has become a key platform and driver for international trade in goods and services. The dramatic surge in the expansion of global trade would not have been made possible without the massive spread, accessibility and usage of Information and Communicative Technologies (ICT, hereinafter). ICT, undoubtedly, has given rise to the world economy as well as international trade in terms of goods and services through its rapid development, adoption and investment in technology by individuals, industries and nations. All these intertwining factors have led to the growth of internationalization across multi-avenues including that of international trade in goods and services. International trade in goods and services are transforming rapidly through many means and by various modes due to the influence of ICT. ICT has also helped shaped modern-day international trade including that of bilateral trade in goods and services. Traditionally influential factors of trade such as distance and common language are dwindling in their influence on modern-day international trade due to the applications of ICT including artificial intelligence. These new applications of ICT are shaping trade factors, in ways never ever thought possible over two decades ago. Thus, simultaneously and gradually, ICT-related costs such as search costs, subscription costs, transportation costs, communication costs, among others, have facilitated in reducing international trade barriers in goods and services worldwide across all different platforms.

The innovation and revolution of ICT continue to have incrementing impact to this day. In 1995, only 0.4% of the world population had internet access (Internet World Stats, 2019). The percentage of the world population that has access to the Internet as of June 2018 is at 55.1% (Internet World Stats, 2019). Fig. 1 shows the steady rise in the world population with internet access from 1993 to 2016.

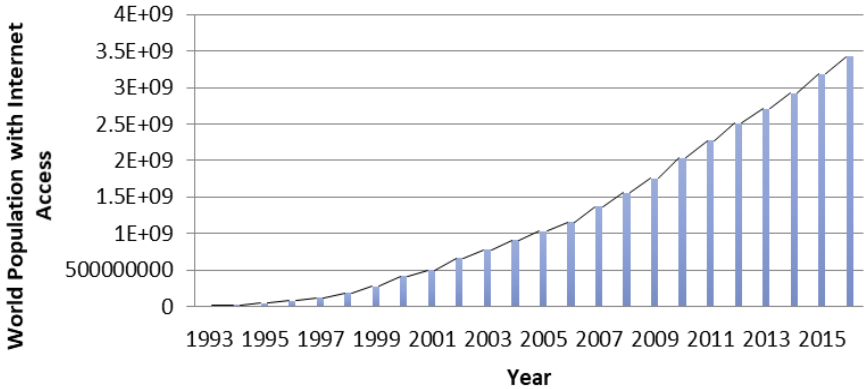

Fig. 1: World population with internet access, 1993-2016.
Source: Internet Live Stats, 1993-2016.

Fig. 2 shows the number of worldwide internet users in selected countries as of

June 2017. China was ranked first with over 738 million internet users, more than double the amount of third-ranked United States with 287 million internet users.

However, when we look at the percentage of population with internet subscriptions in these top three nations in 2017, the US has the highest penetration rate at 87.9%, with China holding second place at 53.2%, and India at 34.40% the third place (Internet World Stats, 2017). According to Meltzer (2013), the US has been, and remains, the focal point of the internet and the burgeoning area of internet policy. The US also captures the most value from the internet, receiving more than 30% of global internet revenues.

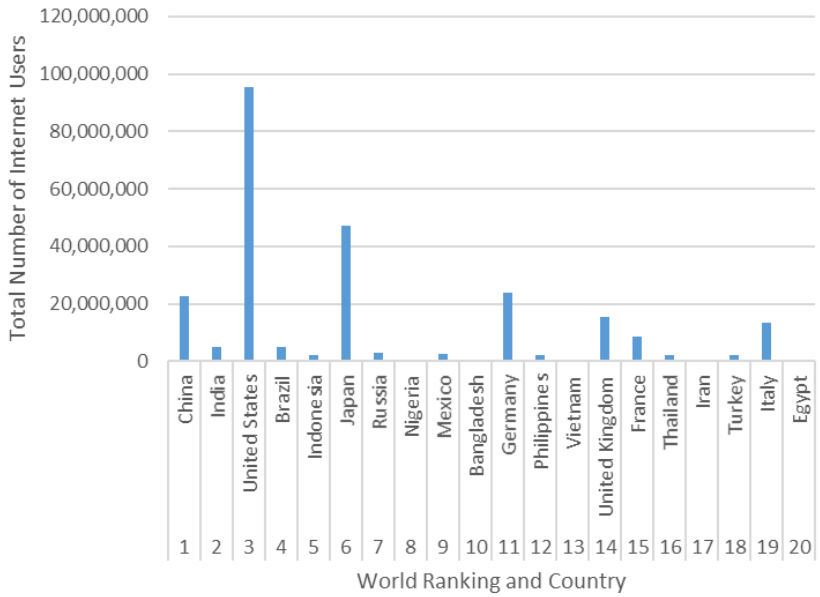

Fig. 2: Top 20 countries with the highest number of internet users, as of June 2017 (in millions), Statista (2017)

Fig. 3 illustrates the relationship between US Internet penetration rates, service trade and goods trade from 2000 to 2016. From 2000 to 2016, US Internet penetration rates increased by 135%, service trade increased by 180% and goods trade increased by 63%.

In this study, we test our hypotheses that (a) ICT enhances bilateral trade in goods and services at varying levels, dependent on the mode of ICT used, and (b) some traditional trade determinants such as common language and distance may have contradictory results from many existing international trade studies. Thus, this study attempts to make several contributions to the research stream investigating the impact of ICT on international trade. First, to the authors' knowledge, this is one of the first studies to (1) investigate the impact of ICT on bilateral trade in goods as well as services, and (2) compare the impact of ICT between bilateral trade in goods and services. An existing study by Tay (2015) investigates the impact of the internet on

trade in education (a form of service trade), whilst another study by Tay (2018) investigates the impact of ICT on bilateral trade in services. Thus, this study is an extension and improvement on the studies by Tay (2015) and Tay (2018) in that it investigates the impact of ICT on bilateral trade in goods as well as services, and compares the impact of ICT between bilateral trade in goods and services.

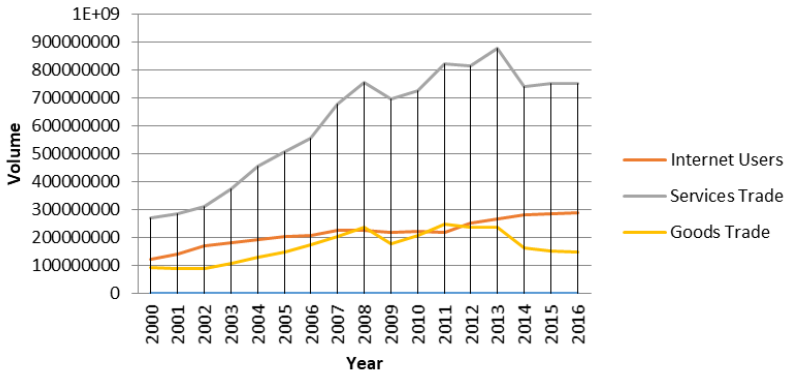

Fig. 3: US Internet Penetration, Service trade & Goods Trade, 2000 to 2016.
Source: US Census Bureau; Internet Live Stats.

Second, in contrary to existing studies by Daly & Miller (1998), Clarke (2002), Freund & Weinhold (2002;2004) and Clarke & Wallsten (2006); this study uses recent ICT data and more direct forms of ICT measurements instead of ICT proxies. Third, few studies include trade determinants in their literature on the impact of ICT on trade (Clarke & Wallsten, 2006; Vemuri & Siddiqi, 2009; Choi, 2010). Third, we posit that in contradictory to some existing international trade studies (Porojan, 2001; Linders & Groot, 2006; Lewer & Berg, 2007; Egger & Lassman, 2012; Tay, 2014), some of our trade determinants such as common language and distance may bear dissimilar results when we insert ICT determinants into our models due to the growing and significant impact of ICT on trade in goods and services today.

To investigate the impact of ICT on bilateral trade in goods and services, and compare the differences in the impact of ICT on bilateral trade in goods and services, we estimate using the Ordinary Least Squares and the Fixed Effects Model to test for the impact of ICT on bilateral trade in services and goods. Using data from the US and its 34 major trade partners from 2000 to 2016, we test using more four ICT measurements including (1) fixed telephone, (2) fixed broadband, (3) mobile-cellular phones, and (4) wired internet. In addition, we include four trade determinants commonly used international trade literatures in our study: (1) GDP per capita, (2) population, (3) common language, and (4) distance. We test our hypotheses using six variations of our estimation models: (1) sum of service exports and service imports, (2) service export, (3) service import, (4) sum of goods exports and goods imports, (5) goods export, and (6) goods import.

The rest of this paper is arranged as follows: Section 2 reviews related literature. Section 3 discusses the data and methodology, Section 4 presents the empirical results, and finally, Section 5 concludes.

2. Literature Review

In this section, we review literatures that examine two diverse strands of literature on trade. The first strand of literature examines the impact of ICT on trade in goods and services, whilst the second strand of literature examines international trade literature. The first strand of literature examining the impact of ICT on trade in goods and services began in the 1990s. Then, when internet usage and access was not as widespread as it is now, studies were mostly confined to using the survey technique on enterprises. For example, studies by Daly & Miller (1998) and Clarke (2002). Daly & Miller (1998) is one of the earliest studies to study the impact of ICT on trade in goods. Their 1998 study uses the survey technique to investigate use of the Internet by enterprises from 15 low- and middle- income countries. At the time of their study, when the Internet was still in its inaugural stages, many firms in developing countries use search engines to research market opportunities. One major conclusion is that such use is extensive, considering deficiencies in telephone networks in many countries and the relative newness of the technology. Only up to 44.8% (26 out of the 58 surveyed enterprises), reported using search engines to search for marketing and production information, with a greater number of enterprises using search engines to search for technical and computer information.

Another study that uses the survey technique using data from the 1990s, in particular, 1999, is a study by Clarke (2002). Clarke (2002) investigates the impact of the internet on export performance of enterprises in low- and middle-income economies in Eastern Europe and Central Asia. Clarke (2002) find that internet access has a significant effect on service enterprises as it does on industrial enterprises. They also find that service enterprises with Internet access export about 7.5% to 10% more of their than enterprises without Internet access; bearing similar results for industrial enterprises.

Freund & Weinhold (2002) investigate the impact of the internet on trade in services in the US. Using data from 1995 to 1999 and data on "Other Private Services" from 31 middle- and high-income countries and 14 industries. Although this significantly reduces concern about reverse causation, if enterprises' current internet use responds to their expectations about future export opportunities. They find that exports of services to the United States grew more quickly for countries with greater internet penetration.

A later study by Freund & Weinhold (2004) was a step up from previous studies by Daly & Miller (1998), Clarke (2002) and Freund & Weinhold (2002) in that it is,perhaps, the first to explore the impact of the internet on trade at a country level. Freund & Weinhold (2004) study the impact of the internet on trade in goods

consisting of 56 developed and middle -income countries from 1995 to 1999. Using data from the Internet Software Consortium (http://www.isc.org) on the number of web hosts attributed to each country and top-level domain names, either an ISO country code or one of the generic domains (com/org/net/etc.). They find that a 10%-point increase in the growth of web hosts in a country leads to about a 0.2%- point increase in export growth. In addition, they also find that trade growth is lower for more distant countries.

Clarke & Wallsten (2006) is perhaps one of the first studies to use data from the early 2000s, in particular, 2001, to study the link between Internet penetration and exports from a country. They employ per capita internet users as a measure of internet penetration. In their formulation, exports from a country depend on the internet penetration of that country alone, and not on that of its importing partners. To control for endogeneity, they use a country's regulation of data services as an instrument for internet usage. They find that exports from poor countries to rich countries are positively related with the level of internet usage.

Vemuri & Siddiqi (2009) uses an instrumental variable approach of Hausman & Taylor and other panel data methods to test their proposition that information and communication technology (ICT) and the Internet have enhanced international trade. Using data from 1985 to 2005 for 64 countries their study finds that ICT infrastructure and the availability of the Internet for commercial transactions have a positive and significant effect on the volume of international trade.

Choi (2010) tests whether an increase in the internet increases service trade using panel data for 151 countries from 1990 to 2006 using the gravity model. Unlike the traditional gravity Eq. model, the distance variable is omitted and they use service trade as their dependent variable. Only one internet variable is included, that is, internet users per hundred people. Choi (2010) finds that doubling of internet usage in a country turned out to lead to a 2 to 4% increase in service trade. In addition, an increase in a country's Internet access will facilitate an increase in its service trade with other countries.

Tay (2015) conducts a study on how the internet impacts trade in services, focusing on trade in education. Tay (2015) divided their data into three time frames

– 2000 to 2006, 2007 to 2012 and 2000 to 2012 using data from 189 countries. Tay (2015) finds that the internet facilitates trade in education. The impact of the internet is between 16% and 21% for every 0.01% increase in Internet access. They also find that the larger countries and countries that share a common language show a highly significant impact of the internet on trade in education for all three time frames. However, economic health of a country does not increase trade volume. Tay (2015) also finds mixed results for fixed broadband over the three time frames. The results explain between 63.2% and 74.9% of the impact of the internet on trade in education. Finally, the results of this study strongly suggest that improving Internet access in a country will stimulate trade in education.

More recently, Tay (2018) examines the impact of information and communication technologies on bilateral trade in services. They find that trade determinants such as GDP, population and common language have significant impacts for all three variations of service trade. Distance shows mixed results. They also find that ICT determinants such as fixed broadband and fixed telephone have significant impacts on service trade, service export and service import. Mobile- cellular phone is insignificant for all three variations of service trade. Finally, they also find that the internet is significant for service trade and service export, but not service import.

Upon review of existing literatures, we find that studies by Daly & Miller (1998) and Clarke (2002) are confined to an enterprise level and uses survey techniques to gather ICT data. Later studies by Freund & Weinhold (2002) and Freund & Weinhold (2004) pushes the level of their studies to a country level, focusing on trade in services and goods. However, data used was back in the late 1990s, upon the first few years of inauguration of the internet. Clarke & Wallsten (2006) uses data from 2001 and employs per capita internet users as a measure of internet penetration. Vemuri & Siddiqi (2009) improves upon earlier studies by using a number of ICT variables including number of telephones (land lines and cellular), number of Internet hosts, number of PCs, price and waiting list for telephone services, monopolies in ISPs, and leased lines and data lines (dummy variables) as measures of ICT infrastructure. Data used is from 1985 to 2005 for 64 countries. The study by Choi (2010) only includes one internet variable and excludes distance, an international trade determinant from their panel model to test for the impact of the internet on service trade. Although the study by Tay (2015) is on trade in services, but it is narrowly confined to trade in education. Thus, a limitation of the study by Tay (2015) is that it may not be able to represent the impact of ICT on trade in services, in general. Tay (2018) improves upon the study by Tay (2015) by focusing on the impact of ICT on specifically trade in services.

We examine a second strand of literature on international trade. This strand of literature normally includes various trade determinants in their investigation on trade and employs a widely model of international trade – the gravity model. The gravity model is able to explain more than 70% of the cross-variation in world trade volume. Many trade determinants such as GDP per capita, population, distance, common language, common religion, amongst others are included in international trade models.

Porojon (2001) is one study that revisits the popular gravity model of trade in the light of the increasingly acknowledged findings of spatial econometrics to predict trade flows between the EU and some of its potential members. For the purpose of comparative analysis Porojon (2001) uses a model trade flows as a function of income per capita (GDP) in the trading partner countries and the distance, the former and latter of which are two common trade determinants used in trade studies. In this study, they estimate the model for both exports and imports using a sample consisting 15

EU member states and 7 OECD countries using data from 1995. They find that the distance variable and GDP per capita income of the exporting / importing country remain statistically significant.

Linders & Groot (2006) also use the gravity model to describe and explain variation in bilateral trade patterns. Their study examines zero-valued bilateral trade flows that is caused by trade records that are between small and distant countries, which are expected to trade very little. Their hypothesis is that disregarding zero flows can result in biased results in empirical results, if they do not occur randomly given that if geographic distance, low levels of national income, and a lack of cultural of historical links may reduce trade. This paper, therefore, approaches trade studies by using various approaches to deal with zero trade flows. Trade determinants such GDP, common language, common border are included in the model specification. They find that trade increases with GDP and decreases with physical distance. Common language, common border, and trade agreement, as proxies for proximity, positively affect trade.

Lewer & Berg (2007) expands on the gravity model to examine how religion affects international trade. Using scaled OLS and nonlinear least squares, they examine whether the sharing of religious cultures enables the formation of exchange networks can help overcome the failure or nonexistence of other social and economic institutions necessary for completing complex international transactions. In their model, they use trade determinants such as GDP per capita, population, distance, common language and contiguous border.

The results of this study is that all variables are significant at the 95% level. Results also confirm that trade increases with the GDPs of the trading economies, trade declines with larger populations; larger populations permit countries to engage in more specialization and exchange within their borders. In addition, trade declines as the distance between countries increases.

Egger & Lassman (2012) uses the gravity models of international trade to estimate the impact of common (official or spoken) language on bilateral trade. This study provides a meta-analysis based on 701 language effects collected from 81 academic articles. On average, a common (official or spoken) language increases trade flows directly by 44%. This study also finds a large variance of the direct semi-elasticity of trade to common language and argues that the unexplained part of that variance is due to measurement error.

Tay (2014), a recent study that uses an augmented gravity model to estimatetrade in education. This study uses a panel data analysis method on 21 exporting countries and 50 importing countries, covering 1050 observations using new UNESCO database. A number of determinants of international trade including wealth of exporter & importer, domestic capacity of exporter & importer, transport costs, common religion, common language and trade restrictiveness of the importer are empirically tested on bilateral trade flows in education. This paper borrows some of

the same assumptions on market structures usually made for services and international trade to show that the international trade theories can help explain the pattern of trade in education, a form of service trade. Tay (2014) finds that traditional measures of bilateral trade such as population, Gross Domestic Product, common borders, common language and trade restrictiveness of the importer are highly significant to trade in education. Their augmented gravity model is also able to explain most of the determinants of trade in education, with the exceptions of trade restrictions of the exporter and distance.

Upon review of the two aforementioned diverging strands of literature, we find several gaps and intend to bridge the gaps in existing studies in several ways. First, this study investigates the impact of ICT on both bilateral trade in goods and services instead of just focusing on either goods trade or service trade. Second, it also compares the impact of ICT on both bilateral trade in goods and services. Third, it uses a varied number of ICT measurements including (1) fixed telephone, (2) fixed broadband, (3) mobile-cellular phones, and (4) wired internet. Finally, it includes four trade determinants commonly used international trade literatures including (1) GDP per capita, (2) population, (3) common language, and (4) distance.

3. Data and Methodology

3.1. Data

The data for this study is obtained for the period 2000 to 2016 from several archival sources. Data on ICT is obtained from International Telecommunication Union (ITU, hereinafter). ITU is one of the United Nation's groups with the most reliable source of data for the information and communications technology sector. The ITU develops a composite index to monitor and compare development of ICT across countries called the ICT Development Index (IDI), reflecting the level of ICT readiness, ICT intensity and ICT skills in a respective country. Indicators of ICT readiness include fixed-telephone line penetration, mobile-cellular telephone subscriptions, international internet bandwidth (bit/s) per internet user, the percentage of households with a computer and percentage of households with internet access. ICT intensity indicators include percentage of individuals using the internet and fixed broadband subscribers per 100 inhabitants. For purposes of this study, data provided by ITU from 2000 to 2016 are used to measure the indices for the internet (Internet World Stats, 2000-2016).

We use, as the dependent variable, the bilateral service/goods exports and imports drawn from the recently published US Bureau on Economic Analysis statistics on international trade in services and goods (US BEA, 2000-2016). The US BEA data comprise of service/goods trade, service/goods export, and service/goods import between the US. A list of the 34 partnering countries is illustrated in Appendix A.

Data on trade in services is measured using US international services which consists of services provided by and to the US in international markets through all

four modes of supply of services: (1) cross-border supply, (2) consumption abroad, commercial presence, and (4) presence of natural persons. International services statistics include detailed annual information on trade in services, which is trade in the conventional sense, and on services supplied through the channel of direct investment by affiliates of multinational enterprises.

Data on trade in services includes nine categories: maintenance and repair services; transport; travel (for all purposes including education); insurance services; financial services; charges for the use of intellectual property; telecommunications, computer, and information services; other business services; and government goods and services. The trade statistics cover both affiliated and unaffiliated transactions between U.S. residents and foreign residents. Affiliated transactions consist of intra- firm trade within multinational enterprises – trade between U.S. parent companies and their foreign affiliates and trade between U.S. affiliates and their foreign parent groups. Unaffiliated transactions are with foreigners that neither own, nor are owned by, the U.S. party to the transaction.

Data on trade in goods are compiled from the documents collected by the U.S. Customs and Border Protection and reflect the movement of goods between foreign countries and the 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and U.S. Foreign Trade Zones. They include government and non-government shipments of goods, and exclude shipments between the United States and its territories and possessions, transactions with U.S. military, diplomatic and consular installations abroad, U.S. goods returned to the United States by its Armed Forces, personal and household effects of travelers, and in-transit shipments. The General Imports value reflects the total arrival of merchandise from foreign countries that immediately enters consumption channels, warehouses, or Foreign Trade Zones. Imports for Consumption measure the total of merchandise that has physically cleared through Customs either entering consumption channels immediately or entering after withdrawal for consumption from bonded warehouses under Customs custody or from Foreign Trade Zones. For imports, the value reported is the U.S. Customs and Border Protection appraised value of merchandise; generally, the price paid for merchandise for export to the United States. Import duties, freight, insurance, and other charges incurred in bringing merchandise to the United States are excluded. Exports are valued at the free alongside ship value of merchandise at the U.S. port of export, based on the transaction price including inland freight, insurance and other charges incurred in placing the merchandise alongside the carrier at the U.S. port of exportation.

Data on the gross domestic product (GDP per capita, in US dollars) and population are obtained from the International Monetary Fund (IMF, 2000-2016). Information on common language is obtained from the US Central Intelligence Agency (2000-2016). Geographical distance between partnering countries are calculated using Mapcrow (Mapcrow Travel Distance Calculator, 2000-2016).

3.2. ICT Explanatory Determinants

Dramatic decreases in communication costs have been the driving forces behind today's global trading system. Therefore, we choose four ICT variables to represent communication measurements including (1) fixed telephone (FTujt), (2) fixed broadband (FBujt), (3) mobile-cellular phones (MBujt), and (4) wired internet (INTujt). The subscript, u, represents the United States; the subscript, j, represents a US trading partner; and the subscript, t, represents year, where t = 2000…2016.

Our first ICT determinant, fixed-telephone line (FTujt) refers to fixed telephone lines that connect a subscriber's terminal equipment to the public switched telephone network and that have a port on a telephone exchange. Goods trade has had a longer trade history than service trade.

Our second ICT determinant, fixed broadband internet (FBujt) refers to the number of broadband subscribers with a digital subscriber line, cable modem, or other high-speed technology. We expect the cost of connecting additional users to the communication means to differ across these variables due to the age of use of each type of ICT technology.

For fixed-telephone line (FTujt) and fixed broadband internet (FBujt), we expect that when long-run marginal costs are above long-run average costs, average costs rise as well. This would consequently decrease these forms of ICT adoptions in a country. Thus, we expect there to be positive correlations between fixed- telephone line (FTujt) & fixed broadband (FBujt) and bilateral trade in goods and services.

Mobile-cellular telephone (MBujt) are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Wired internet access (INTujt) refers to the percentage of population who used the internet (from any location) in the last 12 months. What we infer here is that the internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV.

As for mobile-cellular telephone, due to the rise in the popularity of the usage of mobile-cellular telephones worldwide, its convenience of being wireless, we expect that the impact of mobile-cellular telephone on bilateral trade in goods and services to be highly significant.

As for wired internet (INTujt), we expect that because its accessibility and convenience is largely confined to a specific subscription location, that its impact on bilateral trade in goods and services to be less significant than mobile-cellular telephone (MBujt), and we expect results to be mixed across the six variations of our models.

For mobile-cellular telephone subscriptions (MBujt), we expect that when long-run marginal costs are above long-run average costs, average costs decrease. This would consequently increase this form of ICT adoption in a country. Thus, we expect there to be negative correlation between mobile-cellular telephone (MBujt) and

bilateral trade in goods and services.

For wired internet access (INTujt), we expect that when long-run marginal costs are above long-run average costs, average costs will decrease for service trade. This would consequently increase this form of ICT adoption in a country. Thus, we expect there to be negative correlation between (INTujt) and that of bilateral trade in services.

On the other hand, for the expected correlation between wired internet access (INTujt) and bilateral trade in goods, we expect that when long-run marginal costs are above long-run average costs, average costs will increase for goods trade. This would consequently decrease this form of ICT adoption in a country. Thus, we expect there to be positive correlation between (INTujt) wired internet and bilateral trade in goods.

3.3. Trade Explanatory Determinants

Four commonly used trade determinants in goods trade and service trade literatures are chosen in our study: (1) GDP per capita, (2) population, (3) common language, and (4) distance (Porojan, 2001; Linders & Groot, 2006; Lewer & Berg, 2007; Egger & Lassman, 2012; Tay, 2014).We expect that when the GDP per capita of a country in relation to country size or market size to be large, that there be greater potential for that country to trade with a partnering country. In addition, that the higher level of income in that country, the higher the tendency to adopt ICT technologies, which in turn, increases the bilateral trade in services or goods.

As for our second trade determinant, population, we expect that the higher the population of trading country, the greater the percentage of its population to adopt ICT technologies. This also implies a greater market size and potential in that trading country which, in turn, increases trade potential in services or goods.

As for our third trade determinant, common language, we expect that if a country has a common language with a partnering country, the greater the potential to trade. Thus, if a partnering country has a common language such as English or Spanish, the greater its likelihood to trade with the United States. In this case, a value of 1 is assigned, which otherwise, would assume a value of 0. The existence of a common language between the US and a partnering country is much likely to lower search and communication costs and hence, boost trade. In order to incorporate such a linguistic tie, we include a dummy variable for the countries which use the same language. However, due to the emergence of ICT and other online translation tools, we expect the impact of a common language to be less important than those in existing studies.

Finally, our fourth trade determinant is distance. Traditionally, trade models not only use distance to model trade costs in terms of transport costs (Bouheas et al., 1999), but also, public infrastructure (Zarzoz & Lehmann, 2003). Our fourth trade determinant, logDISTuj, refers to the log of physical distance of country, u from country, j. We expect mixed results for our distance variable as ICT may have changed the face of trade, especially service trade. In terms of service export, we

expect distance to have no direct correlation to ICT, as the US is a developed country with high usage of ICT. On the other hand, we expect distance to still hold high positive correlation to ICT and service import as partnering countries may not necessarily have relative high levels of ICT usage. Similar to common language, we expect that due to the emergence of ICT, the internet may have reduced the need for face-to-face communication, costs of physical distance for service trade as well as goods trade, although we expect the impact to be greater for service trade than goods trade.

3.4. Methodology

This section empirically tests the impact of ICT on bilateral service trade and goods trade. We posit that there is a correlation between international trade in services and goods, arguing that ICT can provide new communication channels, and through time, as communication costs decrease, this would, in turn, lead to an even greater improved trading stimulus for trade. The following sections are our estimation models using the Ordinary Least Squares (OLS) and the Fixed Effects Model (FEM) for bilateral trade in services and bilateral trade in goods.

Ordinary Least Squares Method (OLS) – Bilateral Trade in Services

We use the Ordinary Least Squares method (OLS) to estimate the impact of ICT on service trade in three variations. The first variation for our Ordinary Least Squares model is where our dependent variable is the sum of service export and service import.

Eq. (1) shows the first variation, where $\log X1_{u\leftrightarrow j,t}$ is the sum of service export and service import from/to country, u, to/from country, j, and time, t = 2000…2016.

$$\log X1_{u\leftrightarrow j,t} = \sum_{j=1}^{34}\left(\mathrm{s\dot{E}}_{u\rightarrow j,t} + \mathrm{s\bar{I}}_{j\rightarrow u,t}\right) \quad (1)$$

$\sum_{j=1}^{34}\left(\mathrm{s\dot{E}}_{u\rightarrow j,t} + \mathrm{s\bar{I}}_{j\rightarrow u,t}\right)$ is the sum of service export and service import from/to country, u, to/from country j, at time, t. The total number of countries is where j=1…34.

Eq. (2) shows the second variation, where $\log X2_{u\rightarrow j,t}$ is the service export from country, u to country, j, and, time, t = 2000…2016.

$$\log X2_{u\rightarrow j,t} = \sum_{j=1}^{34}\mathrm{s\dot{E}}_{u\rightarrow j,t} \quad (2)$$

$\sum_{j=1}^{34}\mathrm{s\dot{E}}_{u\rightarrow j,t}$ is service export from country, u, to country j, at time, t. The total number of countries is where, j=1…34.

Eq. (3) shows the third variation, where $\log X3_{j\leftarrow u,t}$ is the service import from

$$\log X3_{j\rightarrow u,t} = \sum_{j=1}^{34}\mathrm{s\bar{I}}_{j\rightarrow u,t} \quad (3)$$

country, j to country, u, and, time, t = 2000…2016. The total number of countries is where, j=1…34.

Where, $s\bar{I}_{j\to u,t}$ is the logarithm used to represent service import from country, j to country, u, in time, t.

We formulate three separate equations for our Ordinary Least Squares Method (OLS) that take into account the three variations of bilateral trade in services: Eq. (4) – service trade (sum of service export and service import); Eq. (5) – service export; and Eq. (6) – service import. To estimate the impact of ICT on bilateral trade in services using OLS regression, a total of four ICT variables: (1) fixed broadband subscriptions (FBujt), (2) wired internet subscriptions (INTujt), (3) mobile phones subscriptions (MBujt), and (4) fixed telephone (FTujt) are included on the right hand side of equations (4) ~ (6). Other control variables and country fixed effects including GDP per capita (GDPujt), population (POPujt), common language (CLuj) and distance (DISTuj) along with country fixed effects as our control variables.

Here, the subscript u represents United States, subscript j represents the trading partner, and subscript t represents year, where t = 2000…2016. The three-dimension panel structure of the data represents errors for country fixed effects for country, u, (γu), partnering country, j, (γj), time-specific effects (γt) and random disturbance effects (uuit).

Eq. (4) estimates the impact of ICT on the sum of service export and service import as follows:

$$\sum_{j=1}^{34}(s\dot{E}_{u\to j,t} + s\bar{I}_{j\to u,t}) = ß\,0 + ß\,1\log FB_{ujt} + ß2\log INT_{ujt} + ß3\log MB_{ujt} + ß\,4\log FT_{ujt} + ß5\log GDP_{ujt} + ß6\log POP_{ujt} + ß7\log CL_{uj} + ß8\log DIST_{uj} + \gamma_u + \gamma_j + \gamma_t + u_{ujt} \quad (4)$$

Where, $\sum_{j=1}^{34}(s\dot{E}_{u\to j,t} + s\bar{I}_{j\to u,t})$ is the logarithm used to represent the sum of service import and service export from/to country, u to/from country, j where, t = 2000…2016.

Eq. (5) estimates the impact of ICT on service export as follows:

$$\sum_{j=1}^{34} s\dot{E}_{u\to j,t} = ß\,0 + ß\,1\log FB_{ujt} + ß2\log INT_{ujt} + ß3\log MB_{ujt} + ß\,4\log FT_{ujt} + ß5\log GDP_{ujt} + ß6\log POP_{ujt} + ß7\log CL_{uj} + ß8\log DIST_{uj} + \gamma_u + \gamma_j + \gamma_t + u_{ujt} \quad (5)$$

Where, $\sum_{j=1}^{34} sE_{u\to j,t}$ is the logarithm used to represent service export from/to country, u to/from country, j in time, where, t = 2000...2016.

Eq. (6) estimates the impact of ICT on service import as follows:

$$\sum_{j=1}^{34} s\bar{I}_{j\rightarrow u,t} = ß0 + ß1\log FB_{ujt} + ß2\,\log INT_{ujt} + ß3\log MB_{ujt} + ß4\,\log FT_{ujt} + ß5\log GDP_{ujt} + ß6\log POP_{ujt} + ß7\log CL_{uj} + ß8\log DIST_{uj} + \gamma_u + \gamma_j + \gamma_t + u_{ujt} \quad (6)$$

Where, $\sum_{j=1}^{34} s\bar{I}_{j\rightarrow u,t}$ is the logarithm used to represent service import from/to country, j to/from country, u, where, t = 2000…2016.

Ordinary Least Squares Method (OLS) – Bilateral Trade in Goods

In this section, we use the Ordinary Least Squares method (OLS) to estimate the impact of ICT on goods trade in three variations. The first variation for our Ordinary Least Squares model is where our dependent variable is the sum of goods export and goods import. Eq. (7) shows the first variation, where $\log Y1_{u\leftrightarrow j,t}$ is the sum of goods export and goods import from/to country, u, to/from country, j, and time, t = 2000…2016.

$$\log Y1_{u\leftrightarrow j,t} = \sum_{j=1}^{34}\left(\Psi\dot{E}_{u\rightarrow j,t} + \Psi\bar{I}_{j\rightarrow u,t}\right) \quad (7)$$

$\sum_{j=1}^{34}\left(\Psi\dot{E}_{u\rightarrow j,t} + \Psi_{j\rightarrow u,t}\right)$ is the sum of goods export and goods import from/to country, u, to/from country j, at time, t. The total number of countries is where j=1…34.

Eq. (8) shows the second variation, where $\log Y2_{u\rightarrow j,t}$ is the goods export from country, u to country, j, and, time, t = 2000…2016.

$$\log Y2_{u\rightarrow j,t} = \sum_{j=1}^{34} \Psi\dot{E}_{u\rightarrow j,t} \quad (8)$$

$\sum_{j=1}^{34} \Psi\dot{E}_{u\rightarrow j,t}$ is goods export from country, u, to country j, at time, t. The total number of countries is where, j=1…34.

Eq. (9) shows the third variation, where $\log Y3_{j\leftrightarrow u,t}$ is goods import from country, j to country, u, and, time, t = 2000…2016. The total number of countries is where, j=1…34.

$$\log Y3_{j\rightarrow u,t} = \sum_{j=1}^{34} \Psi\bar{I}_{j\rightarrow u,t} \quad (9)$$

Where, $\sum_{j=1}^{34} \Psi\bar{I}_{j\rightarrow u,t}$ the logarithm used to represent goods import from country, j to country, u, in time, t.

We formulate three separate equations for our Ordinary Least Squares Method (OLS) that take into account the three variations of bilateral trade in goods: Eq. (10) – goods trade (sum of goods export and goods import); Eq. (11) – goods export; and Eq. (12) – goods import. To estimate the impact of ICT on bilateral trade in goods

using OLS regression, a total of four ICT variables: (1) fixed broadband subscriptions (FBujt), (2) wired internet subscriptions (INTujt), (3) mobile phones subscriptions (MBujt), and (4) fixed telephone (FTujt) are included on the right hand side of equations (4) ~ (6). Other control variables and country fixed effects include GDP per capita (GDPujt), population (POPujt), common language (CLuj) and distance (DISTuj).

Here, the subscript u represents United States, subscript w represents the trading partner, and subscript t represents year, where t = 2000…2016. The three-dimension panel structure of the data represents errors for country, u, (ặu), partnering country, j (ặj), time-specific effects (ặt), and éujt, random disturbance variable.

Eq. (10) estimates the impact of ICT on the sum of goods export and goods import as follows:

$$\sum_{j=1}^{34}\left(\Psi\dot{E}_{u\to j,t} + \Psi\bar{I}_{j\to u,t}\right) = ₡0 + ₡1\log FBujt + ₡2\ logINTujt + ₡3logMBujt + ₡4\ logFTujt + ₡5logGDPujt + ₡6logPOPujt + ₡7logCLuj + ₡8logDISTuj + ặu + ặj + ặt + éujt \quad (10)$$

Where, $\sum_{j=1}^{34}\left(\Psi\dot{E}_{u\to j,t} + \Psi\bar{I}_{j\to u,t}\right)$ is the logarithm used to represent the sum of goods import and goods export from/to country, u to/from country, j where, t = 2000…2016.

Eq. (11) estimates the impact of ICT on goods export as follows:

$$\sum_{j=1}^{34}\Psi\dot{E}_{u\to j,t} = ₡0 + ₡1\log FB_{ujt} + ₡2\ logINT_{ujt} + ₡3logMB_{ujt} + ₡4logFT_{ujt} + ₡5logGDP_{ujt} + ₡6logPOP_{ujt} + ₡7logCL_{uj} + ₡8logDIST_{uj} + ặ_u + ặ_j + ặ_t + é_{ujt} \quad (11)$$

Where, $\sum_{j=1}^{34}\Psi\dot{E}_{u\to j,t}$ is the logarithm used to represent goods export from country, u to country, j in time, where, t = 2000...2016.

Eq. (12) estimates the impact of ICT on goods import as follows:

$$\sum_{j=1}^{34}\Psi\bar{I}_{j\to u,t} = ₡0 + ₡1\log FB_{ujt} + ₡2\ logINT_{ujt} + ₡3logMB_{ujt} + ₡4\ logFT_{ujt} + ₡5logGDP_{ujt} + ₡6logPOP_{ujt} + ₡7logCL_{uj} + ₡8logDIST_{uj} + ặ_u + ặ_j + ặ_t + é_{ujt} \quad (12)$$

Where, $\sum_{j=1}^{34}\Psi\bar{I}_{j\to u,t}$ is the logarithm used to represent goods import from country, j to country, u, where, t = 2000…2016.

Fixed Effects Model – Bilateral Trade in Services

We use the Fixed Effects Model (FEM) to estimate the impact of ICT on service trade in three variations. The first variation for our Fixed Effects Model is where our dependent variable is the sum of service export and service import.

Eq. (13) shows the first variation, where $\log A1_{u\leftrightarrow j,t}$ is the sum of service export and service import from/to country, u, to/from country, j, and time, t = 2000…2016.

$$\log A1_{u\leftrightarrow j,t} = \sum_{j=1}^{34}\left(\text{ÿ}\dot{E}_{u\to j,t} + \eth\bar{I}_{j\to u,t}\right) \quad (13)$$

$\sum_{j=1}^{34}\left(\text{ÿ}\dot{E}_{u\to j,t} + \eth\bar{I}_{j\to u,t}\right)$ is the sum of service export and service import from/to country, u, to/from country, j, at time, t. The total number of countries is where j=1…34.

Eq. (14) shows the second variation, where $\log A2_{u\leftrightarrow j,t}$ is the service export from country, u to country, j, and, time, t = 2000…2016.

$$\log A2_{u\leftrightarrow j,t} = \sum_{j=1}^{34}\left(\text{ÿ}\dot{E}_{u\to j,t}\right) \quad (14)$$

$\sum_{j=1}^{34}\left(\text{ÿ}\dot{E}_{u\to j,t}\right)$ is the service export from country, u, to country, j, at time, t. The total number of countries is where, j=1…34.

Eq. (15) shows the third variation, where $\log A3_{u\leftrightarrow j,t}$ is the service import from country, j to country, u, and, time, t = 2000…2016. The total number of countries is where, j=1…34.

$$\log A3_{u\leftrightarrow j,t} = \sum_{j=1}^{34}\left(\eth\bar{I}_{j\to u,t}\right) \quad (15)$$

Where, $\sum_{j=1}^{34}\left(\eth\bar{I}_{j\to u,t}\right)$ is the logarithm used to represent service import from country, j to country, u, in time, t.

We formulate three separate equations for our Fixed Effects Model (FEM) that take into account the three variations of bilateral trade in services: Eq. (16) — service trade (sum of service export and service import); Eq. (17) — service export; and Eq. (18) — service import. To estimate the impact of ICT on bilateral trade in services using FEM regression, a total of four ICT variables: (1) fixed broadband subscriptions (FBujt), (2) wired internet subscriptions (INTujt), (3) mobile phones subscriptions (MBujt), and (4) fixed telephone (FTujt) are included on the right hand side of equations (16) ~ (18). Other control variables include GDP per capita (GDPujt) and population (POPujt).

Here, the subscript u represents United States, subscript j represents the trading partner, and subscript t represents year, where t = 2000…2016. The three-dimension panel structure of the data represents errors for country, u, (su), partnering country, j (sj), time-specific effects (st) and ȝujt is a random disturbance variable.

Eq. (16) estimates the impact of ICT on the sum of service export and service import as follows:

$$\sum_{j=1}^{34}\left(\text{ÿ}\dot{E}_{u\to j,t} + \eth\bar{I}_{j\to u,t}\right) = ß0 + ß1\log FB_{ujt} + ß2\log INT_{ujt} + ß3\log MB_{ujt} + 4\log FT_{ujt}$$

ß

$$+ ß5\log GDP_{ujt} + ß6\log POP_{ujt} + \S_u + \S_j + \S_t + \mathfrak{Z}_{ujt} \quad (16)$$

Where, $\sum_{j=1}^{34}(\gamma\dot{E}_{u\to j,t} + \eth\bar{I}_{j\to u,t})$ is the logarithm used to represent the sum of service import and service export from/to country, u to/from country, j where, t = 2000…2016.

Eq. (17) estimates the impact of ICT on service export as follows:

$$\sum_{j=1}^{34}(\gamma\dot{E}_{u\to j,t}) = ß0 + ß1\log FB_{ujt} + ß2\log INT_{ujt} + ß3\log MB_{ujt} + 4\log FT_{ujt} + ß5\log GDP_{ujt} + ß6\log POP_{ujt} + \S_u + \S_j + \S_t + \mathfrak{Z}_{ujt} \quad (17)$$

Where, $\sum_{j=1}^{34}(\eth\bar{I}_{j\to u,t})$ is the logarithm used to represent service export from/to country, u to/from country, j in time, where, t = 2000...2016.

Eq. (18) estimates the impact of ICT on service import as follows:

$$\sum_{j=1}^{34}(\eth\bar{I}_{j\to u,t}) = ß0 + ß1\log FB_{ujt} + ß2\log INT_{ujt} + ß3\log MB_{ujt} + 4\log FT_{ujt} + ß5\log GDP_{ujt} + ß6\log POP_{ujt} + \S_u + \S_j + \S_t + \mathfrak{Z}_{ujt} \quad (18)$$

Where, $\sum_{j=1}^{34}(\eth\bar{I}_{j\to u,t})$ is the logarithm used to represent service import from/to country, j to/from country, u, where, t = 2000…2016

Fixed Effects Model – Bilateral Trade in Goods

We use the Fixed Effects Model (FEM) to estimate the impact of ICT on goods trade in three variations. The first variation for our Fixed Effects Model is where our dependent variable is the sum of goods export and goods import.

Eq. (19) shows the first variation, where $\log V1_{u\leftrightarrow j,t}$ is the sum of goods export and goods import from/to country, u, to/from country, j, and time, t = 2000…2016.

$$\log V1_{u\leftrightarrow j,t} = \sum_{j=1}^{34}(\dot{E}_{u\to j,t} + \bar{I}_{j\to u,t}) \quad (19)$$

$\sum_{j=1}^{34}(\dot{E}_{u\to j,t} + \bar{I}_{j\to u,t})$ is the sum of goods export and goods import from/to country, u, to/from country, j, at time, t. The total number of countries is where j=1…34.

Eq. (20) shows the second variation, where $\log V2_{u\leftrightarrow j,t}$ is the goods export from country, u to country, j, and, time, t = 2000…2016.

$$\log V2_{u\leftrightarrow j,t} = \sum_{j=1}^{34}(\dot{E}_{u\to j,t}) \quad (20)$$

$\sum_{j=1}^{34}(\dot{E}_{u\to j,t})$ is the goods export from country, u, to country, j, at time, t.

The total number of countries is where, j=1…34.

Eq. (21) shows the third variation, where $\log V3_{u\leftrightarrow j,t}$ is the goods import from country, j to country, u, and, time, t = 2000…2016. The total number of countries is where, j=1…34.

$$\log V3_{u\leftrightarrow j,t} = \sum_{j=1}^{34}(\text{ẞĪ}_{j\rightarrow u,t}) \quad (21)$$

Where, $\sum_{j=1}^{34}(\text{ẞĪ}_{j\rightarrow u,t})$ is the logarithm used to represent goods import from country, j to country, u, in time, t.

We formulate three separate equations for our Fixed Effects Model (FEM) that take into account the three variations of bilateral trade in goods: Eq. (22) – goods trade (sum of goods export and goods import); Eq. (23) – goods export; and Eq. (24) – goods import. To estimate the impact of ICT on bilateral trade in goods using FEM regression, a total of four ICT variables: (1) fixed broadband subscriptions (FBujt), (2) wired internet subscriptions (INTujt), (3) mobile phones subscriptions (MBujt), and (4) fixed telephone (FTujt) are included on the right hand side of equations (22) ~ (24). Other control variables include GDP per capita (GDPujt) and population (POPujt).

Here, the subscript u represents United States, subscript j represents the trading partner, and subscript t represents year, where t = 2000…2016. The three-dimension panel structure of the data represents errors for country, u, (πu), partnering country, j (πj), time-specific effects (πt) and πujt is a random disturbance variable.

Eq. (22) estimates the impact of ICT on the sum of goods export and goods import as follows:

$$\sum_{j=1}^{34}(\text{ꞁĖ}_{u\rightarrow j,t} + \text{ẞĪ}_{j\rightarrow u,t}) = \text{₡}0 + \text{₡}1\log FB_{ujt} + \text{₡}2\log INT_{ujt} + \text{₡}3\log MB_{ujt} + \text{₡}4\log FT_{ujt} + \text{₡}5\log GDP_{ujt} + \text{₡}6\log POP_{ujt} + \pi_u + \pi_j + \pi_t + \pi_{ujt} \quad (22)$$

Where, $\sum_{j=1}^{34}(\text{ꞁĖ}_{u\rightarrow j,t} + \text{ẞĪ}_{j\rightarrow u,t})$ is the logarithm used to represent the sum of goods import and goods export from/to country, u to/from country, j where, t = 2000…2016.

Eq. (23) estimates the impact of ICT on goods export as follows:

$$\sum_{j=1}^{34}(\text{ꞁĖ}_{u\rightarrow j,t}) = \text{₡}0 + \text{₡}1\log FB_{ujt} + \text{₡}2\log INT_{ujt} + \text{₡}3\log MB_{ujt} + \text{₡}4\log FT_{ujt} + \text{₡}5\log GDP_{ujt} + \text{₡}6\log POP_{ujt} + \pi_u + \pi_j + \pi_t + \pi_{ujt} \quad (23)$$

Where, $\sum_{j=1}^{34}(\text{ꞁĖ}_{u\rightarrow j,t})$ is the logarithm used to represent goods export from/to country, u to/from country, j in time, where, t = 2000...2016.

Eq. (24) estimates the impact of ICT on goods import as follows:

$$\sum_{j=1}^{34}(\text{ẞĪ}_{j\rightarrow u,t}) = \text{₡}0 + \text{₡}1\log FBujt + \text{₡}2\log INTujt + \text{₡}3\log MBujt + \text{₡}4\log FTujt +$$

$$\mathbb{C}5\log GDP_{ujt} + \mathbb{C}6\log POP_{ujt} + \pi_u + \pi_j + \pi_t + \pi_{ujt} \quad (24)$$

Where, $\sum_{j=1}^{34}(\$\bar{I}_{j\to u,t})$ is the logarithm used to represent goods import from/to country, j to/from country, u, where, t = 2000…2016

4. Empirical Results

4.1. Pooled ordinary least squares estimation- Bilateral Trade in Services

Models (1) ~ (3) in Table 1 show our results using the Ordinary Least Squares (OLS) method to estimate the impact of ICT on bilateral trade in services in three variations – service trade (sum of service export and service import), service export, service import, respectively. The coefficients of determination (R2) are 0.621, 0.612 and 0.605 for service trade, service export and service import, respectively. Models (1) ~ (3) are able to explain up to 62.1% of the variation in trade flows for service trade, 61.2% of the variation in trade flows for service export and 60.5% of the variation in trade flows for service import.

A check to take into account any potential endogeneity of such explanatory variables is performed. Results of the multi-collinearity test may be measured by the value of the variance inflation factor (VIF) are all a little more than 1.0, showing very low signs of multi-collinearity. A second check for robustness using the Durbin Watson method shows that all values are less than 2.50 again, showing no signs of multi-collinearity for models (1) ~ (3). Thus, our results are not only economically and statistically significant, but seem robust.

Based on the empirical results of Models (1) ~ (3) in Table 1, we can conclude that the impact of ICT on service import is highest, with all variables holding significant results. Fixed broadband and mobile phones play highly significant roles in service trade, service export as well as service import, at 0.01% levels of significance. Fixed telephone also hold statistically significant results for service trade, service export and service import, but at lower levels of significance than fixed broadband and mobile phones. This goes to show that fixed broadband and mobile phones has gradually overtaken fixed telephone when it comes to service trade, service export or service import.

Table 1: Bilateral Trade in Services and Goods from 2000 to 2016: Pooled Ordinary Least Squares (OLS) Estimates

Dependent Variables	Bilateral Trade in Services			Bilateral Trade in Goods		
	Service Trade	**Service Export**	**Service Import**	**Goods Trade**	**Goods Export**	**Goods Import**
Models	(1)	(2)	(3)	(4)	(5)	(6)
(a) Log (FB)	0.351**** (0.000)	0.145**** (0.000)	0.165**** (0.000)	0.295**** (0.000)	0.306**** (0.000)	0.281**** (0.000)
(b) Log (INT)	-0.209* (0.083)	-0.064 (0.223)	-0.123** (0.037)	0.178 (0.184)	0.226* (0.093)	0.209 (0.154)
(c) Log (MB)	-0.587**** (0.000)	-0.278**** (0.000)	-0.238**** (0.000)	-0.628**** (0.000)	-0.597**** (0.000)	-0.704**** (0.000)
(d) Log (FT)	0.189** (0.042)	0.073* (0.069)	0.105** (0.020)	0.431**** (0.000)	0.433**** (0.000)	0.397**** (0.000)
(e) Log (GDP)	0.209*** (0.013)	0.094*** (0.010)	0.078** (0.055)	-0.389**** (0.000)	-0.303**** (0.001)	-0.455**** (0.000)
(f) Log (POP)	0.054**** (0.000)	0.023**** (0.000)	0.022**** (0.000)	0.036**** (0.000)	0.034**** (0.000)	0.036**** (0.000)
(g) Log (CL)	-0.131 (0.122)	-0.034 (0.350)	-0.110*** (0.008)	-0.118 (0.205)	0.159* (0.088)	-0.329**** (0.000)
(h) Log (DIST)	-0.015 (0.279)	-0.011* (0.065)	-0.011* (0.097)	-0.029** (0.057)	-0.029** (0.058)	-0.034** (0.041)
Constant	0.320**** (0.000)	3.856**** (0.000)	3.588**** (0.000)	14.697**** (0.000)	12.402**** (0.000)	15.287**** (0.000)
Adjusted R^2	0.621	0.612	0.605	0.477	0.517	0.449
No. of countries	34	34	34	34	34	34
No. of observations	544	544	544	526	526	526
Durbin Watson	2.024	1.947	2.144	1.852	1.739	1.920
F-test	41.916	39.989	38.681	19.060	23.549	16.286
VIF Values	(a) 6.143 (b) 9.133 (c) 3.736 (d) 4.242 (e) 6.985 (f) 1.262 (g) 1.223 (h) 1.073	(a) 6.143 (b) 9.133 (c) 3.736 (d) 4.242 (e) 6.985 (f) 1.262 (g) 1.223 (h) 1.073	(a) 6.143 (b) 9.133 (c) 3.736 (d) 4.242 (e) 6.985 (f) 1.262 (g) 1.223 (h) 1.073	(a) 6.360 (b) 9.804 (c) 3.700 (d) 4.204 (e) 6.963 (f) 1.298 (g) 1.270 (h) 1.099	(a) 6.360 (b) 9.804 (c) 3.700 (d) 4.204 (e) 6.963 (f) 1.298 (g) 1.270 (h) 1.099	(a) 6.360 (b) 9.804 (c) 3.700 (d) 4.204 (e) 6.963 (f) 1.298 (g) 1.270 (h) 1.099

In addition, we can also conclude that the greater the size of a country, in terms of population or GDP, the impact of ICT on service trade, service export and service import is highly significant. On the other hand, on the contrary to existing trade studies, we find that common language and distance do not play such significant roles. One major reason may be that the internet has reduced trade barriers, physical distances, language gaps, and thus, confirms our implicit hypotheses that ICT has with time, gradually reduced the aforementioned barriers and allowed greater access to information, cut across countries, trade zones, and regulatory boundaries never possible before.

Across all three models: (1) ~ (3), when we rank the significance of our ICT variables, we find that fixed broadband and fixed telephone have the most significant impact on service trade, service export and service import. Thus, one can imply from the results from models (1) ~ (3) that when countries are contemplating service trade, partnering with countries that have a relatively higher fixed broadband and fixed telephone subscriptions are critical consideration factors. Another finding from models (1) ~ (3) is that we find that both population and GDP have significant impacts on service trade, service export and service import. However, population or market size of a country seem to have a greater impact on service trade, service export and service import than wealth (GDP) of a country. Thus, a second implication from the results from models (1) ~ (3) is that market size of a country is an even more important factor than wealth (GDP) of a country when countries trade in goods. In addition, our results from models (1) ~ (3) on common language shows that a common language is not a critical factor when countries are contemplating service export, but service import.

4.2. Pooled ordinary least squares estimation- Bilateral Trade in Goods

Models (4) ~ (6) in Table 1 shows our results using the Ordinary Least Squares (OLS) method to estimate the impact of ICT on bilateral trade in goods in three variations – goods trade (sum of goods export and goods import), goods export, goods import, respectively. The coefficients of determination (R2) are 0.477, 0.517 and 0.449 for goods trade (sum of goods export and goods import), goods export, goods import, respectively. Models (4) ~ (6) are able to explain up to 47.7% of the variation in trade flows for goods trade, 51.7% of the variation in trade flows for goods export and 44.9% of the variation in trade flows for goods import.

Based on the empirical results of Models (4) ~ (6) in Table 1, we can conclude that the impact of ICT on goods export is highest, with all variables holding significant results. Fixed broadband, mobile phones and fixed telephone play highly significant roles in goods trade, goods export as well as goods import, at 0.01% levels of significance. Similar to bilateral trade in services, the greater the size of a country, in terms of population or GDP, the impact of ICT on goods trade, goods export and goods import.

A check to take into account any potential endogeneity of such explanatory variables is performed. Results of the multi-collinearity test may be measured by the value of the variance inflation factor (VIF) are all a little more than 1.0, showing very low signs of multi-collinearity. A second check for robustness using the Durbin Watson method shows that all values are less than 2.50 again, showing no signs of multi-collinearity for models (4) ~ (6). Thus, our results are not only economically and statistically significant, but seem robust.

Across all three models: (4) ~ (6), when we rank the significance of our ICT variables, we find that fixed broadband, mobile phones and fixed telephone play the most significant impact of goods trade, goods export and goods import. Thus, one can imply from the results from models (4) ~ (6) that when countries are contemplating goods trade, partnering with countries that have relatively higher fixed broadband, mobile phones and fixed telephone subscriptions are critical success factors.

Another finding from models (4) ~ (5) is that population and GDP both play similarly strong and significant impacts on goods trade, goods export and goods import. Thus, a second implication from the results from models (4) ~ (6) is that wealth as well as market size of a country, are critical success factors when it comes to goods trade, goods export and goods import.

We can, therefore, conclude that for future goods trade, partnering with a country that has high fixed broadband, mobile phone and fixed telephone subscriptions, as well as market size and/or wealth of a trading partner are critical success factors when it comes to goods trade, goods export and goods import. In addition, common language is a critical factor when it comes to goods import than goods export, holding a highly significant level of 0.01% for the former, and 10% for the former. One reason is that importing goods from the US, an English- speaking nation, which also happens to be a commonly used language worldwide, is a critical success factor for goods export. This reason, however, may not hold such strong validity when it comes to exporting goods from the US to other nations that do not have a common language.

4.3. Fixed Effects Model Estimation- Bilateral Trade in Services

Models (7) ~ (9) in Table 2 shows our results using the Fixed Effects Model (FEM) to estimate the impact of ICT on bilateral trade in services in three variations — service trade (sum of service export and service import), service export, service import, respectively. The coefficients of determination (R2) are 0.617, 0.607 and 0.597. Models (7) ~ (9) are able to explain up to 61.7% of the variation in trade flows for service trade, 60.7% of the variation in trade flows for service export and 59.7% of the variation in trade flows for service import.

Table 2: Bilateral Trade in Services and Goods from 2000 to 2016: Fixed Effects Model (FEM) Estimates

	Bilateral Trade in Services			**Bilateral Trade in Goods**		
Dependent Variables	**Service Trade**	**Service Export**	**Service Import**	**Goods Trade**	**Goods Export**	**Goods Import**
Models	(7)	(8)	(9)	(10)	(11)	(12)
(i) Log (FB)	0.351*** (0.000)	0.145*** (0.000)	0.166*** (0.000)	0.293**** (0.000)	0.301**** (0.000)	0.281**** (0.000)
(j) Log (INT)	-0.236** (0.050)	-0.145 (0.150)	-0.131** (0.026)	0.519 (0.235)	0.239* (0.076)	0.165 (0.264)
(k) Log (MB)	-0.580*** (0.000)	-0.075*** (0.000)	-0.254*** (0.000)	-0.613**** (0.000)	-0.506**** (0.000)	-0.701**** (0.000)
(l) Log (FT)	0.203** (0.029)	0.270** (0.052)	0.112*** (0.014)	0.444**** (0.000)	0.422**** (0.000)	0.429**** (0.000)
(m) Log (GDP)	0.229*** (0.005)	0.096*** (0.007)	0.106*** (0.008)	-0.384**** (0.000)	-0.355**** (0.000)	-0.409**** (0.000)
(n) Log (POP)	0.055*** (0.000)	0.023*** (0.000)	0.023*** (0.000)	0.036**** (0.000)	0.032**** (0.000)	0.038**** (0.000)
(o) Constant	8.939*** (0.000)	3.717*** (0.000)	3.402*** (0.000)	14.302*** (0.000)	12.620*** (0.000)	14.400*** (0.000)
Adjusted R^2	0.617	0.607	0.597	0.467	0.509	0.418
No. of countries	34	34	34	34	34	34
No. of observations	544	544	544	526	526	526
Durbin Watson	2.026	1.966	2.093	1.882	1.747	1.988
F-test	55.007	52.253	49.451	24.190	30.245	18.827
VIF Values	(a) 6.141 (b) 9.023 (c) 3.672 (d) 4.216 (e) 6.608 (f) 1.256	(a) 6.141 (b) 9.023 (c) 3.672 (d) 4.216 (e) 6.608 (f) 1.256	(a) 6.141 (b) 9.023 (c) 3.672 (d) 4.216 (e) 6.608 (f) 1.256	(a) 6.348 (b) 9.745 (c) 3.623 (d) 4.176 (e) 6.508 (f) 1.286	(a) 6.348 (b) 9.745 (c) 3.623 (d) 4.176 (e) 6.508 (f) 1.286	(a) 6.348 (b) 9.745 (c) 3.623 (d) 4.176 (e) 6.508 (f) 1.286

Our fixed effects model (FEM) fits the data well. However, when we compare the

coefficients of determination (R^2) between FEM and OLS (Section 4.1) for service trade, service export and service import, we see a slightly better fit of OLS. R^2 levels for our OLS models are at 0.621, 0.612 and 0.605, whilst R^2 levels for our FEM models are at 0.617, 0.607 and 0.597 for our FEM models.

Across all three models: (7) ~ (9), when we rank the significance of our ICT variables, we find that mobile phones and fixed broadband has a high on service trade, service export and service import; followed by fixed telephone. As for wired internet, the results are mixed across all three variations: wired internet has a 5% level of significance on both service trade and service import, but no significance on service export. Population and GDP both have significant impacts on service trade, service export and service import. However, we find that population has a greater impact on service trade, service export and service import than GDP. One implication may be that although wealth of a country is of great importance when it comes to service trade, service export and service import; market size/potential of a country (population size) may be an even more critical issue than wealth of a country when it comes to service trade, in general.

A second implication from our results is that for countries contemplating on service trade, partnering with a country with relatively higher high mobile phone and fixed broadband subscription, in addition to relatively greater market size and/or wealth may be critical service trade success factors in this internet era.

4.4. Fixed Effects Model Estimation- Bilateral Trade in Goods

Models (10) ~ (12) in Table 2 shows our results using the Fixed Effects Model (FEM) to estimate the impact of ICT on bilateral trade in goods in three variations — goods trade (sum of goods export and goods import), goods export, goods import, respectively. The coefficients of determination (R2) are 0.467, 0.509 and 0.418. Models (10) ~ (12) are able to explain up to 46.7% of the variation in trade flows for goods trade, 50.9% of the variation in trade flows for goods export and 41.8% of the variation in trade flows for goods import.

Our fixed effects model (FEM) fits the data well. However, when we compare the coefficients of determination (R2) between FEM and OLS (Section 4.2) for goods trade, goods export, goods import, we see a slightly better fit of OLS. R2 levels for our OLS models are at 0.477, 0.517 and 0.449, whilst R2 levels for our FEM models are at 0.467, 0.509 and 0.418 for our FEM models.

Across all three models: (10) ~ (12), when we rank the significance of our ICT variables, we find that fixed broadband, mobile phones and fixed telephone play the most significant impact of goods trade, goods export and goods import. The results from our FEM models (10) ~ (12) show mirroring results to our REM (4) ~ (5). Thus, one can imply from the results from models (10) ~ (12) that when countries are contemplating goods trade, partnering with countries that have relatively higher fixed broadband, mobile phones and fixed telephone subscriptions are critical success

factors to goods trade, goods export and goods import.

Another finding from models (10) ~ (12) is that population and GDP both play similarly strong and significant impacts on goods trade, goods export and goods import. Thus, a second implication from the results from models (4) ~ (6) is that wealth as well as market size of a country, are critical success factors when it comes to goods trade, goods export and goods import.

4.5. Comparison of Bilateral Trade in Goods and Services

As discussed in the introduction section, one of the main purposes of this paper is to compare the similarities and differences between bilateral service trade and goods trade. In order to accomplish this purpose, we also estimate our equations with goods exports and goods imports as dependent variables in place of service exports and service imports, respectively, using the same group of countries. Table 3 reports the results for service trade, service export and service import. Table 4 reports the results for goods trade, goods export and goods import. Table 5 provides a concise report of the estimated coefficients of the key variables of service trade versus goods trade, service export versus goods export and service import versus goods import. The summary of estimated coefficients of the key variables in Table 5 for both service trade and goods trade and the ranges of R2, drawn from Tables 1 to 4. As expected, we find that there are both similarities and differences between bilateral trade in goods and services.

First, we compare our results between service export and goods export. We find some similarities as well as differences of the impact of ICT on service export and goods export. We find that (1) mobile phones have a high level of significance on both service export and goods export, (2) fixed telephone line is a critical success factor for goods export, however, it has a much lesser impact on service export, and

(3) a trading partner that possesses an internet connection subscription does not have high implications when it comes to service export. On the other hand, internet connection has some level of significance when it comes to goods export. One implication that can be made here is that due to the differences in the characteristics of services and goods, the means and usage of ICT tools and their importance may vary.

The results of our control variables show that wealth of a country as well as the market size of a country are highly significant factors for both service export and goods export. Thus, one can imply that if the US were to choose a trade partner, then the greater the wealth and/or the greater the market size of that partnering country, the greater likelihood of success it would have on US service export or US goods export.

Table 3 Comparison of bilateral trade in services
(Summary of estimated coefficients for different types of transactions)

	Bilateral Trade in Services				
Dependent Variables	**Service Trade**		**Service Export**		**Service Import**
(p) Log (FB)	0.351****	>	0.145****	<	0.165****
	(0.000)		(0.000)		(0.000)
(q) Log (INT)	-0.209*	<	-0.064	>	-0.123**
	(0.083)		(0.223)		(0.037)
(r) Log (MB)	-0.587****	<	-0.278****	<	-0.238****
	(0.000)		(0.000)		(0.000)
(s) Log (FT)	0.189**	>	0.073*	<	0.105**
	(0.042)		(0.069)		(0.020)
(t) Log (GDP)	0.209***	>	0.094***	>	0.078**
	(0.013)		(0.010)		(0.055)
(u) Log (POP)	0.054****	>	0.023****	>	0.022****
	(0.000)		(0.000)		(0.000)
(v) Log (CL)	-0.131	<	-0.034	>	-0.110***
	(0.122)		(0.350)		(0.008)
(w)Log (DIST)	-0.015	<	-0.011*	=	-0.011*
	(0.279)		(0.065)		(0.097)
Range of adjusted R^2	0.621	>	0.612	>	0.605

Notes:
(1) *significant at 10%, **significant at 5%, ***significant at 1%, ****significant at 0.01%.
(2) Robust standard errors are in parentheses.
(3) The explanatory variables are as follows:
(a) Log (FB) = Log (Fixed Broadband Internet subscribers per 100 people),
(b) Log (INT) = Log (Individuals with Internet Access),
(c) Log (MB) = Log (Mobile Cellular Telephone Subscriptions),
(d) Log (FT) = Log (Fixed Telephone line penetration per 100 people),
(e) Log (GDP) = Log (GDP per capita),
(f) Log (POP) = Log (Population),
(g) Log (CL) = Log (Common Language),
(h) Log (DIST) = log (distance).
(4) Range of adjusted R^2 is the minimum and maximum values of adjusted R^2 obtained for the regression equations for each type of transaction.

Overall, we find that common language and distance do not seem to play as significant roles as found in existing studies. This is the contrary to many existing international trade studies (Porojan, 2001; Linders & Groot, 2006; Lewer & Berg, 2007; Egger & Lassman, 2012; Tay, 2014). In this study, we find that ICT has helped

overcome trade barriers caused by traditional determinants including common language and distance, giving rise to overwhelming importance of ICT in expanding world trade.

Table 4 Comparison of Bilateral Trade in Goods
(Summary of estimated coefficients for different types of transactions)

	Bilateral Trade in Goods				
Dependent Variables	**Goods Trade**		**Goods Export**		**Goods Import**
(x) Log (FB)	0.295****	<	0.306****	>	0.281****
	(0.000)		(0.000)		(0.000)
(y) Log (INT)	0.178	<	0.226*	>	0.209
	(0.184)		(0.093)		(0.154)
(z) Log (MB)	-0.628****	<	-0.597****	>	-0.704****
	(0.000)		(0.000)		(0.000)
(aa) Log (FT)	0.431****	<	0.433****	>	0.397****
	(0.000)		(0.000)		(0.000)
(bb) Log (GDP)	-0.389****	<	-0.303****	>	-0.455****
	(0.000)		(0.001)		(0.000)
(cc) Log (POP)	0.036****	>	0.034****	<	0.036****
	(0.000)		(0.000)		(0.000)
(dd) Log (CL)	-0.118	<	0.159*	>	-0.329****
	(0.205)		(0.088)		(0.000)
(ee) Log (DIST)	-0.029**	=	-0.029**	>	-0.034**
	(0.057)		(0.058)		(0.041)
Range of adjusted R^2	0.477	<	0.517	>	0.449

Notes:
(1) *significant at 10%, **significant at 5%, ***significant at 1%, ****significant at 0.01%.
(2) Robust standard errors are in parentheses.
(3) The explanatory variables are as follows:
(a) Log (FB) = Log (Fixed Broadband Internet subscribers per 100 people),
(b) Log (INT) = Log (Individuals with Internet Access),
(c) Log (MB) = Log (Mobile Cellular Telephone Subscriptions),
(d) Log (FT) = Log (Fixed Telephone line penetration per 100 people),
(e) Log (GDP) = Log (GDP per capita),
(f) Log (POP) = Log (Population),
(g) Log (CL) = Log (Common Language),
(h) Log (DIST) = log (distance).
(4) Range of adjusted R^2 is the minimum and maximum values of adjusted R^2 obtained for the regression equations for each type of transaction.

Nevertheless, some level of relevance still applies across service export and goods export for traditional determinants such as common language. For example, common language still is more important for goods export than service export, of which, we find that common language has insignificant impact. Another example is distance, whereby we find that it still an important factor for both service export and goods export. However, we find that its significance is not as predominant as other ICT factors, such as fixed broadband, mobile-cellular phones or fixed telephone lines. Nevertheless, as expected, distance holds a higher level of significance for goods export than service export. One simple reason may be due to its tangibility factor that requires physical transportation of goods.

Next, we compare our results between service import and goods import, we find some similarities as well as differences of the impact of ICT on both types of trade. First, mobile-cellular phones play a highly significant role on both service export as well as goods export. This result is similar to that of our results as aforementioned on service export and goods export. The results from our study contradicts that of that by Tay (2018) which finds that mobile-cellular phones play an insignificant factor for service trade, service export and service import. Fixed broadband play a highly significant role on service import as well as goods export. The traditional means of the wired internet still plays a critical role in both these types of trade. As for fixed telephone lines, we find that this is a critical success factor for goods export and has much lesser impact on service export, although both show significances.

A trading partner that possesses a wired internet connection subscription does not have high significance on goods import. On the other hand, wired internet connection has some level of significance when it comes to service import. These results are a reverse of the results we find for service export and goods export. The internet is still a critical factor when it comes to service import, but plays no significant role when it comes to goods import.

The results of our control variables show that market size of a country is a highly significant factor for both service import and goods import. However, wealth of a country does not seem to be as important a factor for service import as it is for goods import. Thus, one can imply that when the US chooses to trade with a partnering country, the greater the market size of a partnering country, then the greater the success of service import or goods import. The wealth of a trading partner is important for both service import and goods import. However, its importance is greater for goods import than service import.

Table 5 Comparison of bilateral trade in services and goods
(Summary of estimated coefficients for different types of transactions)

	Service Trade		Goods Trade	Service Export		Goods Export	Service Import		Goods Import
(bb) Log(FB)	0.351*** (0.000)	>	0.295*** (0.000)	0.145*** (0.000)	>	0.306*** (0.000)	0.165*** (0.000)	<	0.281*** (0.000)
(cc) Log(INT)	-0.209* (0.083)	<	0.178 (0.184)	-0.064 (0.223)	<	0.226* (0.093)	-0.123** (0.037)	<	0.209 (0.154)
(dd) Log(MB)	-0.587*** (0.000)	>	-0.628*** (0.000)	-0.278*** (0.000)	>	-0.597*** (0.000)	-0.238*** (0.000)	>	-0.704*** (0.000)
(ee) Log(FT)	0.189** (0.042)	<	0.431*** (0.000)	0.073* (0.069)	<	0.433*** (0.000)	0.105** (0.020)	<	0.397*** (0.000)
(ff) Log(GDP)	0.209*** (0.013)	>	-0.389*** (0.000)	0.094*** (0.010)	>	-0.303*** (0.001)	0.078** (0.055)	>	-0.455*** (0.000)
(gg) Log(POP)	0.054*** (0.000)	>	0.036*** (0.000)	0.023*** (0.000)	<	0.034*** (0.000)	0.022*** (0.000)	<	0.036*** (0.000)
(hh) Log(DIST)	-0.131 (0.122)	<	-0.118 (0.205)	-0.034 (0.350)	<	0.159* (0.088)	-0.110*** (0.008)	>	-0.329*** (0.000)

Notes:

(1) *significant at 10%, **significant at 5%, ***significant at 1%, ****significant at 0.01%.

(2) Robust standard errors are in parentheses.

(3) The explanatory variables are as follows:

(a) Log (FB) = Log (Fixed Broadband Internet subscribers per 100 people),

(b) Log (INT) = Log (Individuals with Internet Access),

(c) Log (MB) = Log (Mobile Cellular Telephone Subscriptions),

(d) Log (FT) = Log (Fixed Telephone line penetration per 100 people),

(e) Log (GDP) = Log (GDP per capita),

(f) Log (POP) = Log (Population),

(g) Log (CL) = Log (Common Language),

(h) Log (DIST) = log (distance).

(4) Range of adjusted R^2 is the minimum and maximum values of adjusted R^2 obtained for the regression equations for each type of transaction.

The results we find for the impact of common language and distance on service import and goods import are diversely different from what we find for service export and goods export. Common language and distance still play a highly critical role when it comes to service import and goods import. This is in line to existing international trade studies. One implication may be that if an exporting country is a developed country such as the US, as in this study, common language and distance and distance are still critical factors, given that partnering countries may be from less developed countries, and ICT access may not be as high as that in developed countries. Thus, reliance on the more traditional modes of ICT including fixed telephone line, having a common language such as the English/Spanish, and the shorter the distance, the more likely the trade is likely to occur and with greater success levels. Distance and language can help bridge distances in terms of culture and other language barriers.

5. Conclusion

The purpose of this paper are threefold: (1) examine the impact of Information and Communication Technology (ICT) on bilateral service trade, (2) examine the impact of ICT on bilateral goods trade, and (3) compare the similarities as well as the differences between the impact of ICT on bilateral service trade relative to that of bilateral goods trade. We use the Ordinary Least Squares (OLS) method and the Fixed Effects Model (FEM) and ran regressions on bilateral service trade and bilateral goods trade from US to 34 partnering countries covering the years 2000 to 2016.We find that the values of adjusted R2 obtained for service trade (exports and imports) are greater than those for goods trade. This result implies that our models perform better with bilateral trade in services than bilateral trade in goods.

For service trade, we find that more modern forms of ICT such as mobile-phones and fixed broadband play the most significant impacts on service trade compared to the wired internet or fixed telephone lines. Therefore, we suggest that developed countries should consider trading partners that have higher mobile- phones access and fixed broadband subscriptions. In addition to the latter, market size, in terms of the population of a country is a more important factor to consider than wealth or GDP of a country when considering a trading partner in service trade.

For goods trade, we find that a mix of the usage of more traditional forms of ICT such as fixed telephone lines along with more modern forms of ICT such as mobile phones and fixed broadband to be critical to the impact on goods trade. This result slightly differs from that of service trade in that fixed telephone lines although still play a significant role in service trade, its impact is not as prominent as goods trade. In addition, wealth and market size of a country both play equally significant roles on goods trade. This result slightly differs from that of service trade, where we find that market size to be a more important factor than wealth of a country.

Another interesting result concerns the impact of wealth (GDP) and market size (population). In our application, both service trade and goods trade are positively and

significant affected by both these variables. However, the ranking of the importance differs. For service trade, market size is a more important factor than wealth of a country, and vice-versa for goods trade. This implies that as countries move toward greater economic growth, the effect of ICT on goods trade is greater. Tapping on market size is a more important factor when it comes to service trade.

We also find some similarities as well as differences between service trade and goods trade with regard to the elasticities of the explanatory variables. Geographical distance is consistently more important for goods trade (exports and imports) than for service trade. This result may indicate that the cost of transport for tradable goods is "in general" higher than that for services. This results of this study is contrary to those of Porojan (2001), Linders & Groot (2006) Lewer & Berg (2007), Egger & Lassman (2012) and Tay (2014), where they find that geographical distance is consistently more important for service trade (exports and imports) than for goods trade. In general, we also find that common language is more important for goods export, goods import and service import than service export.

In conclusion, we must continually seek to understand the forces shaping world trade in goods and services. Today, rapid advancements in artificial intelligence is also transforming the way we communicate across international borders and in the virtual reality world. Machine-generated text, speech translation tools, other internet translation tools, amongst others, are catalysts to trade and increasingly more accurate than ever. They are also transforming the way the world is communicating to each other, lifting barriers across trade in goods and services, and making trade in goods and services easier and faster than ever before. In this study, we already saw that common language does not play such a significant factor in service trade as it does in goods trade. Thus, future studies could focus on how ICT, including artificial intelligence and other ICT translation tools impact trade in goods and services.

In this study, we also find that each type of ICT alters the landscape of trade in goods and services in a different way, and at varying levels of significance. In the future, new ICT configurations could give rise to new trade patterns in goods and services. These new ICT configurations would compress time, accelerate the speed of information exchange and communication and decrease in costs, with time. Thus, future studies could forecast and compare the speed of which individual ICT determinants would be phased-out or accelerated in its usage. For example, when & which geographical regions, and in what domains would fixed telephone lines (traditional landlines) be phased-out in the future? What is the breaking point between fixed telephone lines and modern ICT means (mobile-cellular & fixed broadband)? Another future study would be to discuss "in what time and manner would we indeed see 'death of distance' due to the impact of ICT?"

Last, but not least, the results of this study are consistent with the assertion that ICT has broken through and cut across countries, trade zones and regulatory boundaries, at least in developed economies such as the US.

6. Appendix A. List of Countries (34)

Argentina, Australia, Belgium-Luxembourg Bermuda, Brazil, Canada, Chile, China, France, Germany, Hong Kong, India, Indonesia, Ireland, Israel, Italy, Japan, Republic of Korea, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, Venezuela.

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