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INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) AND SERVICES TRADE

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Abstract

Using panel data for 49 countries from 2000 to 2013, this paper empirically examines the impacts of ICT on exports and imports of ten service categories. Unlike most previous studies, seven different ICT variables are used to construct a comprehensive ICT development index (IDI) that captures the access, use, and skill aspects of the technology. The results indicate that overall ICT development has significant positive impacts on the exports of 'other business services' and 'transportation services' and the imports of 'insurance services', 'telecommunication services', and 'travel services'. This result is robust under different estimation methods. Among the three ICT components, ICT use is found to be more important than access and skills for trade in a number of services. Furthermore, when the models are estimated separately for advanced economics (AEs) and emerging market economies (EMEs), ICT development appears to be more important for exports from AEs and for imports by EMEs. Finally, ICT use is more important in EMEs than in AEs, particularly for imports. These results provide important policy insights for ICT development and growth of services trade.

Information and Communications Technology (ICT) and Services Trade

1. Introduction

There has been a growing literature that examines the effects of information and communication technology (ICT) on trade. In general, this literature finds evidence of a positive impact of ICT on international trade.[1] While most studies consider merchandise trade, only a handful (Freund and Weinhold, 2002; Choi, 2010) focus exclusively on services trade. However, the role of this technology in services trade has assumed special significance primarily because of two reasons. *First*, a significant acceleration in the growth of world trade in services has coincided with the unprecedented advances in ICT.[2] *Second*, several services have become tradable because of ICT or ICT-enabled innovations. This is particularly true for information-intensive services (IISs).[3] These services involve creating, processing, and communicating information. As ICT advances lower the costs of these processes, IISs can be produced in one place and delivered in another around the world. Thus, the production and consumption of these services evidently become more efficient. ICT may also have an impact on trade in non-IISs as well. For example, the use of ICT may reduce the fixed entry cost into a market and thus stimulates exports. As Freund and Weinhold (2004) discuss, these fixed costs include the costs of finding out information about the market (search cost), advertising, and establishing a distribution

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[1] For example, using U.S. exports and imports data for 14 service items and 31 countries between 1995 and 1999, Freund and Weinhold (2002) find that Internet development in those countries has a significant positive impact on bilateral trade with the U.S. They further extend this analysis to cover merchandise trade and to include 56 countries in a subsequent study (Freund and Weinhold 2004). Fink et al (2005) find evidence of significant influence of communication costs on bilateral trade in the data for 107 countries in 1999. Using data for 98 countries, Clarke and Wallsten (2006) further show that access to the Internet results in developing counties exporting more to developed countries. Vemuri and Siddiqi (2009) analyze panel data for 64 countries for the period 1985 -2005 and conclude that ICT infrastructure and the availability of Internet for commercial transactions have a positive and significant impact on the volume of international trade. Using data for 175 countries, Demirkan et al (2009) also find evidence of bilateral trade enhancing effects of ICT use. Choi (2010) provides further evidence of Internet usage raising services trade for 151 countries for a period from 1990 to 2006. More recently, Mattes et al (2012) examine the effects of availability and use of ICT on trade using data on the European Union (EU) countries. Although they do not find any significant impact of ICT on EU trade, their results suggest that trade is enhanced if both trading partners are advanced users of ICT. In contrast, Liu and Nath (2013) find evidence of a positive impact of ICT use on trade in 40 emerging market economies.

[2] For a brief account on the growth of world trade in services, see Apte and Nath (2013)

[3] Examples of such services include various customer services, education, medical transcription, financial services, tax returns, and web design.

network. By reducing delays in acquiring and transmitting information, the use of ICT also makes planning more efficient and accurate. Consequently, the volume of trade between countries is expected to go up. Furthermore, ICT proliferation itself may lead to the development of ICT-related service (as well as manufacturing) industries (e.g. technical support for computer and mobile phone hardware and software) within a country. These industries may eventually engage in international trade and contribute to the growth of services trade. Because of the multiplicity of channels and the fact that the extent and ways in which ICT is used vary across industries, we can expect differential effects of ICT on various service items.

In this paper, we examine the impact of ICT on trade in various service items. Although Freund and Weinhold (2002) consider U.S. exports and imports of 14 service items, they do not examine the effects of ICT separately for each item. Furthermore, Choi (2010) and Liu and Nath (2013) focus on aggregate service exports and imports. We, therefore, consider ten disaggregated service items to investigate if ICT has differential effects on exports and imports of these services. The services trade among the advanced countries (AEs) has undoubtedly increased over the last decade or so. This trend has been visible even among the emerging market economies (EMEs). Therefore, we consider a sample of 49 countries that include 21 AEs and 28 EMEs during the period 2000-2013.

Previous literature uses the number of Internet hosts (Freund and Weinhold 2002 & 2004; Clarke and Wallsten 2006; Choi 2010) or/and the number of telephone lines, personal computers, and Internet users (Vemuri and Siddiqi 2009) as the measurement of ICT. Yet these measures can only reflect one particular aspect of ICT advances. In a recent study, Liu and Nath (2013) use four alternative variables that capture different aspects of ICT: total annual investment in telecom, international Internet bandwidth (Mega Bits per second), total fixed (wired) broadband Internet subscriptions per 100 people, and the number of Internet hosts per 100 people. In this paper we use an aggregate measure of ICT development that combines three aspects of the technology, namely access, use, and skills.

We use generalized method of moments (GMM) to the relevant data for 49 countries from 2000 to 2013 in our study. This method helps us address potential endogeneity among the variables in our model. In our empirical model, we use natural logarithm of export or import for each service item as the dependent variable. The main variable of interest is the aggregate ICT index that indicates the level of overall development of a country's ICT. Other control variables include the natural logarithms of real GDP per capita, population, and the ratio of M2 (broad measure of money) to GDP (that is

supposed to reflect financial depth). Our results indicate that ICT development has significant positive impacts on the exports of other business services and transportation services and the imports of insurance services, telecommunication services, and travel.

We also estimate the export and import models with ICT access, ICT use, and ICT skills sub-indices separately to investigate if these three components of overall ICT development affect services trade differently. Our results indicate that ICT use is more important than access and skills for trade in a number of services. Furthermore, when we estimate the models separately for advanced economics (AEs) and emerging market economies (EMEs), we find that while ICT development is more important for exports from AEs, it is found to be more important for imports by EMEs. Also, ICT use is more important in EMEs than in AEs, particularly for imports. These results provide important policy insights for ICT development and services trade.

The rest of the paper is organized as follows. Section 2 discusses the data and methodology used for our empirical analysis. In section 3, we present and discuss the empirical results. Section 4 presents the sensitivity analysis results. In the last section, we summarize and include a few concluding remarks.

2. Data and Methodology

2.1 Data

We obtain data on the relevant variables for 49 countries between 2000 and 2013 from three major sources: (i) The World Trade Organization (WTO) - Trade in Commercial Services Dataset; (ii) The World Bank - World Development Indicators (WDI) database; and (iii) The International Telecommunication Union (ITU) - World Telecommunication ICT Indicator database. The choices of the countries and sample period are dictated by the availability of data. Annual data on exports and imports of ten major service items are available in current USD from WTO. The ten major service items include audio-visual and related services, computer services, construction, financial services, insurance services, other business services, royalty and license fees, telecommunication services, transportation, and travel.[4] Since we are interested in examining the ICT impacts on the volume of exports and imports, we convert the current USD export and import values into 2005 constant USD.[5]

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[4] Appendix Table A.1 provides a list of the ten items with their corresponding definitions according to WTO.
[5] Export and import prices are not available separately for each item. Therefore, in order to convert the current USD export and import values into constant USD, we first construct weighted price index for each service item

It is impossible to find a single measure of ICT that reflects all different aspects of this general-purpose technology. [6] In recent years, ITU has constructed and published data on a composite index that combines ten variables to capture three aspects of ICT development in different countries. [7] We follow ITU's general framework and combine seven variables to construct an ICT development index (IDI, hereafter) that incorporates three aspects of ICT: access, use, and skills.[8] These variables and the corresponding ICT aspects that they reflect are:

ICT access: (i) fixed-telephone lines per 100 inhabitants;

(ii) mobile-cellular telephone subscriptions per 100 inhabitants;

ICT use: (iii) international Internet bandwidth (bit/s) per Internet user;

(iv) percentage of individuals using the Internet;

(v) fixed (wired)-broadband Internet subscriptions per 100 inhabitants;

ICT skills: (vi) secondary gross enrollment ratio;

(vii) tertiary gross enrollment ratio.

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using data obtained from the U.S. Bureau of Economic Analysis. In the absence of separate price deflator for each country, we use U.S. price deflator under the implicit assumption that relative price movements for these various services items are similar across countries. Thus, it is a proxy for the missing price deflators. Given that these items are traded, this may not be an unrealistic assumption. We then apply the following equation to obtain services exports and imports in 2005 constant USD.

$$X_{j,t,constant} = \frac{X_{j,t}}{P_{j,t}^{US} \times E_t} * P_{j,2005}^{US} * E_{2005}$$

where $X_{j,t,constant}$ is export or import of service item j in year t in 2005 constant USD, $X_{j,t}$ is export or import of service item j in year t in current USD, $P_{j,t}^{US}$ is the US price index for service item j in year t, $P_{j,2005}^{US}$ is the US price index for service item j in 2005, E_t is the exchange rate in year t and E_{2005} is the exchange rate in 2005; i indexes country with $i = 1, 2, .., N$; j indexes service item; and t indexes year with $t = 1, 2, .., T$. We obtain data on official exchange rates from WDI.

Alternatively, we also apply aggregate export and import (goods and services) price indices, calculated from WDI data, to convert the current USD trade values into constant USD values. Although, in most cases, the results are qualitatively similar, there are quantitative differences that have stemmed from a lack of variation in prices across different service items. We do not report the results of our alternative conversion strategy.

[6] Because of its broad application across different sectors, ICT is referred to as a general-purpose technology. For example, see Basu and Fernald (2007).

[7] ITU's data on this index are available for 2007, 2009, 2010, 2011, and 2012 only.

[8] Although ITU uses ten variables, we use only seven variables as data on the rest three variables are not consistently available for the countries in our sample for the entire period that we consider here. Appendix Table A.2 outlines the construction of our IDI index. In a recent study, Mattes et al (2012) use a similar index that was appropriately modified according to data availability.

The index takes a value between 0 and 10, with 0 representing the lowest level of ICT development and 10 representing the highest level of ICT development. We also consider three separate sub-indices that capture three aspects of ICT development as shown above. They are: ICT access, ICT use, and ICT skills. Besides IDI or any of the sub-indices, we use per capita real GDP, population, and financial depth - measured by M2 divided by GDP - as control variables, data on which are obtained from WDI.

[Insert Table 1]

Table 1 provides the summary statistics of the dependent variables, the ICT variable, and the control variables for the baseline specification. Table 1 indicates that there are wide variations in average value of exports and imports of the service items across countries.[9] Bangladesh has the lowest mean (mean over the sample period) values for 6 export items and 6 import items. Similarly, the USA has the highest mean values for 6 categories of export items and 6 categories of import items. Furthermore, there are substantial differences in average year-to-year volatility of export and import (as reflected in the standard deviations) across service items and across countries. The IDI summary statistics indicate that Denmark has the highest level of average ICT development over the sample period and Pakistan has the lowest. Furthermore, there are significant cross-country variations in the average per capita real GDP, the average population, and financial depth. Norway has the highest average per capita real income during the sample period and Bangladesh has the lowest. In population, China ranks first and Estonia is the last. In financial depth, Japan is at the top and Argentina is at the bottom.

[Insert Table 2]

In order to get a sense of how IDI may be correlated with the trade variables, we calculate correlation coefficients for each country and for each item. Table 2 presents the average correlation coefficients (averaged across countries) along with the minimum and maximum. The average correlations are all positive. They are relatively stronger (the correlation coefficient being greater than 0.70 for either exports or imports or both) for computer services, financial services, insurance services, other business services, royalties and license fees, telecommunication services, transportation services, and travel. However, since correlations do not necessarily imply causation, we can't infer much from these associations.

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[9] A list of countries along with their respective codes is presented in Table A.3

2.2   Methodology

In order to examine the effects of ICT on exports and imports of the service items we have considered here, we use a model of the following form:[10]

$$LT_{it}^{j} = \beta' IDI_{it} + \gamma' Z_{it} + \mu_i + \varepsilon_{it} \tag{1}$$

where LT_{it}^{j} is the logarithm of exports (or imports) of service j for country i in year t; IDI_{it} is the ICT index; Z_{it} is the vector of control variables; μ_i is the unobservable country-specific variable; i indexes country with $i = 1, 2, .., N$; j indexes service item; and t indexes time with $t = 1, 2, .., T$.[11]

We include per capita real GDP, population, and financial depth (M2/GDP) as the control variables.[12] Per capita real GDP measures a country's standard of living. As the country grows, import is expected to increase due to greater consumption and investment demand. However, the effect of GDP on exports is not clear a-priori. As growth takes place, the economy may increase its exports due to increased production. An increase in domestic demand may, however, compete with external demand and thereby lower exports. Moreover, higher per capita GDP also captures better infrastructural capacity which is crucial for international trade. In that case, we would expect it to have a positive impact on both exports and imports.

Like in case of per capita GDP, it is difficult to anticipate how population would affect exports. While a larger population may increase domestic production and exports by increasing labor supply, it can also reduce exports by creating more domestic demand. Similarly, the effect on imports is also not intuitively clear. A larger population is likely to increase the demand for imports. However, if a larger population creates a domestic market large enough for profitable domestic production (because of economies of scale), population growth may have a negative impact on imports. The intuition behind including the financial depth variable is the finding that well-developed financial intermediaries

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[10] This specification is similar to the model used by Choi (2010).

[11] Note that the services trade items that we study include certain categories (e.g. royalty and license fee) that are not services in the sense of an output produced by a specific service industry. They are rather items that appear in balance of payments (BoP) transactions.

[12] There may be some concern about potential multicollinearity among the independent variables. However, as Baltagi (2005) explains, "Time-series studies are plagued with multicollinearity… This is less likely with panel … Since the cross-section dimension adds a lot of variability…" (Baltagi, 2005, pp. 5). Nevertheless, we compute Variance Inflation Factor (VIF) for each control variable to see if multicollinearity is a serious concern. Since the VIF values for all three control variables are much below 5 (a 'rule of thumb' benchmark), multicollinearity does not seem to be a serious issue. We do not report the VIF values to save space. Interested reader can obtain them from the corresponding author.

and markets have positive effects on external financing of trade. Thus, as Svaleryd and Vlachos (2005) argue, they could be "a source of comparative advantage in a way consistent with the Heckscher-Ohlin-Vanek (HOV) model". Therefore, a country with a well-developed financial sector should specialize in production of the goods and services that make relatively intense use of financial resources, and engage in trade.

It is possible that exports and imports may also contribute to ICT development. Similarly, the causality may run from trade to other control variables like GDP and population. Furthermore, changes in both IDI (and other right-hand side variables) and exports/imports may be caused by a third factor that is not observable. These possibilities give rise to the endogeneity problem that has been widely recognized in the literature. Clarke and Wallsten (2006), Vemuri and Siddiqi (2009), and Liu and Nath (2013) extensively discuss this issue in the context of ICT and trade.[13] In order to address this potential endogeneity issue, we apply GMM to estimate the equations. Following Hausman and Taylor (1981), lagged values of potential endogenous variables are used as instruments.[14] Thus, we include 1-period lagged values of the ICT variable, per capita real GDP, population, and M2/GDP, and 2-period lagged values of M2/GDP as the instruments in our estimation. In order to test for the validity of the instruments, we conduct Hansen's *J*-test. Under the null hypothesis that the instruments are valid (i.e. they are orthogonal to the error terms), the test statistic has a chi-square distribution.

3. Empirical Results

Our empirical results are presented in Tables 3 through 6. We first report the estimation results of our baseline specification for the export and import equations in Table 3. For each service item, since the availability of data for the countries in our sample varies, the number of countries included in the estimation ranges from 39 to 49 as shown in Table 3. In our baseline specification, we use the IDI as the variable of interest. Next, we use three different sub-indices representing ICT access, ICT use, and ICT skills separately to investigate if one of these three components of ICT development is more important than the rest. Table 4 presents the results from these estimations. Finally, we separate the

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[13] Clarke and Wallsten (2006) use a country's regulation of data services as an instrument for Internet hosts in order to control for endogeneity. In contrast, Vemuri and Siddiqi (2009) use instrumental variable approach of Hausman and Taylor (1981).

[14] Our approach is similar to Choi (2010).

49 countries into two groups: the AEs and the EMEs. The corresponding results are reported in Tables 5 & 6.

3.1   Baseline Model

Table 3 shows the estimation results for the baseline model for exports and imports of the ten service items. Panel A presents the coefficient estimates for regression equations with natural logarithm of export for each service item as the dependent variable. The estimated coefficients are positive for seven items and statistically significant at the conventional levels for two of them. These two items include other business services and transportation. The first of these two items is an IIS and ICT is the primary vehicle of trade for it. In case of transportation, the ICT development may have enhanced market accessibility and made supply logistics more efficient. In terms of magnitude, the average effect of an increase of 1 point in IDI on export is an increase of 23.3% for other business services and 10.5% for transportation. The effect of IDI is negative for the exports of three services items including computer services and telecommunications but none of the effects is statistically significant. Thus, ICT development has little impact on the exports of these items.

Among the control variables, per capita GDP has a highly significant positive effect on exports of all items. That is, countries with higher per capita real GDP export more of these services. The effects of population on exports are positive for five items and negative for the rest. While the positive effect is statistically significant only for other businesses services, the negative effects are significant for four items. As discussed above, positive effects are presumably due to the supply side impacts and the negative effects are due to the demand side impacts of population growth. Finally, financial depth does not seem to matter much except for the export of financial services, transportation, and travel services. Countries with well-developed financial system tend to export significantly more of these items. While this is expected for financial services, financial resources may be crucial for the growth of transportation and travel and therefore a well-developed financial sector contributes to export growth of these services.

[Insert Table 3]

In Panel B, we present the results for the model with logarithm of imports for various service items as the dependent variable. The estimated coefficients are positive for eight items and statistically significant at the 1% level for three of them. The average effect of a 1 point increase in IDI on imports

is an increase of 24.3% for insurance services, 25.9% for telecommunication services, and 14.5% for travel services. Among the control variables, per capita GDP has a positive effect on imports of all items and the effect is statistically significant for all but insurance services. These results accord well with the intuition: as per capita real GDP grows and, therefore, standard of living improves, the demand for service imports increases. Population has a negative effect on the imports of eight items (of which four are statistically significant) and a statistically significant positive effect on the imports of telecommunication services and travel. In cases of significant negative effects, as we have discussed above, with population increase, the size of the domestic markets for these items may have increased and, as such, instead of importing them, it is profitable to produce them domestically. Consequently, imports decrease. Finally, the effects of financial depth are positive and statistically significant for imports of eight service items. Thus, financial development seems to increase import demand for these services.

In Table 3, we also report Hansen's *J*-statistics and the associated *p*-values. These results indicate that in most cases, our instruments are valid. We reject the null hypothesis that the instruments are valid at least at the 5% level only in two cases: export of travel services and import of insurance services.

Overall, the results suggest that ICT development has contributed significantly to the international trade of not all but only a relatively small number of services (only 25% of all cases considered). Three of these services (other business services, insurance services, and telecommunication services) are IISs and two (transportation and travel) are non-IIS. In case of IISs. In case of IISCs, ICT contributes to trade in a service (e.g. most services in 'other business services' category) by being the primary vehicle of trade or by generating demand for a specific service (e.g. telecommunication services) through its proliferation. In contrast, in case of non-IISs, ICT increases trade primarily by reducing transaction costs as we have discussed in the introduction. In comparing the results across service items, it is important to recognize that the number of countries and the sample period for each country are not the same for different service items.

3.2 *Effects of ICT Access, ICT Use, and ICT Skills on Exports and Imports*

It is possible that different aspects (components) of ICT development may not be equally important for trade in different services. Therefore, we also consider the three different sub-indices that represent ICT access, ICT use, and ICT skills. These sub-indices possess similar properties as does IDI. That is, each sub-index takes a value between 0 and 10, with 0 representing the lowest level of ICT access (or

use or skills) and 10 representing the highest level. We then estimate the export and import equations for different service items, including one of these three sub-indices at a time.

[Insert Table 4]

Table 4 presents the results. We only report the coefficient estimates for the ICT variables in the six sets of regression models (three for exports and three for imports) and do not include the coefficient estimates for the control variables. The estimated coefficients for the control variables are qualitatively (the signs and statistical significance) similar to those shown in Table 3. Table 4 shows that the coefficient estimates are overwhelmingly negative for ICT access. In the export equations, five of the six negative coefficients are statistically significant while only one of the remaining four positive coefficients is significant. Improved access to ICT increases the export of computer services. The negative effect on the export of telecommunication services may simply reflect the fact that as people have more access to ICT (mainly to phone services as the underlying variables suggest), the domestic demand for this service item increases and, consequently, export decreases. However, it is not intuitively clear why increase in ICT access decreases exports of construction, insurance services, royalties and license fees, and transportation. ICT access has positive effects on the imports of only three service items but none of these effects is statistically significant. It has negative effects on the imports of seven items of which only two (other business services and transportation) are significant. Increased ICT access may increase domestic production of other business services thereby reducing the demand for imports. However, it is not clear why imports of transportation services would decline as ICT access increases.

ICT use has positive effects on exports and imports of most items. The positive effects are statistically significant in six out of nine cases of exports and in seven out of eight cases of imports. The majority of these services are IISs. In contrast, it has a significant negative effect only on the export of computer services. This may reflect increase in domestic demand for these services as people use more ICT. ICT skills have significant positive effects on the exports of insurance services, royalty and license fees and transportation, and imports of financial services and insurance. Higher ICT skills seem to increase the supply of these export items and the demand for these import items.

Overall, these results suggest that, among various ICT indicators, ICT use is the most important factor for exports as well as imports of majority of service items. Since ICT use sub-index primarily reflects the extent of internet use, this aspect of ICT development is the most helpful in increasing service trade flows. These results seem to resonate well with results reported in Liu and Nath (2013)

who conclude that the trade enhancing effects of ICT does not depend on ICT infrastructure or ICT capability per se but on its use. Note that their study covers both goods and services trade in 40 emerging market economies.

3.3   *Advanced Economies (AEs) versus Emerging Market Economies (EMEs)*

Since our sample includes both AEs and EMEs, it would be interesting to examine if ICT development affects services trade differently in these two sets of countries. As we see from Appendix Table A.2, there are 21 AEs and 28 EMEs in our sample.

[Insert Table 5]

Table 5 presents the results for AEs. According to Panel A, ICT development has a significant positive impact on the exports of construction, other business services, and transportation in AEs. The estimated coefficients are negative for exports of computer services, telecommunication services, and travel, but none is statistically significant. The effects of ICT development on imports are positive for five items and negative for five items. However, the positive effect is significant only for financial services and negative effect is significant only for travel. We then consider ICT access, use, and skills separately. Unlike for the entire sample of countries, ICT access has significant negative effect on exports and imports of computer services. There are three items for which the export enhancing effects of ICT access are statistically significant. Thus, increased ICT access seems to help develop a domestic market for computer services and as such their exports and imports decline. In contrast, increased ICT access leads to higher external demand for audio-visual and related services, other business services, and travel. For no service item, this ICT variable significantly increases imports.

Similarly, the effects of ICT use are less overwhelming for AEs than for the entire sample. The positive effects on exports are statistically significant only for construction and other business services and those on imports only for telecommunication services. Since most 'other business services' are IISs, ICT is the primary vehicle of trade and, therefore, as its use increases, so does trade in those services. Furthermore, increased ICT use creates demand for telecommunication services. The impacts of ICT skills are significantly positive for exports of three items and for imports of one item. Further, ICT development and its various components do not seem to have any impact whatsoever on the exports of insurance services and royalty and license fees, and imports of construction, other business services, royalty and license fees, and transportation in AEs. Interestingly, the majority of

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them are IISs. Our finding of insignificant impact of ICT on services trade of several items in AEs is consistent with the results reported in Clarke and Wallsten (2006) for merchandize trade. In general, the number of export items for which ICT has significant positive effects is larger than the number of import items in AEs. Since we do not consider the factors in the destination (for exports) and source (of imports) countries, it is difficult to speculate on factors - other than those that are specific to the services trade items – that drive these results.

[Insert Table 6]

Table 6 reports the results for EMEs. ICT development has a significant negative effect on exports of construction only. However, three of the nine positive coefficients for IDI in the import equations are statistically significant. The effects of ICT access on exports are negative for six items and four of them are statistically significant. In contrast, there are two items for which this ICT variable significantly decreases imports. The effects of ICT use are overwhelmingly positive and statistically significant for three export items and seven import items. Similarly, ICT skills are beneficial mostly for services imports. In general, our results show that overall ICT development, ICT use, and ICT skills primarily benefit imports of a number of items. It may be noted that exports of audio-visual and related services, other business services, and travel from EMEs have not been significantly affected by any of the ICT variables. The significant impact of ICT on imports of most service items seems to suggest that ICT development has significantly improved the access to the EMEs market for foreign companies, which has contributed to the increase in imports.

In summary, ICT seems to have relatively broader and stronger effects on service trade, particularly imports, in EMEs. There is not a single service import item considered here that has not been significantly affected by at least one component of ICT development. Furthermore, ICT use has been the most important driver of service imports in EMEs. In contrast, the significant positive effects of ICT in AEs are confined to a relatively small number of export items and even smaller number of import items. It is likely that the most ICT-induced trade growth in AEs occurred before the sample period we consider here. Major advances in ICT took place in the 1990s and AEs were the first to introduce and benefit from these advances. Thus, the growth of exports and imports during the post-1990s was primarily due to factors other than ICT advances in those countries. However, for EMEs, their services trade may have just started to benefit more from ICT with the proliferation of technology in these countries in the post-1990s. Furthermore, AEs are matured service economies and demand and supply of services are likely to be quite stable. Therefore, we do not see any trade

enhancing effect of ICT in those economies, particularly in the 2000s. Nevertheless, trade in general, and services trade in particular, between these two groups of countries increased significantly during the first decade of the 21st century and our results show that ICT played an important role in promoting trade in EMEs.

4. Sensitivity Analysis

In order to examine if the results with regard to the effects of ICT on exports and imports are robust to the estimation method, we now estimate panel data fixed effects models with both year and country-specific effects included in our model. The results are reported in Table 7. We include the coefficient estimates for the ICT variables only.[15] Note that since the treatment takes place at the country level in our models, the reported standard errors are clustered at that level.

Comparing with the coefficient estimates of IDI from GMM, we find that the signs change for two items each in export as well as import equations but none of these four coefficients is statistically significant under any of the estimation procedure. Furthermore, the significant positive effects of IDI on exports of other business services and transportation services, and on imports of insurance services, telecommunication services and travel are robust under these two estimation methods. Additionally, the estimated coefficient for imports of financial services is found to be statistically significant when we use the panel data fixed effects approach. While other business services, insurance services, and telecommunication services are IISs, the other two are non-IISs. As we discussed before, the channels through which ICT affects trade in these two types of services are different.

[Insert Table 7]

Among the three ICT components, only ICT use has significant positive effects for the largest number of services items: three export items and four import items. The significant positive effects of this ICT variable on the export as well as import of other business services and transportation services, and import of travel are robust across these two methods. The significant negative impact of ICT access on the export of construction and the significant positive impact of ICT skills on the imports of insurance service are also robust. However, there are quantitative differences in the coefficient estimates between the methods.

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[15] Interested reader may obtain coefficient estimates for other control variables as well as goodness-of-fit measures and test statistics for significance of the fixed effects from the corresponding author.

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5. Concluding Remarks

Most previous studies show that ICT advances have a significant positive impact on trade, particularly on services trade. However, this impact may vary across various service categories, depending on the extent and ways in which ICT is used by a particular service. This paper empirically examines the impact of ICT on exports and imports of ten service items using panel data from 49 countries - including both AEs and EMEs for the period from 2000 to 2013. We combine seven different ICT variables to construct a comprehensive ICT development index (IDI) that captures the access, use, and skills aspects of the technology. Our results indicate that ICT development has significant positive impacts on the exports of other business services and transportation services and the imports of insurance services, telecommunication services, and travel. This result is robust under two estimation procedures, namely, GMM and panel data fixed effects estimation method.

We also estimate the export and import models with ICT access, ICT use, and ICT skills sub-indices separately to investigate if these three components of overall ICT development affect services trade differently. Our results indicate that ICT use is more important than access and skills for trade in a number of services. Furthermore, when we estimate the models separately for AEs and EMEs, we find that while ICT development is more important for exports from AEs, it is found to be more important for imports by EMEs. Finally, ICT use is more important in EMEs, particularly for imports.

These results provide important insights for development of theory to explain the link between ICT and services trade. *First*, it is important to recognize that different aspects of ICT are important for trade in different services. For example, ICT access is important for exports of computer services while ICT use is more important for exports of other business services. Thus, a model that is intended to explain trade in computer services (or similar services) will have to consider ICT access while a model that is intended to explain trade in other business services (or similar services) will have to focus on modeling ICT use. This differentiation will help uncover the channel through which ICT affects trade in different services. *Second*, it may be important to take into account the level of development of a country in examining the effect of ICT on services trade. Our results seem to suggest that at a much higher level of overall development, ICT may have little trade-enhancing effect on services. Thus, any theoretical model may have to consider such non-linearity in the effects of ICT on exports and imports.

The results reported in the paper also have implications for policy towards ICT development and growth of services trade. They seem to suggest that policies that facilitate and encourage the adoption and use of ICT will go a long way in boosting trade of several services particularly in EMEs. The biggest advantage of ICT is that over the years the price of ICT has gone down substantially and it is relatively inexpensive to increase ICT adoption and use. Thus, based on these results, one can argue that EMEs trying to promote international trade may introduce policies that would increase the use of ICT.

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Table 1

Summary Statistics of the Major Variables

Variables	Mean						Standard Deviation					
	Overall	Minimum		Maximum			Overall	Minimum		Maximum		
Export (millions of 2005 constant USD)												
Audio-Visual and related services	330	1.08	(BGD)	2040	(GBR)		541	0.25	(PAK)	646	(GBR)	
Computer services	3290	24.10	(BGD)	26800	(IRL)		7010	7.99	(IRN)	16900	(IRL)	
Construction	1540	10.20	(BGD)	9680	(DEU)		2910	6.56	(IRL)	5900	(CHN)	
Financial services	3620	6.19	(ARG)	50400	(USA)		10700	4.75	(ARG)	20500	(USA)	
Insurance services	1320	2.41	(LTU)	11500	(GBR)		2920	2.57	(BGD)	6040	(GBR)	
Other business services export	13100	161.00	(IRN)	81100	(USA)		19800	68.60	(IRN)	26800	(DEU)	
Royalties and license fees	4110	0.24	(BGD)	84300	(USA)		13700	0.22	(BGD)	24200	(USA)	
Telecommunication services	1050	50.80	(IRN)	7880	(USA)		1890	11.70	(IRN)	3590	(USA)	
Transportation	10100	121.00	(BGD)	57100	(USA)		13300	49.00	(BGD)	16300	(DEU)	
Travel	12200	66.70	(BGD)	113000	(USA)		19100	4.95	(BGD)	14100	(USA)	
Import (millions of 2005 constant USD)												
Audio-Visual and related services	489	0.25	(BGD)	2950	(DEU)		679	0.27	(BGD)	665	(DEU)	
Computer services	1730	3.00	(BGD)	11100	(DEU)		3290	1.89	(BGD)	8870	(USA)	
Construction	1030	2.53	(COL)	7050	(DEU)		1830	2.56	(COL)	2670	(JPN)	
Financial services	1500	16.40	(LTU)	13800	(USA)		2760	13.40	(LTU)	3330	(GBR)	
Insurance services	2190	1.60	(EST)	39300	(USA)		6440	0.69	(EST)	16000	(USA)	
Other business services	11100	148.00	(BGD)	54300	(DEU)		15200	18.60	(IRN)	18700	(USA)	
Royalties and license fees	3680	7.62	(BGD)	26400	(USA)		6970	4.52	(IRN)	14300	(IRL)	
Telecommunication services	1000	14.00	(BGD)	6190	(USA)		1580	3.48	(IDN)	2240	(ITA)	
Transportation	12000	547.00	(LVA)	71500	(USA)		16100	223.00	(LVA)	30200	(CHN)	
Travel import	11700	195.00	(BGD)	73800	(USA)		18000	73.40	(BGD)	38800	(CHN)	
Independent variables												
IDI index	4.81	1.43	(PAK)	7.59	(DNK)		1.98	0.41	(BGD)	1.39	(LTU)	
Per Capita GDP (thousands of 2005 USD)	19.49	0.46	(BGD)	46.57	(NOR)		17.66	2.23	(PAK)	73.95	(KOR)	
Population (million)	102	1.35	(EST)	1310	(CHN)		242	0.03	(EST)	67.30	(IND)	
M2 /GDP x 100	87.46	25.75	(ARG)	218.68	(JPN)		49.91	2.51	(NOR)	44.10	(IRL)	

Note: The codes of the countries that have the minimum or the maximum value of the relevant variable are in parentheses. For codes, see Appendix Table A.3.

Table 2

Average Correlations between Trade Variables and IDI

Services trade	Correlation coefficients	Services trade	Correlation coefficients
Audio-Visual and related services	0.57 (-0.91, 0.99)	Audio-Visual and related services	0.52 (-0.80, 0.99)
Computer services	0.83 (-0.93, 1.00)	Computer services	0.77 (-0.83, 0.99)
Construction	0.50 (-0.70, 0.98)	Construction	0.46 (-0.99, 0.96)
Financial services	0.72 (-0.51, 0.98)	Financial services	0.64 (-0.71, 0.98)
Insurance services	0.71 (-0.24, 1.00)	Insurance services	0.71 (-0.85, 0.99)
Other business services import	0.78 (-0.93, 0.98)	Other business services export	0.76 (-0.95, 0.99)
Royalties and license fees	0.76 (-0.66, 0.99)	Royalties and license fees	0.80 (-0.54, 0.99)
Telecommunication services	0.62 (-0.93, 1.00)	Telecommunication services	0.73 (-0.73, 0.99)
Transportation	0.73 (-0.74, 0.99)	Transportation	0.74 (-0.66, 0.98)
Travel	0.70 (-0.66, 0.98)	Travel	0.67 (-0.97, 0.93)

Note: The minimum and the maximum values are shown in parentheses.

Table 3 ICT and Services Trade: IV-GMM Estimates for All Countries

Variables	Audio-visual and related services	Computer services	Construction	Financial services	Insurance services	Other business services	Royalty and license fees	Tele-communication services	Transportation	Travel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Service exports										
IDI index	0.121	-0.018	-0.072	0.171	0.016	0.233***	0.133	-0.010	0.105**	0.035
	(0.180)	(0.113)	(0.122)	(0.109)	(0.130)	(0.082)	(0.149)	(0.095)	(0.044)	(0.045)
Log of per capita GDP	0.995**	2.054***	1.995***	1.892***	1.591***	0.704***	0.977**	1.019***	1.010***	1.018***
	(0.458)	(0.352)	(0.327)	(0.280)	(0.342)	(0.219)	(0.394)	(0.282)	(0.115)	(0.118)
Log of population	0.407	0.050	-2.798***	0.233	0.815	1.369**	-2.423**	-2.501***	-0.676**	-0.254
	(1.230)	(0.807)	(0.895)	(0.788)	(0.992)	(0.584)	(1.094)	(0.645)	(0.314)	(0.322)
Log of (M2/GDP)	-0.466	0.200	0.267	0.451**	0.353	0.186	0.375	0.068	0.282***	0.408***
	(0.432)	(0.299)	(0.245)	(0.215)	(0.258)	(0.162)	(0.308)	(0.247)	(0.085)	(0.087)
R-squared	0.251	0.775	0.412	0.580	0.452	0.635	0.454	0.532	0.763	0.698
No. of countries	40	39	44	48	48	49	48	42	49	49
No. of observations	387	381	464	515	525	536	522	437	553	553
Hansen's *J* statistics	0.662	1.213	0.987	1.161	3.044	0.445	0.201	0.38	0.286	10.167
Hansen's *J* p-value	0.416	0.271	0.320	0.281	0.081	0.505	0.654	0.538	0.593	0.001
Panel B: Service imports										
IDI index	0.209	-0.064	0.318	0.132	0.243***	0.109	0.102	0.259***	-0.036	0.145***
	(0.181)	(0.0984)	(0.211)	(0.111)	(0.089)	(0.072)	(0.070)	(0.082)	(0.041)	(0.056)
Log of per capita GDP	2.483***	1.351***	1.601***	1.521***	0.361	1.083***	1.351***	1.141***	1.453***	1.575***
	(0.460)	(0.298)	(0.564)	(0.286)	(0.234)	(0.190)	(0.186)	(0.237)	(0.108)	(0.148)
Log of population	-2.573**	-0.696	-0.074	-0.351	2.187***	-0.149	-1.387***	-1.005*	-0.622**	2.085***
	(1.214)	(0.700)	(1.523)	(0.800)	(0.641)	(0.518)	(0.507)	(0.551)	(0.295)	(0.404)
Log of (M2/GDP)	-0.075	-0.016	0.888**	0.829***	0.380**	0.725***	0.508***	0.211	0.301***	0.656***
	(0.427)	(0.247)	(0.417)	(0.220)	(0.176)	(0.142)	(0.141)	(0.199)	(0.080)	(0.109)
R-squared	0.337	0.754	0.207	0.494	0.488	0.610	0.730	0.664	0.802	0.638
No. of countries	39	39	45	49	49	49	49	42	49	49
No. of observations	389	386	469	527	547	549	542	439	553	553
Hansen's *J* statistics	1.488	0.016	0.092	3.282	6.696	2.494	0.207	0.073	0.835	0.03
Hansen's *J* p-value	0.223	0.898	0.762	0.070	0.0097	0.114	0.649	0.787	0.361	0.863

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors are reported in parentheses.

Table 4

ICT Components and Services Trade: IV-GMM Estimates for All Countries

ICT variables	Audio-visual and related services	Computer services	Construction	Financial services	Insurance services	Other business services	Royalty and license fees	Tele-communication services	Transportation	Travel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Service exports										
ICT Access	-0.086	0.256***	-0.224***	0.0324	-0.194**	0.037	-0.202**	-0.152**	-0.093***	0.009
	(0.108)	(0.082)	(0.072)	(0.068)	(0.079)	(0.049)	(0.092)	(0.064)	(0.026)	(0.027)
ICT Use	0.163*	-0.183***	0.117*	0.072	0.095	0.122***	0.181**	0.121**	0.123***	0.037
	(0.090)	(0.064)	(0.067)	(0.064)	(0.071)	(0.045)	(0.083)	(0.054)	(0.023)	(0.024)
ICT Skills	-0.067	0.036	0.023	0.063	0.122*	0.027	0.138*	-0.053	0.039*	-0.041*
	(0.092)	(0.058)	(0.065)	(0.058)	(0.071)	(0.044)	(0.082)	(0.049)	(0.023)	(0.024)
Observations	387	381	464	515	525	536	522	437	553	553
Number of countries	40	39	44	48	48	49	48	42	49	49
Panel B: Service imports										
ICT Access	-0.065	-0.111	-0.107	0.066	0.066	-0.175***	-0.051	0.069	-0.081***	-0.044
	(0.107)	(0.072)	(0.126)	(0.069)	(0.055)	(0.042)	(0.043)	(0.056)	(0.025)	(0.034)
ICT Use	0.180*	-0.006	0.358***	-0.044	0.070	0.214***	0.098**	0.127***	0.053**	0.154***
	(0.093)	(0.059)	(0.117)	(0.065)	(0.049)	(0.039)	(0.039)	(0.047)	(0.022)	(0.030)
ICT Skills	-0.010	0.039	-0.087	0.168***	0.095**	-0.012	0.025	0.028	-0.034	-0.044
	(0.093)	(0.050)	(0.117)	(0.059)	(0.048)	(0.038)	(0.038)	(0.042)	(0.022)	(0.030)
Observations	389	386	469	527	547	549	542	439	553	553
Number of countries	39	39	45	49	49	49	49	42	49	49

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors are reported in parentheses.

Table 5

ICT and Services Trade in Advanced Countries: IV-GMM Estimates

ICT variables	Audio-visual and related services	Computer services	Construction	Financial services	Insurance services	Other business services	Royalty and license fees	Tele-communication services	Transportation	Travel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Service exports										
ICT IDI	0.177	-0.176	0.447**	0.194	0.079	0.249***	0.119	-0.055	0.090*	-0.011
	(0.197)	(0.112)	(0.187)	(0.123)	(0.134)	(0.064)	(0.115)	(0.114)	(0.052)	(0.046)
ICT Access	0.458**	-0.312**	0.035	0.214	-0.166	0.202***	0.0191	0.219	0.056	0.145***
	(0.225)	(0.156)	(0.209)	(0.142)	(0.160)	(0.067)	(0.128)	(0.143)	(0.054)	(0.046)
ICT Use	-0.056	-0.044	0.324**	-0.001	0.120	0.128***	0.091	-0.037	0.045	-0.059*
	(0.144)	(0.087)	(0.140)	(0.090)	(0.096)	(0.048)	(0.084)	(0.089)	(0.038)	(0.034)
ICT Skills	0.067	-0.056	0.153*	0.129**	0.032	0.054*	0.036	-0.088*	0.028	-0.018
	(0.096)	(0.053)	(0.091)	(0.061)	(0.067)	(0.033)	(0.058)	(0.054)	(0.026)	(0.023)
No. of obs.	183	180	206	225	229	234	231	177	234	234
No. of countries	19	18	20	21	21	21	21	18	21	21
Panel B: Service imports										
ICT IDI	-0.287	-0.153	0.223	0.341***	-0.082	0.039	0.094	0.021	-0.075	-0.123**
	(0.194)	(0.113)	(0.254)	(0.129)	(0.122)	(0.071)	(0.103)	(0.093)	(0.050)	(0.058)
ICT Access	-0.131	-0.261*	0.260	0.444***	-0.009	0.025	0.064	0.0001	-0.024	0.004
	(0.221)	(0.159)	(0.290)	(0.150)	(0.138)	(0.073)	(0.114)	(0.118)	(0.052)	(0.059)
ICT Use	-0.295**	-0.117	0.068	-0.084	-0.153*	-0.001	0.088	0.158**	-0.036	-0.103**
	(0.144)	(0.086)	(0.188)	(0.095)	(0.088)	(0.052)	(0.074)	(0.073)	(0.037)	(0.042)
ICT Skills	0.030	0.016	0.076	0.278***	0.070	0.035	-0.008	-0.107**	-0.035	-0.036
	(0.095)	(0.052)	(0.126)	(0.063)	(0.061)	(0.035)	(0.051)	(0.043)	(0.025)	(0.029)
No. of obs.	181	187	198	225	231	234	231	182	234	234
No. of countries	18	18	19	21	21	21	21	18	21	21

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors are reported in parentheses.

Table 6

ICT and Services Trade in Emerging Market Economies: IV-GMM Estimates

ICT variables	Audio-visual and related services	Computer services	Construction	Financial services	Insurance services	Other business services	Royalty and license fees	Tele-communication services	Transportation	Travel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Service exports										
ICT IDI	-0.003	0.218	-0.598***	0.115	-0.120	0.154	-0.039	-0.041	0.072	0.111
	(0.368)	(0.206)	(0.155)	(0.170)	(0.223)	(0.147)	(0.269)	(0.173)	(0.069)	(0.072)
ICT Access	-0.162	0.168	-0.346***	0.154*	-0.441***	0.057	-0.217	-0.226***	-0.127***	0.031
	(0.149)	(0.110)	(0.077)	(0.087)	(0.111)	(0.075)	(0.142)	(0.085)	(0.035)	(0.038)
ICT Use	0.274	0.079	0.026	-0.075	0.394***	0.023	0.098	0.267**	0.190***	0.045
	(0.176)	(0.125)	(0.092)	(0.100)	(0.128)	(0.085)	(0.162)	(0.104)	(0.039)	(0.042)
ICT Skills	-0.279	-0.230*	-0.175*	-0.054	0.124	0.079	0.446**	-0.145	0.035	0.017
	(0.220)	(0.136)	(0.105)	(0.113)	(0.149)	(0.094)	(0.198)	(0.112)	(0.045)	(0.048)
Observations	204	201	258	290	296	302	291	260	319	319
No. of countries	21	21	24	27	27	28	27	24	28	28
Panel B: Service imports										
ICT IDI	0.355	0.280	0.471	-0.048	0.588***	0.141	0.080	0.434***	0.031	0.369***
	(0.349)	(0.192)	(0.310)	(0.165)	(0.133)	(0.117)	(0.103)	(0.155)	(0.065)	(0.091)
ICT Access	0.098	-0.094	0.010	0.140*	0.107	-0.117*	-0.062	0.056	-0.096***	0.008
	(0.143)	(0.102)	(0.156)	(0.085)	(0.072)	(0.061)	(0.054)	(0.078)	(0.034)	(0.050)
ICT Use	-0.018	0.267**	0.306*	-0.148	0.251***	0.219***	0.090	0.254***	0.134***	0.285***
	(0.177)	(0.120)	(0.175)	(0.096)	(0.078)	(0.067)	(0.060)	(0.092)	(0.037)	(0.052)
ICT Skills	0.418**	0.238*	0.112	-0.164	0.256***	0.086	0.132*	0.054	-0.001	-0.006
	(0.210)	(0.128)	(0.209)	(0.108)	(0.090)	(0.077)	(0.068)	(0.101)	(0.043)	(0.062)
Observations	208	199	271	302	316	315	311	257	319	319
No. of countries	21	21	26	28	28	28	28	24	28	28

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors are reported in parentheses.

Table 7

ICT and Services Trade: Panel Fixed Effects Estimates

ICT variables	Audio-visual and related services	Computer services	Construction	Financial services	Insurance services	Other business services	Royalty and license fees	Tele-communication services	Transportation	Travel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Service exports										
ICT IDI	0.056	0.021	-0.032	0.228	0.100	0.261***	0.168	0.093	0.158*	0.128
	(0.181)	(0.160)	(0.234)	(0.153)	(0.129)	(0.088)	(0.177)	(0.119)	(0.082)	(0.083)
ICT Access	-0.279	0.160	-0.164*	0.037	-0.174	0.003	-0.117	-0.064	-0.090	0.008
	(0.185)	(0.156)	(0.086)	(0.146)	(0.159)	(0.081)	(0.139)	(0.124)	(0.054)	(0.056)
ICT Use	0.197	-0.085	0.082	0.117	0.122	0.160***	0.122	0.124	0.132***	0.088**
	(0.122)	(0.099)	(0.120)	(0.085)	(0.078)	(0.058)	(0.101)	(0.095)	(0.045)	(0.043)
ICT Skills	0.020	0.011	0.020	0.037	0.115	0.006	0.144	-0.047	0.057	-0.031
	(0.098)	(0.075)	(0.095)	(0.073)	(0.078)	(0.108)	(0.111)	(0.086)	(0.038)	(0.033)
No. of obs.	445	437	537	595	609	627	609	503	647	649
No. of countries	40	40	44	48	49	49	48	43	49	49
Panel B: Service imports										
ICT IDI	0.253	0.024	0.494	0.315**	0.385*	0.150	0.153	0.255**	0.089	0.268**
	(0.261)	(0.158)	(0.344)	(0.155)	(0.229)	(0.094)	(0.109)	(0.106)	(0.056)	(0.112)
ICT Access	-0.068	-0.161	-0.018	0.088	0.029	-0.178**	-0.059	0.014	-0.075	-0.017
	(0.121)	(0.122)	(0.188)	(0.138)	(0.117)	(0.079)	(0.083)	(0.102)	(0.057)	(0.075)
ICT Use	0.152	0.097	0.357**	0.094	0.166	0.191***	0.108	0.119	0.091**	0.181***
	(0.131)	(0.108)	(0.173)	(0.087)	(0.109)	(0.065)	(0.072)	(0.093)	(0.037)	(0.049)
ICT Skills	0.073	0.042	-0.028	0.132	0.134*	0.033	0.064	0.068	0.026	-0.011
	(0.109)	(0.070)	(0.112)	(0.093)	(0.070)	(0.055)	(0.066)	(0.073)	(0.036)	(0.047)
No. of obs.	446	435	537	609	638	643	632	504	649	649
No of countries	39	40	45	49	49	49	49	43	49	49

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors are reported in parentheses

Table A.1

Services Trade Items and WTO definitions

Sl. No.	Trade Items	WTO definition
1	Audio-visual and related services	Includes services and fees related to the production of motion pictures, radio and television programmes, and musical recordings.
2	Computer services	Includes hardware and software related services and data processing services.
3	Construction	Covers work performed on construction projects and installation by employees of an enterprise in locations outside the territory of the enterprise.
4	Financial services	Includes financial intermediation and auxiliary services provided by banks, stock exchanges, factoring enterprises, credit card enterprises, and other enterprises.
5	Insurance services	Covers the provision of various types of insurance to non-residents by resident insurance enterprises, and vice versa, for example, freight insurance, direct insurance (e.g. life) and reinsurance.
6	Other business services	Comprises trade-related services, operational leasing (rentals), and miscellaneous business, professional and technical services such as legal, accounting, management consulting, public relations services, advertising, market research and public opinion polling, research and development services, architectural, engineering, and other technical services, agricultural, mining and on-site processing.
7	Royalty and license fees	Covers payments and receipts for the use of intangible non-financial assets and proprietary rights, such as patents, copyrights, trademarks, industrial processes, and franchises.
8	Telecommunication services	Encompasses the transmission of sound, images or other information by telephone, telex, telegram, radio and television cable and broadcasting, satellite, electronic mail, facsimile services etc., including business network services, teleconferencing and support services. It does not include the value of the information transported. Also included are cellular telephone services, Internet backbone services and on-line access services, including provision of access to the Internet.
9	Transportation	Covers sea, air and other including land, internal waterway, space and pipeline transport services that are performed by residents of one economy for those of another, and that involve the carriage of passengers, the movement of goods (freight), rentals (charters) of carriers with crew, and related supporting and auxiliary services.
10	Travel	Includes goods and services acquired by personal travelers, for health, education or other purposes, and by business travelers.

Source: WTO Statistical Datasets Technical Notes

Table A.2

Composition of ICT Development Index

Variables	Weight in sub-group	Weight of sub-group
ICT Access		
(1) fixed-telephone lines per 100 inhabitants	33%	
(2) mobile-cellular telephone subscriptions per 100 inhabitants	33%	40%
(3) international Internet bandwidth (bit/s) per Internet user	33%	
ICT Use		
(4) percentage of individuals using the Internet	50%	40%
(5) fixed (wired)-broadband Internet subscriptions per 100 inhabitants	50%	
ICT Skills		
(6) secondary gross enrollment ratio	50%	20%
(7) tertiary gross enrollment ratio	50%	

Source: Adapted from Measuring the Information Society by ITU, 2012

Table A.3

List of countries and country codes

Advanced economies		Emerging market economies			
Country	Country code	Country	Country code	Country	Country code
Australia	AUS	Argentina	ARG	Peru	PER
Belgium	BEL	Bangladesh	BGD	Philippines	PHL
Canada	CAN	Brazil	BRA	Romania	ROM
Denmark	DNK	Bulgaria	BGR	Russian Federation	RUS
Finland	FIN	Chile	CHL	Slovenia	SVN
France	FRA	China	CHN	Thailand	THA
Germany	DEU	Colombia	COL	Turkey	TUR
Greece	GRC	Czech Republic	CZE		
Ireland	IRL	Egypt	EGY		
Israel	ISR	Estonia	EST		
Italy	ITA	Hungary	HUN		
Japan	JPN	India	IND		
Netherlands	NLD	Indonesia	IDN		
New Zealand	NZL	Iran, Islamic Rep. of	IRN		
Norway	NOR	Korea, Republic of	KOR		
Portugal	PRT	Latvia	LVA		
Spain	ESP	Lithuania	LTU		
Sweden	SWE	Malaysia	MYS		
Switzerland	CHE	Mexico	MEX		
United Kingdom	GBR	Morocco	MAR		
USA	USA	Pakistan	PAK		

Note: The country codes are taken from the WDI database