



Note

The Impacts of Information and Communications Technology (ICT) and E-commerce on Bilateral Trade Flows

By Zhongwei Xing*

* Zhongwei Xing (Ph.D.), Economic development & international trade consultant. The author thanks CUTS International Geneva for commissioning this empirical analysis. The usual caveat applies.

Introduction

Access to the Internet has changed the way we do business. Internet is seen as a revolutionary medium for collaboration and interaction between individuals and their computers regardless of geographic locations. Its influence reaches not only to the technical fields of computer communications but throughout society as peoples move toward increasing use of online tools for learning, conducting business, information acquisition, and community operations. On the one hand, the technology infrastructure plays a critical role in the adoption and assimilation of Information and Communications Technology (ICT) in a country, which constructs a foundation for its penetration and adoption. On the other hand, the Internet technologies create the basis for continual advances with respect to new goods and services, new markets and new business models in the digital economy. This in return provides the basis for e-commerce development.

In a broad sense, international e-commerce involves cross-border and/or cross-country transactions over the internet which generates substantial savings in transaction costs. The most important cost-saving aspect of e-commerce is reduction in travel, administration, communication and market search costs. E-commerce is being promoted in the global south economies because it enables their producers/exporters to overcome traditional limitations associated with restricted access to information, higher market-entry cost, and isolation from potential markets (April & Cradock, 2000). It is also acknowledged that the web holds significant advantages over Electronic Data Interchange (EDI) technology, as a result the web is easier to use with greater flexibilities and both fixed and variable costs are lower. This in return encourages enterprises to search the best producers regardless of location

(Davidow & Malone, 1992; Panagariya, 2000).

There are three types of e-commerce: Business-to-Business (B2B), Business-to-Consumer (B2C), and Consumer-to-Consumer (C2C). The B2B commerce consists of a wide range of inter-company transactions, including wholesale trade and trade in intermediate goods and services. The B2C is a segment of e-commerce where enterprises sell goods and services to consumers. Although the estimated value of global B2C (US\$1.2 trillion) in 2013 is considerably smaller than B2B (US\$15 trillion), the B2C sector experienced much more rapid growth due to increasing use of the Internet, the emergence of specialised online shops, and global integration of trade (UNCTAD, 2015).

The third type of e-commerce (C2C) is related to the selling of goods and services among consumer. In this market, a growing number of specialised e-commerce firms such as Alibaba (China), Amazon (USA), eBay (USA), Rakuten (Japan), and TradeMe (New Zealand) act as intermediaries allowing individuals to sell new and used goods. While each of these different e-commerce segments relates to a particular interaction between buyers and sellers, all have a potential role in promoting possible new kinds of international trade and transactions in goods and services. It can be safely assumed that e-commerce would become the mainstream of international (export and import) trade in the coming decades.

Although the growth of internet access is widely acknowledged, it imposes numerous integration challenges for developing countries and Least Developed Countries (LDCs) to participate in this e-trade mode. For instance, it is estimated by International Telecommunication Union (ITU) (2015) that 4 billion people from developing countries remain offline, and only 89 million people

living in the LDCs use the Internet. This study is motivated by the need of a robust foundation of knowledge concerning how the development of ICT contributes to international trade. Using panel dataset on recent bilateral trade flow between 30 countries of the Organisation for Economic Cooperation and Development (OECD) and 21 middle- to low-income countries, this study examines the impacts of ICT and e-commerce on export performance. In particular, it attempts to investigate whether the ICT and e-commerce development play a role in boosting total exports of goods in developing- and least-developed countries.

Given the commitment of East African Community (EAC)¹ to be the frontrunner in the export-led economy across the African continent, a separate gravity model of trade is presented to analyse the relationship between the e-commerce adoption and EAC export performance with their trading partner countries.

The rest of the paper is set out as follows: Section 2 provides a brief literature review on the definition of e-commerce, and the nexus of ICT and international trade. Section 3 discusses the data, methodology and model specifications utilised in analyses of various ICT and e-commerce variables noted above. Section 4 presents the empirical results followed by concluding remarks in the final section.

Literature Review

In this section, definition of e-commerce is discussed followed by a brief literature on the linkages between ICT adoptions on trade performance.

Definition of E-commerce

There are various definitions of e-commerce in the literature. In the academic literature, e-commerce is broadly referred to as an activity that is part of information and communication technology (ICT) activities. For instance, Zwass (1996, p.3) defines e-commerce as “**the sharing of business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks.**” Treese and Stewart (1998, p.5) define e-commerce as “**the use of global Internet for purchase and sale of goods and services, including services and support after the sale.**” Kalakota and Whinston (1996, p.3) define e-commerce as “**the delivery of information, products/services, or payments via telephone lines, computer networks or any other means**”, while Kauffman and Walden (2001, p. 3) emphasize “**the Internet as a medium for enabling end-to-end business transactions.**” It also applies (ibid, p.3) “**...in dotcom [and] Internet-only business settings, as well as more traditional business settings where the new channel of the Internet is being used alongside existing channels.**”

Amongst global intergovernmental organisations, the universal definitions of e-commerce seem to be transaction-oriented. For instance, OECD (2009) defines e-commerce as “**an e-commerce transaction is the sale or purchase of goods or services,**

¹ The EAC includes: Burundi, Kenya, Rwanda, Tanzania, and Uganda.

conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders. The goods or services are ordered by those methods, but the payment and the ultimate delivery of the goods or services do not have to be conducted online. An e-commerce transaction can be between enterprises, households, individuals, governments, and other public or private organisations. To be included are orders made over the web, extranet or electronic data interchange. The type is defined by the method of placing the order. To be excluded are orders made by telephone calls, facsimile or manually typed e-mail.²² World Trade Organisation (WTO) (2013, p.ii) defines e-commerce as “the sale or purchase of goods or services conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders.”

For the purpose of this study, the international e-commerce is defined as consisting of cross-border transactions that involve online orders leading to the delivery of goods and services from exporting countries to importing countries. The next section discusses the linkage between ICT infrastructure and international trade.

ICT and International Trade

In the early studies, growth theory was the theoretical vantage point to observe and examine the contribution of exogenous technological progress to economic growth (see Solow, 1956; Swan, 1956). As technology infrastructure progresses, the contribution of penetration and adoption of ICT to a country's economic growth is observed. For instance, using cross-sectional time series data for 60

countries over 13 years, Hardy (1980) found that the usage of telephones per capita promotes growth in GDP per capita a year later.

It is also observed that there are few studies on the contribution of the Internet to international trade. For instance, Freund and Weinhold (2002) estimate the effect of the Internet use on trade in services among a selected sample of developed and middle income countries for the period of 1995-1999, indicating that a 10 percentage point increase in the growth of web hosts (as proxy for Internet adoption) in a country leads to an increase of 1.7 and 1.1 percentage point in exports of services and imports of services, respectively. In a companion paper, Freund and Weinhold (2004) find that a 10 percentage point increase in the adoption of Internet leads to a 0.2 percentage point increase in trade in goods. They indicate that the Internet contributed a 1 percentage point to annual growth on average in their panel of 56 countries between 1997 and 1999.

Tang (2006) investigates how the usage of different means of telecommunications affects US imports of differentiated goods from 1975 to 2000. With a fixed-effect model approach, the study finds that adoptions of fixed line telephones, mobile phones, and internet connection in the exporting countries have significant impact on US imports of differentiated goods, indicating that a 10% rise in **exporter's internet adoption rate increases the total exports of goods to the US by 1%**. By utilising cross-sectional data on the total exports of goods in 2001 for 26 developed countries and 72 developing countries, Clarke and Wallsten (2006) find that internet use promotes trade flows from developing countries to developed countries, but no significant

²²See OECD (2009) at http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011/en/06/10/index.html?contentType=&itemId=%2Fcontent%2Fchapter%2Fsti_scoreboard-2011

64en&mimeType=text%2Fhtml&containerItemId=%2Fcontent%2Fseriesal%2F20725345&accessItemIds=

effect is found when the trade flow is from developed countries to developing countries.

Vemuri and Siddiqi (2009) analyse the effect of ICT infrastructure and internet use on international trade for a panel of 64 countries between 1985 and 2005. They find that a 10% increase in internet adoption leads to a 2% increase in bilateral trade. While Choi (2010) indicates that a doubling of internet usage would increase a country's export of services by 2-4% among 151 countries between 1990 and 2006, Liu and Nath (2013) find internet subscriptions and internet hosts are positively and significantly related to trade performance in 40 emerging market economies between 1995 and 2010.

Yushkova (2014) uses the business Internet usage index to estimate the effect of the Internet on total exports of goods in 2011 for 40 countries (OECD countries plus Brazil, China, India, Indonesia, Russia and South Africa). She finds that the Internet usage by business communities in both exporting and importing country has a positive link with the export flows between these countries. The next section discusses data and variable definitions, methodology and model specification.

Data, Methodology and Model Specification

Data and Variable Definitions

The dataset for this study is assembled using a variety of sources (see Table 1). The sample includes a panel of 21 developing- and least-developed countries³ and 30 OECD⁴ countries to empirically examine whether the emergence of e-commerce plays a role in boosting developing- and least-developed countries' export performance. The sample countries are further divided into three subsample groups: 1) *South-to-North*; 2) *North-to-South*; and 3) *EAC-to-Rest of the World*⁵. For instance, the subsample group of *EAC-to-Rest of the World* indicating the bilateral trade between EAC member countries and their counterparts, while the *South-to-North* subgroup implies trade directions from countries are considered as the global south economies to countries that are referred to as the global north economies. Moreover, the *EAC-to-Rest of the World* implies the total amount of final goods the EAC member countries exported to the countries of interest.

³ They are: Brazil, Brunei, Burundi, Cambodia, China, India, Indonesia, Kenya, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Russia, Rwanda, Sri Lanka, South Africa, Thailand, Tanzania, Uganda, and Vietnam.

⁴ They are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and United States.

⁵ Rest of the World includes Australia, Austria, Belgium, Brazil, Brunei, Cambodia, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Luxembourg, Malaysia, Myanmar, Nepal, Netherlands, New Zealand, Norway, Poland, Pakistan, Philippines, Portugal, Russia, Slovak Republic, Slovenia, South Africa, Sri Lanka, Spain, Sweden, Switzerland, Thailand, United Kingdom, United States, and Vietnam.

Table 1: Variable Definition and Source

Variable	Definition	Source
<i>lnTrade_{ij}</i>	Total exports of goods from country <i>i</i> to country <i>j</i> . The variable is created by taking the logarithm of (exports _{ij} +0.001) for the year 2014 in current US\$	OECD STAN Bilateral Trade Database by Industry and End-use category.
<i>Distance_{ij}</i>	Physical distance between the capital cities of country <i>i</i> and country <i>j</i> in kilometres	French Research Centre in International Economics (CEPII)
<i>Contiguous_{ij}</i>	Country <i>i</i> and country <i>j</i> shares the same border (Yes = 1, No = 0)	CEPII
<i>Language_{ij}</i>	Country <i>i</i> and country <i>j</i> shares at least one common language (Yes = 1, No = 0)	CEPII
<i>Colony_{ij}</i>	Country <i>i</i> and country <i>j</i> have a former colonial link (Yes = 1, No = 0)	CEPII
<i>Telephone_i</i>	Fixed telephone subscriptions per 100 people in country <i>i</i> .	World Development Indicators (WDI) database (World Bank, 2014).
<i>Telephone_j</i>	Fixed telephone subscriptions per 100 people in country <i>j</i> .	WDI 2013-2014
<i>Cellphone_i</i>	Mobile cellular subscriptions per 100 people in country <i>i</i> .	WDI 2013-2014
<i>Cellphone_j</i>	Mobile cellular subscriptions per 100 people in country <i>j</i> .	WDI 2013-2014
<i>Broadband_i</i>	Broadband subscriptions per 100 people in country <i>i</i> .	WDI 2013-2014
<i>Broadband_j</i>	Broadband subscriptions per 100 people in country <i>j</i> .	WDI 2013-2014
<i>InternetSecurity_i</i>	Secure internet services per 1 million people in country <i>i</i> .	WDI 2013-2014
<i>InternetSecurity_j</i>	Secure internet services per 1 million people in country <i>j</i> .	WDI 2013-2014
<i>InternetUser_i</i>	Number of Internet users per 100 people in country <i>i</i> .	WDI 2013-2014
<i>InternetUser_j</i>	Number of Internet users per 100 people in country <i>j</i> .	WDI 2013-2014
<i>lnMarketSize_{ij}</i>	Relative market size between the country <i>i</i> and country <i>j</i> for the year 2014 in constant US\$.	WDI 2013-2104
<i>lnGDPPC_i</i>	Log of real GDP per capita in country <i>i</i> for the year 2014 in constant US\$.	WDI 2013-2014
<i>lnGDPPC_j</i>	Log of real GDP per capita in country <i>j</i> for the year 2014 in constant US\$.	WDI 2013-2014
<i>B2B_i</i>	Extent of B2B internet use in country <i>i</i> . An index valued in the range between 1 and 7 (best).	INSEAD, The Global Information Technology Report 2014-2015, World Economic Forum (WEF).
<i>B2B_j</i>	Extent of B2B internet use in country <i>j</i> . An index valued in the range between 1 and 7 (best).	WEF, 2014-2015.
<i>B2C_i</i>	Extent of B2C internet use in country <i>i</i> . An index valued in the range between 1 and 7 (best).	WEF, 2014-2015.
<i>B2C_j</i>	Extent of B2C internet use in country <i>j</i> . An index valued in the range between 1 and 7 (best).	WEF, 2014-2015.
The Nexus of E-commerce and EAC Trade Performance		
<i>B2B_i</i>	Extent of B2B internet use in country <i>i</i> . An index valued in the range between 1 and 7 (best).	INSEAD, The Global Information Technology Report 2013-2014,
<i>B2B_j</i>	Extent of B2B internet use in country <i>j</i> . An index valued in the range between 1 and 7 (best).	WEF, 2013-2014.
<i>B2C_i</i>	Extent of B2C internet use in country <i>i</i> . An index valued in the range between 1 and 7 (best).	WEF, 2013-2014.
<i>B2C_j</i>	Extent of B2C internet use in country <i>j</i> . An index valued in the range between 1 and 7 (best).	WEF, 2013-2014.

The value of total exports of goods from country set (*i*) to country set (*j*) is obtained from the OECD STAN Bilateral Trade Database. As shown in Table 1, the study created a number of dummy variables to capture a common language (*Language*), former colonial links (*Colony*) and a common border (*Contiguous*). These dummy variables take the value of **1 when countries' characteristics are shared and 0** otherwise. These variables along with geographic distance (*Distance*) between the two sets of countries are derived from French Research Centre in International Economics (CEPII).

Data on real GDP, real GDP per capita, and ICT-related infrastructure (such as telephone subscriptions, mobile cellular subscriptions, broadband subscriptions, number of secure Internet servers, and number of Internet users) for country set *i* and *j* are originated from the World Bank's *World Development Indicators Database*.

The e-commerce indices (i.e., B2B and B2C) are drawn from the World Economic Forum's Executive Opinion Survey (Dutta, Geiger, & Lanvin, 2015) as part of the networked readiness index. The index consists of 54 indicators and organised by 10 pillars. The index of B2B measures the extent of ICTs adoption for business-to-business transactions, while B2C indicates the extent of business Internet use for selling their goods and services to consumer.

These indices are under the business usage subindex (7th pillar) and measured on a 1-to-7 scale (with 7 being the best possible outcomes)⁶. The B2B and B2C Internet use indices are calculated for the period 2014/2015, hence, to capture the effects of e-commerce readiness and adoption between country

set *i* and country set *j*, a 1-year time lag is considered.

To overcome the data limitations in the nexus of e-commerce and EAC export performance, the value of total exports of goods from EAC countries (i.e., country set *i*) to *Rest of the World* (i.e., country set *j*) is obtained from the OECD STAN Bilateral Database for the year 2013. Therefore, the 2013/2014 B2B and B2C Internet use indices are used to examine the role of e-commerce in EAC countries export performance. Other associated macroeconomic variables are for the year 2013 (see Table 1).

The ranking of selected countries by B2B and B2C Internet usage is presented in Table 2. Most of the **OECD countries are ranked in the world's top 50** in terms of B2B and B2C Internet adoptions except for Poland, Greece and Italy. The extent of e-commerce Internet usage varies across the developing- and least-developed countries, for instance, Malaysia (21), South Africa (37) and Kenya (45) are in the top 50 spots in B2B Internet use, whereas Malaysia (15), Indonesia (28), China (34), Russia (36) and Brazil (37) are occupied in the top 50 in B2C Internet use (see Table 2). The regional development in the B2C e-commerce segment also differs considerably. For instance, in Africa, the expansion is linked to the rapid growth of mobile solutions for making digital transactions, whereas the patterns are highly diverse **in Asia ranging from the world's largest B2C e-commerce market in China** to countries in which e-commerce is only beginning to emerge (UNCTAD, 2015). The next section discusses the methodology and model specification.

⁶ see the Global Information Technology Report 2015, at http://www3.weforum.org/docs/WEF_GITR2015.pdf

Table 2: The Extent of B2B and B2C Internet Usage Indices in 2014/2015

	South				North				
	B2B		B2C		B2B		B2C		
	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Value
Brunei	59 (148)	5	75 (143)	4.5	Australia	28 (143)	5.5	16 (143)	5.7
Cambodia	83 (143)	4.6	109 (143)	3.8	Austria	15 (143)	5.7	24 (143)	5.5
Indonesia	51 (143)	5.1	28 (143)	5.4	Belgium	22 (143)	5.6	31 (143)	5.2
Malaysia	21 (143)	5.6	15 (143)	5.7	Canada	23 (143)	5.6	17 (143)	5.7
Myanmar	136 (143)	3.4	129 (143)	3.2	Czech Republic	25 (143)	5.6	12 (143)	5.8
Nepal	129 (143)	3.9	114 (143)	3.6	Denmark	27 (143)	5.6	23 (143)	5.5
Pakistan	97 (143)	4.3	102 (143)	3.9	Estonia	2 (143)	6.1	11 (143)	5.8
Philippines	52 (143)	5.1	58 (143)	4.7	Finland	5 (143)	6.1	33 (143)	5.2
Sri Lanka	57 (143)	5	56 (143)	4.8	France	44 (143)	5.2	29 (143)	5.3
Thailand	59 (143)	4.9	49 (143)	4.9	Germany	29 (143)	5.5	13 (143)	5.8
Vietnam	49 (143)	5.1	54 (143)	4.9	Greece	102 (143)	4.3	81 (143)	4.3
Brazil	84 (143)	4.6	37 (143)	5.1	Hungary	30 (143)	5.5	46 (143)	4.9
Russia	66 (143)	4.8	36 (143)	5.1	Iceland	12 (143)	5.8	22 (143)	5.5
India	119 (143)	4	95 (143)	4.1	Ireland	35 (143)	5.3	45 (143)	5
China	61 (143)	4.9	34 (143)	5.2	Israel	31 (143)	5.5	21 (143)	5.5
South Africa	37 (143)	5.3	65 (143)	4.6	Italy	103 (143)	4.3	73 (143)	4.4
Burundi	142 (143)	2.9	140 (143)	2.6	Japan	4 (143)	6.1	3 (143)	6.1
Kenya	45 (143)	5.2	61 (143)	4.7	Luxembourg	11 (143)	5.8	19 (143)	5.6
Rwanda	81 (143)	4.6	100 (143)	4	Netherlands	9 (143)	5.9	4 (143)	6
Tanzania	117 (143)	4	121 (143)	3.5	New Zealand	16 (143)	5.6	9 (143)	5.9
Uganda	114 (143)	4	125 (143)	3.4	Norway	8 (143)	5.9	7 (143)	5.9
					Poland	98 (143)	4.3	52 (143)	4.9
					Portugal	24 (143)	5.6	30 (143)	5.3
					Slovak Republic	26 (143)	5.6	25 (143)	5.5
					Slovenia	38 (143)	5.3	47 (143)	4.9
					Spain	46 (143)	5.1	48 (143)	4.9
					Sweden	10 (143)	5.9	5 (143)	6
					Switzerland	6 (143)	6	10 (143)	5.8
					United Kingdom	3 (143)	6.1	1 (143)	6.3
					United States	17 (143)	5.6	2 (143)	6.3

Methodology and Model Specification

In the basic forms of the gravity model, the trading volumes between the source and destination countries is assumed to increase with their relative size of economies, and to decrease with the geographical distance between these countries. It is also common to include dummy variables such as sharing the same common border, common language, and former colonial link (Tingergen, 1962, McCallum, 1995, Shepherd, 2013, Yushkova, 2014).

In terms of econometric issues of choosing between a random-effect or fixed-effect model, it is suggested that a random-effect model is preferred for estimating trade flows through a randomly drawn sample of trading partners, while the fixed-effect model is a better choice for estimating trade between an ex-ante predetermined selection of economies (Egger, 2000). Given the structural feature of the dataset, the current study adopts the latter empirical strategy to examine the contribution of ICT infrastructure and e-commerce penetration to bilateral trade. In addition, the current study adopts model estimation strategies by Freund and Weinhold (2004) and Yushkova (2014) to determine the relationship between the different means of ICT adoptions and bilateral trade performance but also contributes several innovations in estimating the contribution of e-commerce Internet use to international trade.

The underlying augmented gravity model with fixed-effects takes the following form:

$$\begin{aligned} \ln Trade_{ij} = & \beta_0 + \beta_1 \ln MarketSize_{ij} + \beta_2 \ln GDPPC_i + \beta_3 \ln GDPPC_j \\ & + \beta_4 \ln DIST_{ij} + \beta_5 Contiguous_{ij} + \beta_6 Language_{ij} \\ & + \beta_7 Colony_{ij} + \beta_8 Telephone_i + \beta_9 Telephone_j \\ & + \beta_{10} Cellphone_i + \beta_{11} Cellphone_j + \beta_{12} Broadband_i \\ & + \beta_{13} Broadband_j + \beta_{14} InternetSecurity_i \\ & + \beta_{15} InternetSecurity_j + \beta_{16} InternetSecurity_{ij} \\ & + \beta_{17} InternetUser_{ij} + \beta_{18} B2B_{ij} + \beta_{19} B2C_{ij} + \varepsilon_{ij} \end{aligned} \quad (1)$$

where $\ln Trade_{ij}$ ⁷ is the natural log of total exports of goods from country *i* to country *j*;

$\ln MarketSize_{ij}$ ⁸ is the relative market size between the origin country and country *i* (measured in the natural log of real GDP of each country);

$\ln GDPPC_i$ is the natural log of GDP per capita in country *i*;

$\ln GDPPC_j$ is the natural log of GDP per capita in country *j*;

$\ln DIST$ is the log of physical distance between the capital cities of country *i* and country *j* (in kilometres); *Contiguous* is a dummy variable that takes 1 if the country *i* and country *j* shares the same border and 0 otherwise;

Language is a dummy variable that takes 1 if the country *i* and country *j* shares at least one common language and 0 otherwise;

Colony is a dummy variable that takes 1 if the country *i* and country *j* have a former colonial link;

Telephone is the fixed telephone subscriptions (per 100 people);

Cellphone is the mobile cellular subscriptions (per 100 people);

Broadband is the fixed broadband subscriptions (per 100 people);

InternetSecurity is secure internet servers (per 1 million people);

*InternetUser*⁹ is an interaction term represents the internet usage in country *i* and country *j*;

⁷ To overcome the problem of zero values, the dependent variable is created by taking the logarithm of (exports_{ij}+0.001) for the year 2014 in current US\$.

⁸ In line with Egger (2000), the coefficient of $\ln MarketSize_{ij}$ defined as $\ln \left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}} \right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}} \right)^2 \right]$

⁹ The interaction term is defined as: $InternetUser_{ij} = \frac{InternetUser_i \cdot InternetUser_j}{\max_{ab}(Internet_a \cdot Internet_b)}$ (2), where $InternetUser_i$ and $InternetUser_j$ are internet users (per 100 people) in country *i* and *j*, respectively.

$B2B^{10}$ is an interaction term represents the extent of business-to-business use in country i and country j ;
 $B2C^{11}$ is an interaction term represents the extent of business-to-consumer use in country i and country j ;
 ϵ_{ij} is the disturbance term.

Apart from non-technology variables as suggested in the literature of gravity model of trade, equation (1) includes five ICT-related infrastructure indicators (i.e., telephone subscriptions, mobile cellular subscriptions, broadband subscriptions, number of secure internet servers) and two e-commerce Internet usage indices (i.e., B2B and B2C). The estimations are made for the year 2014 for the full-sample, South-to-North, and North-to-South groups. In the case of EAC country-specific analysis, the panel estimations are made for the year 2013 due to the unavailable bilateral trade data for Burundi and Uganda for the period 2014. The estimation results are presented and discussed in the following section.

Empirical Results

Empirical Results: Full Sample Analysis

Table 3 in Annex 1 presents the results pertaining to the estimation of nine different model specifications of equation (1). Column 1 shows the results of a basic gravity model without ICT infrastructure and e-commerce Internet use variables. Each of these variables is then added sequentially in the regression equation and the results are inserted in columns 2 to 9. In doing so, it allows the current study to examine the level of ICT infrastructure and the extent of e-

commerce Internet usage on bilateral trade performance from country set i to country set j . The results of all coefficient estimates in equation (1) are presented in column 9.

As shown in column 1, the relative market size ($\ln MarketSize_{ij}$) of country j and country i is an important determinant of trade flows from country i to country j , implying that for a one percentage point increase in the relative market size, trade flows increase by 0.042%. The coefficients for the GDP per capita for country i ($\ln GDPPC_i$) and country j ($\ln GDPPC_j$) are statistically significant and positively related to bilateral trade (and remain significant across model specifications from column 2 to 9), with the estimated coefficient ranging from 0.207 to 0.45 for country j , and from 0.263 to 0.759 for country i . The coefficient of geographical distance ($\ln Distance_{ij}$) is negative and significant, indicating that the longer the distance, the higher the transaction costs and the less trade between the exporting and importing countries. The result is consistent with the studies in the literature and support the view that the level of transaction costs determines trade flows between source and destination countries.¹²

Contiguity ($Contiguous_{ij}$) has no significant effect on trade flows across all model specifications of equation (1), although one would expect a positive effect of sharing a common border on trade. However, many studies in the literature using the gravity model of trade either do not implement a comparable fixed effects econometrics strategy or adopt a different sample of countries (see Baldwin & Taglioni, 2007). The estimated coefficients of

¹⁰ $B2B_i$ and $B2B_j$ is the business-to-business readiness indices as measured on a 1-to-7 (best) scale for the country i and country j , $B2B$ in equation (1) is formulated in the same way as in equation (2).

¹¹ $B2C_i$ and $B2C_j$ is the business-to-consumer readiness indices as measured on a 1-to-7 (best) scale for the country i and country j , $B2C$ in equation (1) is formulated in the same way as in equation (2).

¹² See Tingergem (1962); McCallum (1995); Deardorff (1995); Egger & Lassman (2012); Anderson & van Wincoop (2003); Sharma (2003); Shepherd (2013).

$Language_{ij}$ and $Colony_{ij}$ are significant and positive, implying that having a common language and a colonial political tie (or a regional trade agreement) boost trade flows from country i to country j .

The estimated coefficients of ICT and e-commerce Internet usage variables are presented in columns 2 to 8. The coefficients of ICT variables (i.e., *Telephone & Cellphone*) in columns 2 and 3 are positive and significant, indicating that two-way telecommunications between exporters and importers with good ICT facilities benefit both trading partners. For instance, a 10% increase in the number of fixed and mobile phones in both exporting and importing countries increase bilateral trade by 0.1-0.2%. The estimated coefficients of *BroadBand_{ij}* and *InternetSecurity_{ij}* (in columns 4 and 5) are positive and significant, implying that a 10% increase in the number of high-speed Internet subscriptions and secure servers boost trade by 0.23-0.36% and 0.03-0.04%, respectively. As per column 6, it finds that the number of internet users (as a proxy for internet penetration) has a positive and significant effect on trade flows from country i to country j , with a coefficient estimate of 0.123 at one percent significance level, indicating that a one percentage point increase in bilateral internet adoption boosts trade flows by 0.12%. The empirical results are in line with the general consensus that internet expansion promotes international trade and reduces communication and transaction costs. For instance, Freund and Weinhold (2004) find that growth of the number of internet hosts by 10 percentage points boosts a country's exports by 0.2 percentage points, while Clarke and Wallsten (2006) indicate that a higher internet penetration rate in developing economies improves export performance from developing economies to developed economies. Liu and Nath (2013) find that internet subscriptions and web hosts have a positive and significant effect on exports in emerging market

economies.

Per columns 7 and 8, the current study finds that the extent of importing and exporting countries for e-commerce Internet usage is an important determinant of trade flows from country i to country j , with the estimated coefficients of 0.128 ($B2B_{ij}$) and 0.0003 ($B2C_{ij}$) at one percent significance level, indicating that for every one percentage point increase in e-commerce Internet usage, trade increases by 1.28% and 0.003% respectively. The findings are coincided with the current trend in recognising the importance of global e-commerce in global trade (UNCTAD, 2015).

Empirical Results: South-to-North & North-to-South Subsample Country Analysis

To examine the impacts of ICT and e-commerce on **exporting countries' trade performance**, the dataset has been reorganised into two subsamples: South-to-North and North-to-South. In the South-to-North bilateral trade, *Country i* refers to exporters from developing- and least-developed countries (South), whereas importing countries are the global North economies.

Equation (1) has been re-estimated and results are presented in Table 4 (Annex 2). As per column 1, except for broadband subscriptions in importing countries, the estimated coefficients of ICT infrastructure and e-commerce Internet use variables are found to be statistically significant with expected signs for South-to-North bilateral trade direction. For instance, a one percentage point increase in internet penetration (*InternetUser_{ij}*) in global south economies leads to a 0.09% increase in trade flows from South to North. In order words, a greater access to the Internet lowers communication costs

The readiness of developing and least-developed countries for global e-commerce is more likely to benefit from South-to-North bilateral trade. The results show that for a 10 percentage point increase in B2B- and B2C-type e-commerce Internet adoption in the global south economies, South-to-North trade flows increase by 0.66% and 0.003%, respectively. The coefficient of *Cellphone_i* suggests that mobile phone subscriptions in the developing and least-developed countries can be a potential platform to accommodate e-commerce technology diffusion and promote global e-trade participation.

It is worth noting that while the variables of interest (ICT infrastructure and e-commerce Internet usage) underscore a significant effect on South-to-North trade flows, no significant relationship is found from North-to-South, except for mobile phone subscriptions (see Column 2 in Table 4). The estimated coefficient of *Cellphone* is significant and positive, indicating a 10% increase in mobile phone subscriptions in the importing countries, trade flows increase by 0.1%. The result confirms the international trade enhancing effect of mobile network penetration in the developing- and least-developed countries.

It is also plausible to argue that most of enterprises and consumers in the developed economies already have greater access to the Internet and are experienced in conducting business online, whereas being able to connect with reliable IT networks presents a greater advantage if the micro- and small-enterprises in developing and least-developed countries are aiming to sell their products online to developed countries. Moreover, even with a relatively higher level of ICT infrastructure, in some kinds of markets there may be reason for continued reliance on the services of “middle-person” (see

Bailey & Bakos, 1997; Panagariya, 2000). The middle-person is a pervasive response to information and other market imperfections in developing countries. Intermediaries provide many additional functions beyond simple matching services, including some that are difficult for producers to replicate. Whilst it is inevitable that competition will eliminate intermediaries who fail to add value, low barriers to entry and information asymmetries will continue to provide a lucrative environment for web-based intermediaries.

Empirical Results: EAC-Rest of the World Country Analysis

The estimation results of *EAC-Rest of the World analysis* are presented in Table 4 Column 3. Despite the various degree of fixed telephone line infrastructure across the EAC member countries (i.e., Burundi, Kenya, Rwanda, Tanzania, and Uganda), having a reliable landline is crucial for EAC traders to engage in the international trade. It estimates that a 10% increase in the fixed telephone subscriptions (*Telephone_i*) in EAC member states would boost exports by 1.7%. Mobile phone penetration (*cellphone_i*), on the other hand, has greater magnitude in EAC trade performance, indicating a 10% increase in mobile phone users **raises EAC’s exports by about 3.1%**. Being connected to the Internet, use of high-speed broadband and secured servers are also important elements to enabling EAC traders and enterprises to participate in the global trade. Development efforts have been made through the Backhaul System (EABS) providing EAC member countries with access to submarine cables (The New Times, 2010)¹³. **The recent development in ICT such as “undersea fibre-optic cables have encircled Africa’s coastlines**

¹³ <http://www.newtimes.co.rw/section/article/2010-01-15/15692/>

and begun the long journey inland. Telecommunications providers are investing in 3G and subsidizing smartphone ownership. Innovative solutions are emerging that allow for the delivery of small pieces of the Internet event to basic handsets. At the same time, digital payment services are becoming more important and various online marketplaces are spreading” (UNCTAD, 2015, p.25).

The coefficients of B2B and B2C Internet usage are positive but not statistically significant, implying a need for further e-commerce development in the EAC region. Indeed, as identified by UNCTAD (2015, p.25), major barriers to using e-commerce effectively in Africa “remain in areas such as transport and logistics, inadequate legal frameworks, and limited purchasing power”. Table 2 shows the extent of B2B and B2C penetration is not consistent among EAC member countries. For instance, Kenya is ranked at 45th (B2B) and 61st (B2C) for its e-commerce adoption, followed by Rwanda (81st, 100th), Uganda (114th, 125th), Tanzania (117th, 121st), and Burundi (142nd, 140th).

To address this disparity in e-commerce adoption in the region, a reliable and uninterrupted Internet connectivity is a prerequisite for unlocking the e-trade potentials for the EAC member countries. Thus, it is necessary for the EAC to adopt effective policies and strategies to make broadband available, affordable and accessible. For example, an integrated tariff for broadband subscriptions is needed for the EAC region. As shown in Table 5, Burundi has the highest broadband cost at US\$100 per month, followed by Uganda (US\$39.92), Kenya (US\$34.99), Tanzania (US\$18.96), and Rwanda (US\$17.43).

Lowering broadband cost in Burundi would encourage more entrepreneurs, traders, exporters, small business owners to use the Internet as an effective means not only to conducting business within the EAC region but also at the global level. Meeting the challenge of lowering the broadband Internet cost as a whole, the EAC members should encourage greater uses of e-commerce related technologies by gradually reducing market distortions while building up effective competition enforcement, as it shown in the case of opening the M-Pesa mobile money platform to competition in Kenya (see box 1).

Table 5 Average broadband cost per month: EAC member countries

EAC Members	Price (US\$)	Download Speed
Burundi	100	128kps
Kenya	34.99	256kps
Rwanda	17.43	256kps
Tanzania	18.96	256kps
Uganda	39.92	256kps

Notes: The average monthly broadband tariff plan is targeted for business communities in the EAC member countries. The tariff is quoted in July 2012, except for Rwanda (which is recorded in 2015); The tariff has drawn from Google Fusion Tables at <https://www.google.com/fusiontables/DataSource?docid>; The average monthly broadband tariff in Rwanda is calculated based on Airtel (see <http://africa.airtel.com/>).

Box 1 Opening the M-Pesa mobile money platform to competition

Safaricom's mobile money system is a well-known success story. It was able to grow quickly because Kenya's banking regulators initially decided to take a hands-off approach. For seven years, Safaricom maintained a dominant position through exclusivity agreements locking agents into the system. Initially, such arrangements were perhaps justified because Safaricom incurred high costs developing the system. But in 2014, Kenya's Competition Authority changed the rules and opened the system to alternative mobile operators. The Transaction cost of [money] transfers of up to KSh500 (US\$4.91) fell from KSh66 to KSh44 (US\$0.43).

Source: World Development Report 2016 (World Bank, 2016, p. 32)

The overall findings above confirm that the level of ICT infrastructure and the networked readiness for e-commerce adoption play an important role in boosting export growth by encouraging firms/producers/exporters, especially those who are located in developing and least-developed countries to increase trade in response to the proliferation of global e-commerce value chains. In other words, e-commerce can provide firms/producers/exporters in developing- and least-developed countries with opportunities for accessing new international markets at low-cost and minimal capital investment, for improving competitiveness and customer services, and for reducing transaction cost and overheads.

Concluding Remarks

The focus of this study is to examine the impact of Internet and e-commerce adoption on bilateral trade in 2014 using a panel of 51 countries (i.e., 21 middle- and low-income countries, and 30 OECD countries). The empirical results indicate that access to the physical infrastructure for ICT and e-commerce improves export performance at various levels. For instance, a 10% increase in the number of fixed and mobile phone subscriptions in the source and destination countries increase bilateral trade by

0.1-0.2%.

The study confirms that Internet expansion promotes international trade and reduces communication and transaction costs. It estimates that a 10% growth in high-speed Internet subscriptions and Internet security boost bilateral trade by 0.23-0.36% and 0.03-0.04%, while a 10 percentage point increase in bilateral internet adoption increase exports of goods by 1.2%. The emergence of B2B and B2C e-commerce adoptions also contribute to trade growth, suggesting that for every one percentage point increase in e-commerce Internet usage, trade increases by 1.28% and 0.003% respectively. In the subsample bilateral trade analysis, a higher degree of Internet and e-commerce adoption increases exports of goods from the global south economies to the global north economies. However, no significant relationship is found when the bilateral trade flows are reversed. In the nexus of e-commerce and EAC export performance, the empirical findings suggest that having a reliable and uninterrupted Internet connectivity and encouraging greater use of digital technologies in the region is a prerequisite for unlocking the e-trade potentials for the EAC countries to compete in the global trade.

The empirical results obtained in this study highlight a great potential of e-commerce for developing- and least-developed countries. In the nexus of the South-to-North trade, developing- and least-developed countries must improve the access to the physical infrastructure for e-commerce by pursuing technical and development assistance programmes offered by the Intergovernmental organisations. These programmes could also be achieved within the purview of bilateral official development assistance or other development programmes administered by international and regional organisations.

At the national level, the internet-based export development should be focused on two key areas: 1) infrastructure and logistics; and 2) capacity building and training. Firstly, the need to overcome infrastructural bottlenecks in telecommunications and transport system must be addressed prior to unlocking the potential of e-commerce for developing- and least-developed countries. Improvements should be made in the following areas:

- Improve national roads and railway networks, logistic links to ports and airports;
- Improve transport governance and taking effective measures against antitrust and corruption;
- Establish efficient import and export procedures for e-commerce (including fast track handling of intermediate goods under e-commerce transaction);
- Upgrade ICT infrastructure with tax incentives for private sector's participations and encourage foreign investment in ICT-related sectors;
- Upgrade courier services by improving the coverage of postal home delivery and encourage the small- and medium-sized enterprises (SMEs) to participate in this sector.

Access to technology and ICTs must also combined with relevant skills, opportunities and capacities, thus it is vital to extend access to digital education services and new capability training schemes. While many developing- and least-developed countries have abundant cheap labours, there still remains the issue of developing IT literacy and education to ensure the quality and size of the IT workforce.

Support should be given on aligning curricula with computer science and IT-related courses throughout schools. Vocational training should be in line with the subjects of international business and management, business communication, cross-cultural and language learning, as well as website development and business marketing skills.

In the context of e-commerce participation, practical training should be given on converting paper-based information into a digital format, integrating logistics operations, financial administration, production formation, and managing a network of customers and suppliers. This will involve arranging workshops on organisational and management issues for exports and producers. They need to know which e-commerce marketplaces and web-based information sources may be relevant to their industry. They also need to be informed with regard to **the destination country's** e-marketplace entry requirements and regulations (i.e., customs duties and procedures, the level of online security, Consumer and Sales Laws, online payments and taxes regulations, business subject to intellectual property rights and infringements, roaming charges via mobile devices, and product or service certification). Government and the associated agencies can help fill this gap by establishing an e-commerce specific information centre to assist exporters and producers or individuals who are interested in global e-commerce participation.

References

- Anderson, J. E., & van Wincoop, E. (2003). Trade costs. *Journal of Economic Literature*, 42(3), 691-751.
- April, K., & Craddock, J. (2000). *E-business: redefining the corporate landscape*. Durban: Butterworths.
- Bailey, J. P., & Bakos, Y. (1997). An exploratory study of the emerging role of electronic intermediaries. *International Journal of Electronic Commerce*, 1(3), 7-20.
- CEPPII Gravity Dataset. Retrieved from http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8, 30 April 2016.
- Choi, C. (2010). The effect of the Internet on services trade. *Economic Letters*, 109, 102-104.
- Clarke, G. R., & Wallsten, S. J. (2006). Has the internet increased trade? Developed and developing country evidence. *Economic Inquiry*, 44(3), 465-484.
- Davidow, W. H., & Malone, M. S. (1992). *The virtual corporation: structuring and revitalizing the corporation for the 21st century*. New York: Harper Business.
- Deardorff, A. V. (1995). Determinants of bilateral trade: does gravity work in a neoclassical world? *The Regionalization of the World Economy*, 7, 7-28.
- Dutta, S., Geiger, T., & Lanvin, B. (2015). The global information technology report 2015: ICTs for inclusive growth. World Economic Forum.
- Egger, P. (2000). A note on the proper econometric specification of the gravity equation. *Economics Letters*, 66(1), 25-31.
- Egger, P., & Lassman, A. (2012). The language effect in international trade: a meta-analysis," *Economics Letters*, 116, 221-224.
- Freund, C., & Weinhold, D. (2004). The effect of the Internet on international trade. *Journal of International Economics*, 62, 171-189.
- Freund, C., & Weinhold, D. (2002). The Internet and international trade in services. *American Economic Review*, 92(2), 236-240.
- Hardy, A. P. (1980). The role of the telephone in economic development. *Telecommunications Policy*, 4(4), 278-286.
- International Telecommunication Union (ITU) (2015). ICT facts and figures. Retrieved from <https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>
- Kalakota, R., & Whinston, A. B. (1996). *Electronic commerce: A manager's guide*. London: Addison Wesley Publishing.
- Kauffman, R. J., & Walden, E. A. (2001). Economics and electronic commerce: survey and directions for research. *International Journal of Electronic Commerce*, 5(4), 5-116.
- Linneman, Hans (1966). *An econometric study of international trade flows*. North-Holland, Amsterdam
- Liu, L., & Nath, H. K. (2013). Information and communications technology and trade in emerging market economies. *Emerging Markets Finance & Trade*, 49(6), 67-87.
- McCallum, J. (1995). National borders matter: Canada-U.S. regional trade patterns. *The American Economic Review*, 85(3), 615-623.
- Organisation for Economic Cooperation and Development (OECD) (2009). Guide to measuring the information society. Retrieved from <http://www.oecd.org/sti/sci-tech/43281062.pdf>
- Panagariya, A. (2000). Preferential trade liberalization: the traditional theory and developments'. *Journal of Economic Literature*, 38(2), 287-331.
- Tinbergen, J. (1962). *Shaping the world economy: suggestions for an international economic policy*. New York: Twentieth Century Fund
- Treese, G. W., & Stewart, L. C. (1998). *Designing systems for Internet commerce*. Reading, MA: Addison-Wesley.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65-94.
- Swan, T. W. (1956). Economic growth and capital accumulation. *Economic Record*, 32(2), 334-361.
- Tang, L. (2006). Communication costs and trade of differentiated goods. *Review of International Economics*, 14(1), 54-68.
- United Nations Conference on Trade and Development (UNCTAD) (2015). Information Economy Report 2015: unlocking the potential of e-commerce for developing countries. Retrieved from http://unctad.org/en/PublicationsLibrary/ier2015_en.pdf
- Vemuri, V. K., & Siddiqi, S. (2009). Impact of commercialization of the Internet on international trade: a panel study using the extended gravity model. *The International Trade Journal*, 23(4), 458-484.
- World Bank (WB) (2016). World development report 2016: digital dividends. World Bank Group.
- World Trade Organization (WTO) (2013). E-commerce in developing countries: opportunities and challenges for small and medium-sized enterprises. WTO.
- Yushkova, E. (2014). Impact of ICT on trade in different technology groups: analysis and implications. *International Economics and Economic Policy*, 11(1), 165-177.
- Zwass, V. (1996). Electronic commerce: structure and issues. *International Journal of Electronic Commerce*, 1(1), 3-23.

Annex 1

Table 3: Estimation Results for the Impact of ICT & E-commerce on Trade for the Year 2014: The Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>InMarketSize_{ij}</i>	0.042 (41.98)***	0.044 (41.68)***	0.042 (42.57)***	0.041 (40.12)***	0.043 (42.1)***	0.041 (41.24)***	0.042 (43.05)***	0.04 (34.45)***	0.044 (30.61)***
<i>InGDPPC_i</i>	0.802(10.01)***	0.951 (8.58)**	0.507 (5.16)***	0.759 (6.35)***	0.699 (7.4)***	0.604(7.23)***	0.543 (6.18)***	0.68 (8.35)***	0.263 (1.66)*
<i>InGDPPC_j</i>	0.518 (6.31)***	0.358 (3.78)**	0.346 (4.05)***	0.312 (2.84)***	0.391 (4.15)***	0.343 (4.08)***	0.319 (3.71)***	0.45 (5.53)***	0.207 (1.92)*
<i>InDIST_{ij}</i>	-0.0001(-2.87)***	-0.8E05 (-3.17)***	-0.7E05 (-3.10)***	-0.6E05 (-2.79)***	-0.72E05 (-3.04)***	-0.58E05 (-2.51)**	-0.59E05 (-2.56)**	-0.81E05 (-3.46)***	-0.61E05 (-2.61)***
<i>Contiguous_{ij}</i>	0.441 (0.43)	0.319 (2.03)	0.536 (0.53)	0.388 (0.38)	0.493 (0.48)	1.049 (1.04)	1.051 (1.04)	0.004 (0.00)	0.156 (0.11)
<i>Language_{ij}</i>	0.319 (2.04)**	0.247 (1.53)	0.25 (1.57)	0.036 (0.22)	0.043 (0.28)	0.021 (0.14)	0.0985 (0.65)	0.166 (1.08)	0.334 (2.09)**
<i>Colony_{ij}</i>	1.062 (2.36)**	0.777 (1.75)*	0.869 (2.19)**	0.883 (1.96)**	0.987 (2.2)**	0.821 (6.81)*	0.684 (1.54)	1.09 (2.46)**	0.734 (1.67)*
<i>Telephone_i</i>	-	0.019 (3.81)***							0.002 (0.34)
<i>Telephone_j</i>	-	0.015 (3.02)***							0.013(1.87)*
<i>Cellphone_i</i>	-		0.014 (4.81)***						0.016 (3.93)***
<i>Cellphone_j</i>	-		0.01 (4.02)***						0.009 (3.56)***
<i>Broadband_i</i>	-			0.023 (2.32)**					0.027 (2.14)**
<i>Broadband_j</i>	-			0.036 (3.83)***					0.019 (1.7)*
<i>InternetSecurity_i</i>	-				0.0004 (3.22)***				0.0003 (2.36)**
<i>InternetSecurity_j</i>	-				0.0003 (3.62)***				0.0002 (1.82)*
<i>InternetUser_{ij}</i>	-					0.123 (6.81)***			0.065 (2.08)**
<i>B2B_{ij}</i>	-		-				0.128 (6.52)***		0.059 (2.61)***
<i>B2C_{ij}</i>	-		-					0.0003 (5.88)***	0.0002 (3.98)***
<i>Constant</i>	-16.54 (-22)***	16.45(-21.71)***	-20.01 (-13.07)***	-22.49 (-15.41)***	-23.37 (-16.87)***	-22.28 (-16.07)***	-23.67 (-17.44)***	-20.95 (-14.15)***	-17.56 (-10.39)***
No. of observations	1006	1006	1006	1006	1006	1006	1006	1006	1006
Adjusted R ²	0.7036	0.7104	0.7140	0.7178	0.7119	0.7165	0.7155	0.7133	0.7292

Notes: *, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level respectively. Numbers in parentheses are *t*-statistics. See Table 1 for the variable definitions.

Dependent variable: $\ln Trade_{ij} = \log(\text{Export}_{ij} + 0.0001)$.

Annex 2

Table 4 Panel Data Estimation Results for the Impact of ICT & E-commerce on Trade: The Continent Samples

	South to North (1)	North to South (2)	EAC to Rest of World (3)
<i>lnMarketSize_{ij}</i>	0.0408 (20.78)***	0.0393 (19.89)***	0.059(10.36)***
<i>lnGDPPC_i</i>	0.4568 (2.32)**	0.5095 (1.05)	9.326(4.33)***
<i>lnGDPPC_j</i>	1.3144 (2.92)***	0.2565 (2.18)**	5.345(2.02)**
<i>lnDIST_{ij}</i>	-6.38E-05 (-3.68)***	-2.07E-06 (-0.05)	-0.003(-3.12)***
<i>Contiguous_{ij}</i>	-	0.7556 (0.78)	-
<i>Language_{ij}</i>	0.6894 (2.49)**	0.1498 (0.69)	0.793(2.07)**
<i>Colony_{ij}</i>	0.4570 (1.07)	-	1.344(1.21)
<i>Telephone_i</i>	0.0705 (3.3)***	0.0009 (0.1)	0.174(2.57)**
<i>Telephone_j</i>	0.0136 (1.73)*	-0.0251 (-1.13)	0.002(3.51)***
<i>Cellphone_i</i>	0.0263 (5.89)***	0.0106 (1.81)*	0.312(3.82)***
<i>Cellphone_j</i>	0.0095 (2.16)**	0.0024 (0.43)	0.012(1.44)
<i>Broadband_i</i>	0.0585 (2.22)**	0.0213 (1.14)	0.069(1.79)*
<i>Broadband_j</i>	0.0303 (1.22)	0.004 (0.2)	0.001(1.88)*
<i>InternetSecurity_i</i>	0.0115 (4.23)***	0.0003 (0.18)	0.083(2.09)**
<i>InternetSecurity_j</i>	0.0004 (2.02)**	0.0036 (1.31)	0.001(0.25)
<i>InternetUser_{ij}</i>	0.0883 (1.81)*	0.0278 (0.59)	0.201(5.25)***
<i>B2B_{ij}</i>	0.0662 (1.97)**	0.0459 (0.94)	0.142(0.95)
<i>B2C_{ij}</i>	0.0003 (3.29)***	0.0001 (1.18)	0.039(0.72)
<i>Constant</i>	-7.069 (-1.35)	-23.89 (-4.3)***	-31.196(-5.62)***
No. of observations	509	492	201
Adjusted R ²	0.7827	0.7081	0.7005

Notes: *, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level respectively. Numbers in parentheses are t-statistics. See Table 1 for the variable definitions. Dependent variable: $\ln Trade_{ij} = \log(Export_{ij} + 0.0001)$. This table is the subsample analysis of Table 2, South refers to the sample where country *i* is developing and least-development countries. The estimation result for the EAC to Rest of World is for the year of 2013.



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37-39, Rue de Vermont, 1202 Geneva, Switzerland
geneva@cuts.org • www.cuts-geneva.org
Ph: +41 (0) 22 734 60 80 | Fax: +41 (0) 22 734 39 14 | Skype: cuts.grc