The Study on the Effect of the Internet and Mobile-Cellular on Trade in Services: Using the Modified Gravity Model

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Abstract

This study empirically examines the relationship between the Internet, mobile-cellular and service trade in South Korea. From this perspective, the main objective of this study is to identify key determinants of service trade over the period from 1990 to 2018 by using the modified gravity model. To do this, the study employs ordinary least squares methods and estimates the unknown parameter in a log-linear regression model. The study recognizes that South Korea is more likely to engage in service trade if it uses the Internet and mobile-cellular as a communication tool. The empirical results show that the Internet and mobile-cellular have a significant positive effect on service trade, service exports and imports respectively. In addition, the study also shows strong evidence for the causal relationship between service trade and GDP, trade openness. However, the Internet and mobile-cellular variables have a quantitatively small effect on service trade because the study uses the aggregated data for service trade. Therefore, to achieve greater positive results of the Internet and mobile-cellular on service trade, future research needs to utilize a disaggregated trade data in services. On the other hand, as the Covid-19 outbreak has changed people's lives and disrupted international trade, expanding access to the Internet and increasing usage are expected to play a more crucial role in enlarging service trade in the future.

Keywords: Internet, Mobile-cellular, Service trade, GDP, Trade openness, Gravity model

1 Introduction

Innovative technologies in the fourth Industrial Revolution are transforming international trade by making the process more efficient with the growing use of the Internet, especially for service trade around the world. According to a recent study of International Telecommunications Union (ITU), 97 percent of the world population now lives within reach of a mobile-cellular signal. In addition, in America, the Asia-Pacific region and Europe, over 93 percent of the population is covered by the third generation (3G) or higher mobile broadband network. Significantly, the Internet has provided new opportunities for all countries to engage in international trade. In this regard, it is a clear fact that the Internet has played an important role in increasing service trade as well. However, many previous studies on that issue are relatively few compared to other studies, which are more interested in investigating the effect of the Internet on economic growth or international trade of goods and services. It certainly is the truth that the Internet presents an opportunity for both suppliers and buyers over the past three decades. First of all, the Internet has the potential to reduce information costs because suppliers can more easily find and access information about new markets. Secondly, it can also advertise to a large number of buyers around the world at the same time and communicate with them globally instantly. Further, it can reach

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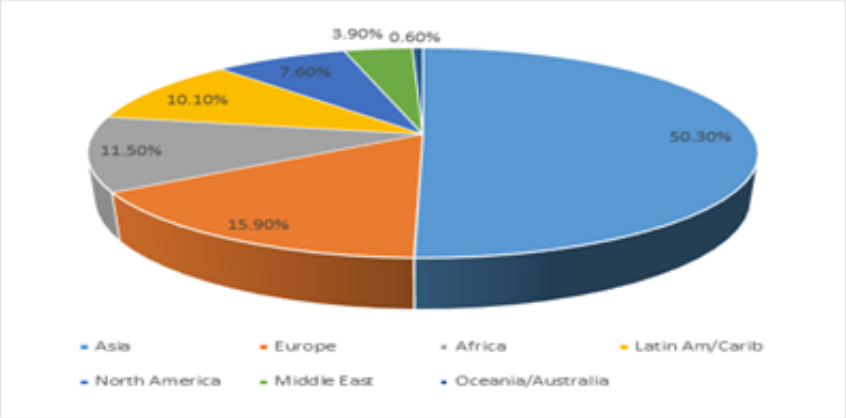

Figure 1: Internet Users Distribution in the World (2020 1st Quarter)
Source: Internet World Stats, Internet Users in March 3, 2020.

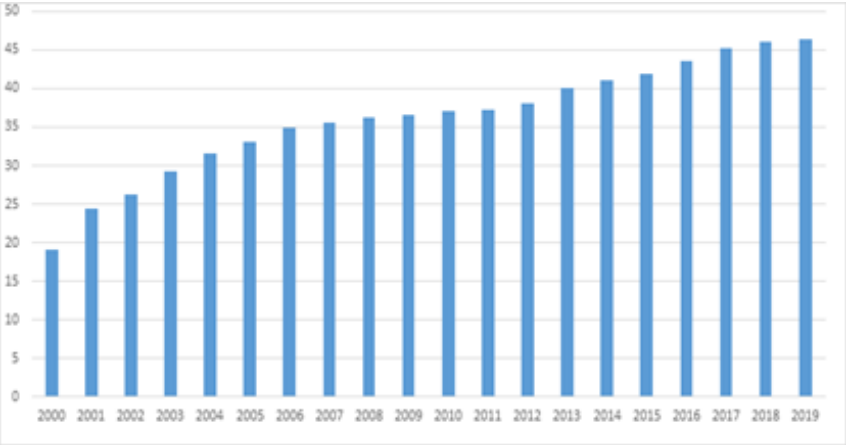

Figure 2: Number of Internet Users in South Korea from 2000 to 2019 (in millions, ITC)

a very large market, directly, fast and economically. In the light of above, it is absolutely certain that the Internet has played a significant role in enhancing international trade. In addition, it has allowed and improved countries to do trade safely and quickly with each other. Therefore, it should be acknowledged that the Internet has become a crucial platform for international trade in services and the influence of the Internet is consistently growing even more and more. 1 indicates Internet user distribution in the world. It shows that Internet-enabled population of Asia accounts for more than 50 percent and the Europe has the second largest share.

South Korea has a well-earned reputation as a global information and communication technology (ICT) leader and leads the world in Internet penetration rate. This implies that a large portion of the nation's households are hooked up to the Internet. In view of this, the study truly desires to examine the impacts of the Internet on service trade because the widespread use of the Internet is increasingly playing an important role in service trade in South Korea. As is well known, South Korea has some of the world's fastest Internet speeds. This could have been possible through decades of government interventions and investment in modern technology. 2 presents the number of Internet users in South Korea from 1999 to 2019. The statistics indicates that the population of Internet users in 2019 is more than twice as much as in 2000. In addition, it also shows that there were around 46.35 million Internet users in South Korea, up from around 46.13 million in the previous year.

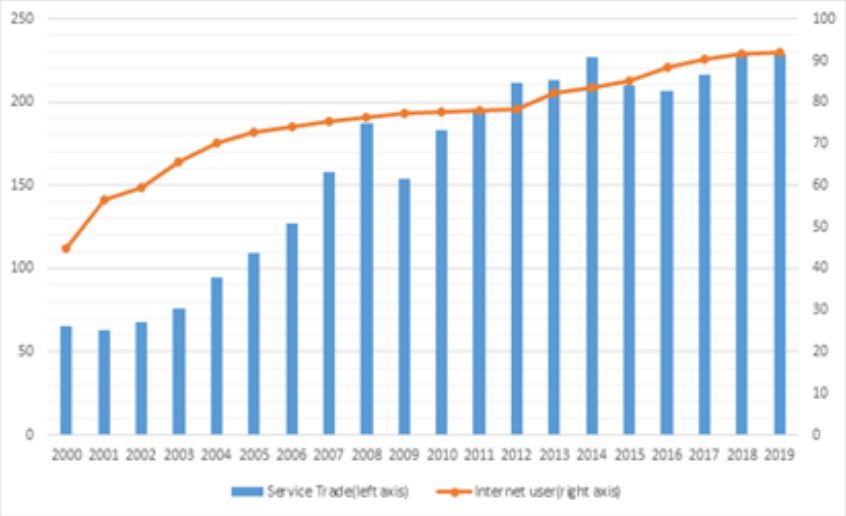

Figure 3: Internet Usage Rate (%) and South Korea Service Trade (million US $, ITC)

Internet usage is defined as the number of people who have used the Internet within the previous month. A governmental survey in 2019 found that the Internet usage rate among South Koreans aged 3 years and older was at around 91.8 percent in 3. Paired with the high availability of high-speed Internet, it is no surprise that nearly 92 percent of South Koreans use the Internet. Figure 3 also shows that South Korea's service trade has followed upward trends with the growing use of the Internet.

Furthermore, the Internet is a valuable research tool for buyers and sellers and it provides information that is critically important in purchase decision. In this respect, it is also widely accepted that the Internet has had a big impact on international trade, especially trade in service. Regarding this, the study expects that the Internet can stimulate international trade in service in South Korea as well. This could have important implications for trade volumes in services and bilateral trade patterns in services around the world. In particular, if the new technology reduces transaction costs, then the Internet growth or development will promote the growth of international trade in services. Thus, the study anticipates that as competition increases with the Internet, then it can increase service trade among countries. Therefore, it is quite certain that the Internet penetration or development of ICT, which implies the improvement of the ICT access and usage of the Internet, mobile-cellular and fixed-telephone, has consistently enabled South Korea to increase service trade since 2000. Thus, the main purpose of this study is to identify the causal relationship between development of ICT and service trade and to reveal the major determinants of service trade in South Korea. To do this, the paper employs a sophisticated model to analyze the impact of development of ICT on total service trade, service exports and imports. In addition, three independent variables of GDP, population and trade openness are included in the model as important variables. Given this economic model, the findings of this study are expected to help government policy makers to enhance service trade by means of the development of ICT. The practical development of ICT can be feasible based on an increase in government's active investment and availability and usage level of ICT. Given these primary intentions, the rest of this paper is organized as follows. Section 2 reviews the previous literatures focused on examining the association between the Internet and service trade and presents theoretical framework for this study. Section 3 specifies the model for this study and describes the data used. Section 4 presents the empirical results and discusses the outcome of regression analysis. Finally, Section 5 concludes with some policy implications from the findings of this study.

2 Literature Review and Theoretical Framework

There have been many economic literatures examining the influence of the Internet on international trade over the last two decades. Most studies have shown that there was some significant positive relationship between the Internet and economic growth and international trade. In addition, plenty of recent studies tend to show that there is a positive impact of the Internet on service trade as well. Therefore, the key question addressed in this study is to find out whether there exists a positive impact of the Internet on service trade in South Korea. Regarding this, in this section, this paper reviews previous studies and classifies them into two categories according to the object of interest, such as the Internet's impact on economic growth & international trade and more importantly, its impact on service trade. First, the paper reviews previous studies, which are focused on examining the effect of the Internet on economic growth and international trade. To begin with, Freund and Weinhold used the gravity model to investigate the effect of the Internet use on international trade among 56 countries from 1995 to 1999 by using both cross-sectional and panel data [4]. The empirical results indicate that a 10% point increase in growth of Web hosts increases about a 0.2 percent point in export growth. In addition, Clarke and Wallsten also test the effect of the Internet use on total exports of goods in 2011 by using cross-sectional data for 26 high income countries and 72 developing countries. The results show that Internet access appears to stimulate exports from poor countries to rich ones [2]. Further, Vemuri and Siddiqi investigate whether there exists a positive relationship between the Internet and international trade for 64 countries from 1985 to 2005 by using the extended gravity model. They insist that the Internet has a positive and significant impact on increasing international trade among them [18]. In 2011, Vu [19] examines the effect of ICT penetration, which includes the Internet, mobile phones and personal computers, on economic growth using panel data of 102 countries over the time period from 1996 to 2005. He finds that ICT penetration has a positive effect on economic growth by increasing demand and reducing production costs, which will increase the output level in the end. Miraskari et al. [12] also explore the effect of the Internet on bilateral export and trade volume for 30 countries over the period of 2001 to 2008. They find that an increase in the number of the Internet users have a positive and significant effect on export and trade volume. In 2013, Matters et al. investigate the effect of ICT use on trade by using data of European Union (EU) countries [11]. The regression results show that advanced use of ICT among EU countries turn out to stimulate trade for each other. Liu and Nath [8] also estimate the effect of ICT use on international trade in emerging markets by using panel data for 40 emerging market economies from 1995 to 2010. The results of study indicate that both Internet subscriptions and Internet hosts have a strong positive impact on exports and imports simultaneously. Meijers [5] also investigates the association between Internet usage and international trade by using panel data. He finds out that there is a significant impact of the Internet usage on international trade. More importantly, he shows that the Internet use has had a greater impact on international trade in non-high income countries than high income countries. In 2015, Lin also examines the impact of the Internet on increasing international trade by covering about 200 countries from 1990 to 2006 [7]. He indicates that the regression result supports a strong impact of the Internet on increasing international trade. Keller and Timmis [6] make an attempt to find empirical evidence of the effect of broadband Internet technology on service exports by using the firm-level data in UK. They provide that there is a significant effect of broadband Internet use on service exports clearly. Recently, Wang and Li used country-level ICT data and bilateral trade data. They show that Internet development, such as broadband subscriptions, the use of a skill of ICT, has a significant impact on international trade [20]. In 2018, Ozcan also studies the impact of ICT on international trade between Turkey and its trading partners including 35 countries for the period of from 2000 to 2014 [13]. The empirical results indicate that ICT has a positive and significant impact on Turkish trade. In addition, he shows that ICT has a larger effect on imports rather than on exports. More importantly the study explores previous researches, which builds and analyzes a model with greater emphasis on the effect of

the Internet on service trade since the 2000s. Those studies are as follows. First, Freund and Weinhold examine the impact of the Internet on international trade in 14 service industries between the US and 31 countries in 2002 [3]. The empirical result shows that the Internet has a positive and significant effect on increasing services trade between them. In 2010, Choi also presents the evidence of the Internet usage by examining service trade for 151 countries with respect to the panel data from 1990 to 2006 [1]. He finds that an increase in Internet access can facilitate service trade, exports and imports respectively. In addition, Salmani et al. study the effect of the Internet on international service trade in developing countries using a modified gravity model over the time period from 1990 to 2011 [15]. They provide that the Internet had a positive and significant effect on service trade among developing countries. They also suggest that there is a positive relationship between service trade and GDP and population as expected. Riker analyzes the relationship between the number of broadband users and the volume of international trade in goods and services for 148 countries from 2001 to 2012 [14]. He indicates that the growth in broadband use increases a country's trade openness and leads to increase in international service trade in turn. In 2017, Liu and Nath also examine the effect of ICT on exports and imports of 10 service categories for 49 countries over the time period of 2000 to 2013 by using panel data [9]. The empirical results indicate that ICT development has a positive impact on a limited number of service categories. Quite recently Tee et al. examine the effect of ICT development on ASEAN-5's service exports [16]. The regression results prove that the higher the ICT development level among trading partner countries, the higher bilateral service exports among them. Another recent study of Luong and Nguyen [10] test the impact of the subscriptions of broadband, fixed telephones, mobile phones and Internet on service trade by using more than 200 countries from 2005 to 2015. The results show that those of all variables had a statistically significant impact on service trade. With this theoretical basis, the study likes to establish a proper model and analyze the case of South Korea focusing on service trade. Thus, the paper empirically attempts to reconsider the role of the Internet on service trade employing the modified gravity model by using time-series data rather than using panel data. Therefore, the study anticipates that an increase of the Internet usage can stimulate the level of total service trade including service exports and imports in South Korea. In the end, given the distinct previous researches on Internet use, the purpose of this study is twofold. First, the major priority is to identify the main determinants of service trade in South Korea. Secondly, it is to propose some useful policies for the government policy makers to enhance service trade considering an increasing important role of the Internet in service trade since the outbreak of Covid-19.

3 Model Specification and Data Sources

As previously stated, the main purpose of this study is to test the effect of internet use and mobile-cellular on service trade in South Korea by using time-series data. To do this, the study uses a modified gravity equation by dropping the distance variable from the original gravity equation. In 1962, Tinbergen introduced a basic so-called gravity model of international trade [17]. In this model, the international trade flows between two countries depend positively on income and country size of the exporting and importing countries and negatively on the distance between these countries. A minor version of this study, controlling for income effects and country size, is a modification of original gravity equation by incorporating variables of GDP, population, trade openness and adding the Internet, mobile-cellular and fixed-telephone use as the most interested variables in the model. Thus, the intuitive model is specified as follows. First, the dependent variables are total service trade as a percentage of GDP, total service trade, service exports and imports. On the other hand, independent variables are GDP, population and trade openness, which is defined as the ratio of South Korea's total trade in goods and services to its GDP. Additionally, the study includes ICT development indices, which are closely related to ICT access and ICT use. In this study, ICT development index are classified into two aspects according to technology.

First of all, ICT access includes MCS, which indicates mobile-cellular subscriptions per 100 inhabitants and FTS, which denotes fixed-telephone subscriptions per 100 inhabitants. Finally, ICT use includes the Internet users, which is the percentage of individuals using the Internet. In recent years, it is widely acknowledged that ICT-enabled trade in services is regarded as an important ingredient of the information economy more than ever. Therefore, the development of ICT is expected to boost service trade in South Korea. By assuming that those ICT variables have a significant impact on service trade, the specification of the proposed model can have the following basic equation form 1:

$$ServiceTrade(ST) = f(GDP, POP, TradeOpenness, ICT) \tag{1}$$

In addition, the basic equation by taking the logarithm transformation creates the following types of model in the form of a log-log function:

$$Log(ST)_{it} = \beta_0 + \beta_1 log(GDP)_{it} + \beta_2 log(POP)_{it} + \beta_3 log(TO)_{it} + \beta_j log(ICT)_{it} + \varepsilon_{it} \tag{2}$$

This study empirically assesses a model of factors which is likely to affect to service trade in South Korea. The observable variables in 2 are all in natural logarithm form and represent the economic relationship between service trade and variables of ICT development or penetration. Here, subscript i represents South Korea and subscript t indicates the time period. The dependent variable ST, stands for the service trade of South Korea in year t, has four variations, such as total trade in service of GDP, total service trade (which is the sum of service exports and imports), service exports and imports respectively. First of all, β_0 is the intercept of the regression. GDP stands for the economy size and it is likely to increase the service trade. Thus, β_1, the coefficient of GDP, is expected to have a positive sign. POP stands for the population. It is also expected to enhance service trade and have a positive sign as well. In addition, TO, stands for trade openness, is expected to stimulate trade in service as well. It implies that the more the degree of trade openness rises, the more the service trade increases. Consequently, β_3 is expected to have a positive sign. More importantly the primary concern of this study is to determine the influence of the ICT development indices on service trade. In here, β_j is the coefficient for explanatory variables of ICT development and it is predicted to have an impact on four variations of service trade differently. In this regard, ICT development variables of interest include three variables, such as ITN, MCS, and FTS. Consequently, the log of ITN indicates the percentage of individuals using Internet users, the log of MCS represents the mobile-cellular subscription per 100 people and the log of FTS stands for the fixed-telephone subscription per 100 people. These variables are also all expected to stimulate trade in service. Therefore, all of these variables are likely to have a positive impact on increasing service trade. Finally, ε it indicates the error term. In the end, the study estimates an econometric model that adopts features of the proposed model and expects that the growth of the Internet and mobile-cellular use have a significant positive effect on service trade in South Korea. 1 presents the expected signs of all independent variables and data sources used in this study. The study uses annual data of total trade in service, service exports and imports, GDP, population, trade openness, MCS and FTS. Those are all obtained from the statistics of the World Bank's World Development Indicators (WDI). On the other hand, the data of the Internet use, ITN is collected from International Telecommunication Union (ITU)'s World Telecommunication/Information and Communication Technology (ICT) indicators database.

4 Empirical Results and Discussion

The model of this study used time-series data by incorporating a log-log linear equation form to take a close look at the effect of the Internet and mobile-cellular use on total service trade, service exports and imports. To test this kind of inquiry, the study treats ICT development indices as important variables

Table 1: Expected sign and Data sources

Explanatory Variables	Expected Sign (+ or -)	Data Sources
GDP	+	World Bank, WDI(World Development Indictors)
Population	+	World Bank, WDI(World Development Indictors)
Trade Openness	+	World Bank, WDI(World Development Indictors)
ITN	+	ITU, World Telecommuniation Indicators
MCS	+	World Bank, WDI(World Development Indictors)
FTS	+	World Bank, WDI(World Development Indictors)

Table 2: The Summary of Descriptive Statistics of the Considered Variables

Variables	Description	Unit	Mean.	St.Dev.
LogTSGDP	Log of total trade in service of GDP	(% of GDP)	2.460	0.276
LogTTS	Log of total trade in service	(current US $)	25.23	0.780
LogSEXP	Log of service export	(current US $)	24.49	0.759
LogSIMP	Log of service import	(current US $)	24.59	0.801
LogGDP	Log of GDP	(current US $)	27.38	0.538
LogPOP	Log of population	(total population)	17.68	0.054
LogTO	Log of trade openness	(% of GDP)	4.228	0.246
LogITN	Log of internet users	(% of individuals using the internet)	2.672	2.674
LogMCS	Log of mobile-cellular users	(per 100 people)	3.340	1.984
LogFTS	Log of fixed-telephone users	(per 100 people)	3.877	0.182

given the recent surge in service trade in South Korea as well as in the world. In this section, the study reports the descriptive statistics of considered variables and presents estimation results.

First, 2 reports the summary of descriptive statistics of all variables and units used in this study. Further, based on the well-established of the modified gravity model, 3, 4 and 5 report the ordinary least squares (OLS) estimation results. From these results, it is easy to recognize that empirical results provide the support for the expectations of this study. First of all, the adjusted R^2 values are shown in the 3. R^2 is a statistical measure of how close the data to the fitted regression line. Therefore, generally a higher R^2 indicates a better fit for the proposed model. Therefore, R^2 values of 0.956, 0.994, 0990 and 0.995 in 3 are quite high and it implies that the proposed model has the high explanatory power as a result.

In 3, most of the coefficient values have expected signs and turn out to be all strongly significant at the

Table 3: The Internet User and Service Trade

Explanatory Variable	Dependent Variable			
	Log(TSGDP)	Log(TTS)	Log(SEXP)	Log(SIMP)
LogGDP	-0.174(-2.110)	0.826(9.999)	0.689(6.414)	0.959(12.16)
LogPOP	1.773(1.524)	1.774(1.524)	2.023(1.336)	1.384(1.245)
LogTO	0.774(8.824)	0.774(8.823)	0.949(8.314)	0.62(7.405)
LogITN	0.031(2.821)	0.031(2.820)	0.029(2.081)	0.033(3.166)
Constant	-27.49(-1.484)	-32.09(-1.733)	-34.24(1.421)	-28.85(-1.631)
Adj.R^2	0.956	0.994	0.990	0.995
No. of Obs.	29	29	29	29

Table 4: The Mobile-Cellular User and Service Trade

Explanatory Variable	**Dependent Variable**			
	Log(TSGDP)	Log(TTS)	Log(SEXP)	Log(SIMP)
LogGDP	-0.139(-1.786)	0.860(11.01)	0.735(7.163)	0.983(12.69)
LogPOP	1.098(0.983)	1.098(0.983)	1.102(0.751)	0.950(0.859)
LogTO	0.772(9.516)	0.772(9.516)	0.947(8.891)	0.618(7.695)
LogMCS	0.053(3.656)	0.053(3.656)	0.055(2.923)	0.051(3.603)
Constant	-16.57(-0.932)	-21.17(-1.191)	-19.29(-0.827)	-21.91
Adj.R^2	0.962	0.995	0.991	0.995
No. of Obs.	29	29	29	29

1 percent or 5 percent significance level, except for the population variable. First, the coefficient values of GDP and trade openness have expected signs and are robustly significant at the 1 percent significant level respectively. More importantly, the coefficient value of the Internet user proves to increase total service trade of GDP, total service trade, service exports as well as service imports. These empirical results imply that the association between the Internet user and service trade is very robust. The results show that a 10% increase in Internet users per hundred people increases total service trade of GDP by 0.31%, total service trade by 0.31%, service export by 0.29% and service import by 0.33% respectively. The measured impacts of the Internet user on service trade are also significant, but actual impacts of the Internet use on service trade turns out to be slightly small in comparison to its expectation. The reason seems to have something to do with utilizing an aggregated data instead of using disaggregated data in this study. Finally, the study provides an interesting fact that the Internet use has slightly bigger positive impact on service imports compared to service exports. This might imply that Koreans use the Internet a lot in service trade, especially in the case of importation. Finally, the Internet user best explains service import, followed by total service trade and service export. 4 reports the results of the impact of mobile-cellular subscriptions and other explanatory variables on service trade. The result shows that the coefficient of mobile-cellular use has an expected sign and strong positive effects on service trade, exports and imports all together. Most of them turn out to be statistically significant at the 1 percent significance level respectively. In addition, the coefficient of GDP and trade openness values have a positive impact on all dependent variables and both are also statistically significant at the 1 percent significance level. On the other hand, even if the coefficient value of population has a positive sign, it is not statistically significant. These results are very similar to the results of the Internet use as shown in 3.

More importantly, the coefficient of mobile-cellular users per 100 people turns out to stimulate total service trade, service exports as well as service imports except total service trade of GDP. A 10% increase in mobile-cellular per hundred people appears to increase 0.53% for total service trade of GDP and total service trade respectively. It also increases 0.55% for service exports and 0.51% for service imports. Overall, mobile-cellular use best explains service export, followed by service trade and finally service import. From 3 and 4, an interesting result can be shown as the measured impact of the mobile-cellar user on service trade, service export and imports turns out to be greater than that of Internet user. The study also pays attention to the effect of ITN and MCS on service exports and imports, regarding their effectiveness on increasing service trade. The study shows that there is a mixed result for the scale of ITN and MCS's impact on service exports and imports. In 3, the coefficient value of ITN for service imports has somewhat bigger impact than that of service exports, whilst the coefficient value of MCS for service exports has a bigger influence than that of service import. Despite its small-scale difference in influence between them, it is necessary to analyze the results in more detail in the future. To sum up, most of coefficients values have expected signs and turn out to be statistically significant at the 1 or 5 percent

Table 5: The Fixed-Telephone User and Service Trade

Explanatory Variable	Dependent Variable			
	Log(TSGDP)	Log(TTS)	Log(SEXP)	Log(SIMP)
LogGDP	-0.266(-2.743)	0.734(7.551)	0.625(5.289)	0.843(8.802)
LogPOP	3.932(3.141)	3.932(3.141)	3.653(2.399)	3.994(3.234)
LogTO	0.769(7.454)	0.769(7.454)	0.933(7.436)	0.622(6.113)
LogFTS	0.041(0.248)	0.041(0.248)	0.126(0.628)	0.014(0.088)
Constant	-63.17(-3.277)	-67.77(-3.516)	-61.65(-2.629)	-71.69(-3.769)
Adj.R^2	0.941	0.992	0.988	0.993
No. of Obs.	29	29	29	29

significance level, except population as shown in 3 and 4. Finally, 5 presents the regression result of the fixed-telephone subscription (FTS) user's impact on service trade. The empirical results indicate that the coefficient value of GDP, population, trade openness, and FTS variables all have expected positive signs and turn out to be statistically significant at the 1 or 5 significance level except FTS. First of all, the coefficient value of GDP, population and trade openness have positive effect on total service trade, service exports as well as service import. In addition, these variables turn out to be all statistically significant at the 1 percent or 5 percent significant level individually. On the other hand, even though the coefficient value of fixed-telephone subscriptions has a positive sign likewise the cases of Internet user and mobile-cellular user, but it shows no significance for all four variations of service trade as shown in 5. This result is somewhat contrary to the expectations of this study as mentioned in 1.

To sum up the whole situation, four important points can be noted from the all regression results. First, the number of Internet users and Mobile-cellular users have a strong positive impact on service trade and both turn out to be statistically significant at the 1 percent or 5 percent significance level. Secondly, the interrelationship between Internet user and service import has a stronger influence than that of service export, while the interrelationship between mobile-cellular user and service export is more likely to be greater than that of service import. Thirdly, MCS variable has a quantitatively larger effect on service trade, service export and imports than those of ITN variables. Finally, the results of the study are robust with respect to GDP and trade openness variables for all dependent variables. The results show that the coefficients of GDP and trade openness are statistically significant and have consistently robust results for each regression analysis except population, which shows conflicting results for all dependent variables. This is because GDP, as a proxy for income level and trade openness variable, as a proxy for country size, have been regarded as one of the most important factors in international trade over the long period of examination. Therefore, the study could confirm the impact of these variables on service trade turn out to be firmly remained in this case.

5 Conclusions and Policy Implications

5.1 Conclusions and Future Research

The study discusses about the great potential of the Internet and mobile-cellular use as a platform for expanding trade in services among countries. Up to now, most of the studies have attempted to examine the effect of the Internet on international trade, whereas studies investigating the impact of the Internet on service trade have recently begun to rise. Given this fact, the study significantly considers that more use of the Internet can create new opportunities for South Korea to engage in service trade. This is because South Korea is one of the leading countries in the development of ICT in the world. With all this in mind,

this study attempts to find out the relationship between Internet use, mobile cellular use and service trade in South Korea from 1990 to 2018. Finally, the study includes aggregated data of service trade, service export and import with 28 years of time-series data by applying modified gravity model. The estimation results indicate that the Internet use and mobile-cellular use have a positive link with service trade, service export and service imports all together in South Korea as the study expected. The study also shows that most of the variables are statistically significant at the 1 or 5 percent significance level. In addition, the coefficient value of GDP and trade openness also have expected signs and both variables have a statistically significant effect on service trade. However, the results of this study demonstrate that the measured influence of the Internet use and mobile-cellular use on service trade turn out to be quite small compared to other economic variables. This is believed to be due to the fact that this study employs an aggregated data of service trade rather than that of disaggregated data. Therefore, it is desirable to use disaggregated data of service trade to get more enhanced trade performance in future research. Secondly, given the growing use of the Internet and mobile-cellular in developing countries, it is also very useful and necessary to analyze how the Internet and mobile-cellular use have affected service trade in developing and developed countries respectively in the future. In summary, future studies need to focus more on disaggregated data of service trade by including more countries in terms of using panel data. Furthermore, it is also necessary to establish a model by placing more emphasis on service trade between non-high income countries and high income countries. As an extension of this study, it is also very meaningful to compare and analyze the effect of the Internet on service trade among developing countries by region.

5.2 Policy Implications

Our methodology requires the Bluetooth function to be enabled in the host device for scanning purposes. It cannot be a concern as most of the mobile users nowadays would have their devices' Bluetooth module turned on for various reasons such as connecting with headsets or making payments with the NFC technology. On the other hand, the existence of other surrounding mobile devices could degrade our measurement results. However, since the device discoverability is being disabled by default in most of the mobile operation systems, it should pose minor effect to the scanning results. Last but not least, long period of continuous scanning using Bluetooth signals could cost vast energy consumption to the device but fortunately, with the adoption of the Bluetooth Low Energy (BLE) technology, such problem can be adequately alleviated.

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