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**Conference Paper**

## Reducing internet demand-side gap improves digital inclusion in low-income countries: - analysis that is more comprehensive

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**Reducing internet demand-side gap improves digital  
inclusion in low-income countries: - analysis that is  
more comprehensive**

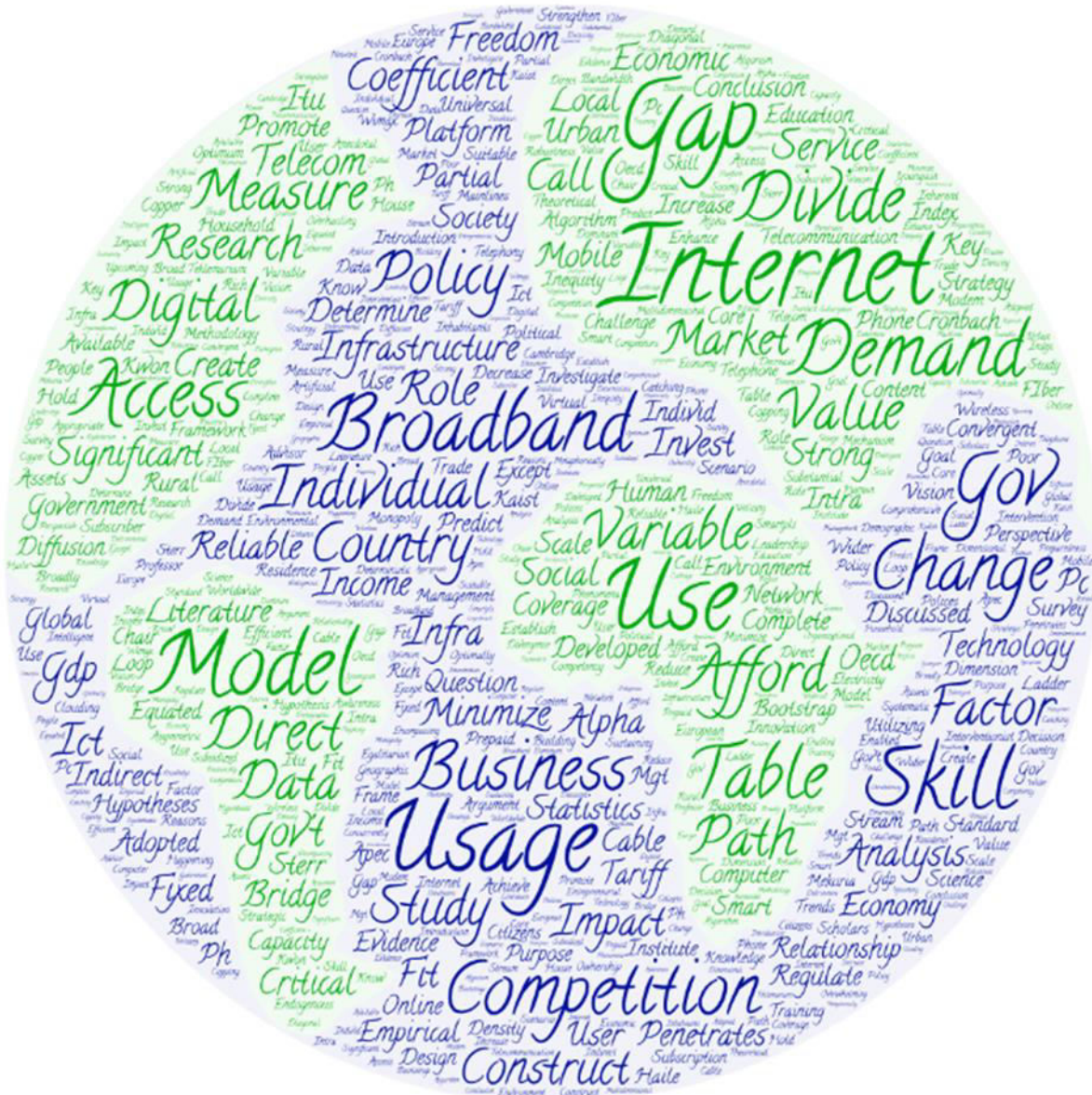
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## **Abstract**

Reducing the broadband demand-side gap brings greater improvement in digital inclusion especially in low-income countries compared to developed economies. The demand-side gap between network coverage and penetration is less than 10% in developed countries. However, the digital divide and demand-side gap in low-income countries reach 60% and 30% respectively. From this, we developed the hypothesis: the effective use of existing internet facilities can reduce half of the digital divide in low-income countries. To test this hypothesis using regression analysis, we collected four-year data of 120 economies with 44 factors. The present study findings show that 100 points change in policy and regulation of ICT, energy infrastructure, gender literacy, software piracy rate, demographic dividend, competition in telecom sector, network coverage and quality, digital content, digital skill, and gender income will bring 5.5, 10, 6, -15.8, 12, 12.5, 12, 12.5, 24.4, 13, 15, and 8.5 points change in the internet usage of individuals respectively. Furthermore, 100 points change in this internet usage of the individuals will also bring 51.9 points increase on use of the existing network facilities. This implies that low-income countries can improve their total internet subscription significantly by increasing the internet usage of individuals without having further investment. Therefore, low-income countries can use these findings as input for their digital inclusion policy that shows how to improve the driving factors and internet subscription of their citizens.

## **Key Words**

Demand-side gap, low-income countries, digital skill, internet usage of individual, and infrastructure access.

## **I. Introduction**

Recently, broadband internet has been identified as a critical technology for various purposes and applications. The improvement of citizens' service provision efficiency, the improvement of the efficiency and effectiveness of business operations and their security, and the flow of supply chains and logistics are getting inertia from internet technology. In today's globalized world the relationships of private and business institutions within the country and across the world, the interconnections of the given nation with global economy through a variety of channels are having significant impact on the socio-economic development of the country through the improvement of its competitiveness in production and operation (Irani et al.,

2010). The Internet is becoming one of the important indicators in measuring the conduciveness of the national environment for the overall development in developing and developed countries.

Since the introduction of broadband technology in the 1990s, it has shown fast expansion and adoption process across the world through creating socially and economically interconnected society. When we say broadband internet, it is about the process of data, video, and voice transmission process using broadband internet technology that allows the huge amount of messages and traffic to be communicated from one to the other end of the institutions and individuals concurrently. The term is highly associated with access that is always on and faster than the traditional dial-up access (Hart, et al., 1992). The up-to-date internet technology can be classified as fixed, DSL, fixed wireless, mobile broadband, cable modem, fiber optics, and satellite.

When we talk about internet access and usage, there are three different conceptual approaches used by scholars taking the perspective of the network availability. Firstly, the physical internet connection or access between those who are connected and those who are not connected (Eastin et al., 2015), secondly, acknowledging the difference between internet physical access divide and skill divide, focusing on utilizing internet (Hargittai, 2002), Thirdly, identifying the benefit being connected with the internet becomes the critical issue in developed countries. Hence in developed countries, the digital divide challenge has shifted from mere internet access (the 1st issue), skills and usage of the Internet effectively (the second 2nd issue) to the maximum beneficial outcomes of Internet use (the third issue) [Wei et al., 2011].

The internet connection (the 1st) has not become the only issue especially on today's big data world, in which the quality and quantity of data based on demand (not mere inclusion) has become a driver of social, cultural, political, and economic development (Hilbert, 2016). However, these all the three issues described in the former paragraph are still prevalent and critical issues in the developing economies. The internet exclusion of the significant segments of the society in low-income countries as it has been suggested by several scholars is exacerbating social inequalities (e.g., Helsper, 2012).

Based on the data organized by International Telecommunication Union Report (2016), as of the end of June 2016, 50.1 % of the world population had opportunity to use the internet at

the individual level. When it is analyzed at the region level, 89.0% of the population of North America, 73.9% of the population of Europe; 61.5% of the population of Latin America and the Caribbean; 57.4% of the population of the Middle East; 45.6% of the population of Asia and Pacific; 28.7% of the population of Africa are connected to the internet network technology. According to the World Economic Forum (Report, 2016), the demand-side gap between the network coverage and the internet usage in developed countries is around 10%, implying that digital exclusion due to demand-side gap is not a major issue. However, the gap in low-income countries reaches 30% or higher, implying that digital exclusion due to demand-side gap is a serious problem. In the mobile communications market, the gap in the low-income countries reaches 33%, meaning that one-third of the population served by mobile broadband networks does not use the service even though the operators offer broadband service in their residential areas.

The digital inclusion in this paper refers to the interventions that have to be taken to create the enabling environment for the individuals and businesses to use the internet. Here, special emphasis has been given to facilitate the usage of internet by the community when the broadband service is available in their locality. The interventions could include elements such as the affordability of internet service including last mile connection cost addressing, the existence of the digital literacy that can enable the use of, and the availability of beneficial content in order to use the internet. Furthermore, the demographic factors and gender issues to be taken into consideration to have comprehensive digital inclusion policy.

For this study purpose, we defined the digital demand-side gap as the number of individuals and businesses, which do not use the internet, network service even though the operators offer broadband service in their residential areas. Therefore, improving broadband subscription, so-called digital inclusion, is the research issue, especially in the low-income countries. It is very clear that without having new investment for infrastructure, there is a possibility of significant improvement on digital inclusion by reducing the demand-side gap through taking appropriate policy measures in low-income countries. This issue has been sorted out in the case of developed countries as it has been depicted by the statistics above. It is noticeable that broadband Internet connections and internet usages are impossible without networks availability, but the expansion of networks coverage by itself does not necessarily bring forth digital inclusion. If the countries build the broadband internet infrastructure, citizens do not always necessarily come to use the internet unless otherwise they are going to

have beneficial content.

Therefore, it is imperative that in addition to the physical internet network infrastructure, there are so many factors that affect demand for broadband services, e.g., computer and internet skills, income, lack of devices and computers, availability of electricity, the density of the population's settlement and rate of urbanization, gender, and internet content. Hence, in this paper, we are going to investigate the effects of determinant factors of the digital inclusion or internet usage, which have the influence on reducing demand-side gap. The study tries to provide useful implications for formulating digital inclusion policies at national level for low-income countries.

The paper is organized as follows: - Section 2 investigates works of literature that are related to this topic and identifies their contribution and locate the gap in the domain of the research. In section 3, we present the context of the research, which includes research methodology, statement, and the arguments of the research. Section 4 presents the research data and its results. In section 5, we present discussion and analysis based on the findings of the data. Section 6 concludes with future research proposals.

## **II. Literature Review**

The use of internet has been rapidly evolving since its adoption in the 1990s (Eastin et al., 2015). However, Internet access and usage remains one of the low-income countries' greatest infrastructure access challenges.

According to Kauffman and Techatassanasoontorn (2005), the determinant factors for digital divide are grouped into countries' digital divide indicators and geographical area indicators. The scholars listed the countries' digital divide indicators as wealth, telecommunications infrastructure, market competition, access charges, and access standards. The factors that are identified with the geographical regional indicators are the social, political, and economic influences. The major factors that were identified by Di Gregorio et al. (2005) are ICT infrastructure, human resource, institutional space, path dependence, entrepreneurial activity, and regional differences. The digital divide factors, which were investigated by Dewan et al. (2005), could also be enumerated as economic (GDP; and technology cost), demographic (urban population), and environmental (telephone lines; and trade in goods) factors. In addition to these, in terms of IT adoption and digital exclusion, Shih et al. (2008) studied that capital resources, complementary assets (IT facility and human capital), and exposure to

external influence identified to be the three important determinant indicators.

As indicated by Compaine (2001), technology arguments used in digital exclusion study emphasize a simple category between those who have access to the IT facility and technology and who do not have access to them. It can be emphasized that scholars tend to identify the infrastructure access exclusion (supply gap) as the main factor that has created an inherent delay in the adoption of internet among different individuals, regional areas, and social groups (Adriani & Becchetti, 2003; Compaine, 2001). From this analysis, it could be established that once the network facility is accessible, and then there would not be the digital exclusion. Individuals would use the internet purposefully; the digital exclusion would be bridged continuously; and finally, the digital divide considered to be closed (Compaine, 2001). Scholars who endorse these propositions have often promoted the concept by justifying that without the government intervention the demand and supply gap of the service can be bridged through the market forces. Through these processes, they argue that the digital divide would eventually is being closed. Part of the society who is excluded from the internet usage would be included and then after are often equated (DiMaggio & Hargittai, 2001).

However, the digital divide issue has shifted from not only the binary Internet coverage and subscription problems but also internet usage digital skill challenges, and securing benefits from the internet connection are becoming decisive factors for bridging the digital divide (Wei et al., 2011). In addition to the infrastructure access, the digital divide challenge has continued to exist until we address the issues of digital skills problems, and local content shortage (Stern et al., 2009; Van Deursen et al., 2016). Similarly, other scholars studied the socio-economic determinant factors that have the influence on the internet usage, and these factors are usually associated with multiple digital divides in an attempt to frame the problems more accurately. They proceeded with the assumption that access to technology is not the only one of the determinant factors for internet usage but a basic milestone (Servon, 2002; Norris, 2001). DiMaggio and Hargittai (2001) explained, "As the technology adopted to every group of society, the pressing question will be not who can find a network connection at home, work, or in a library or community center from which to log on, but instead, what are people doing on it, and what are they able to do, when they go online?" This perspective treats broadband internet access and its usage as very different issues for evaluation of internet adoption (Servon, 2002; Norris, 2001; Bimber, 2000).

Similarly, Dewan's and Riggins' (2005), reviewed the digital divide literature works, and they



mainly categorized the studies into two groups. The first order effects of supply gap, which is inequality among those who have access to technology, and the second order effects of demand gap, which is the inequality in the ability to use the technology among those who have the access.

The approach to the problem identification of internet usage has been changing through time from coverage (Eastin et al., 2015), subscription (Mehra et al., 2004; Riggins and Dewan, 2005) to benefits from the connection (Stern et al., 2009; Van Deursen et al., 2016). Even though the first and the second are no pressing problems in the developed countries, these all the three issues are still prevalent and critical issues in the low income economies. The internet exclusion of the society in developing countries as it has been suggested by several scholars is exacerbating existing social inequalities (e.g., Helsper, 2012).

Scheerder, et al. (2017) reviewed 126 articles on the determinants of internet usage, skills, and outcomes; they categorized the determinant factors into seven major variables that were identified by those studies. The list of the variables are demographic such as age and gender, economic such as household income and work circumstances, social such as networking and political participation, cultural such as religion, cultural capital and cultural possession, personal such as leisure and health related activities, material such as home internet access and number of devices, and motivation such as online skills, internet experience and internet attitude. As it was well explained by these authors, the determinant factors of the internet usage were addressed in fragment ways instead of addressing the issue comprehensively with empirical data analysis.

Falch and Henten (2017) discussed the possibility of implementing regulator and/or developmental internet adoption policy to solve these three problems, and it is imperative that any country can apply many different strategies at the same time. In different countries, there is different potential from the private sectors to make adequate broadband internet infrastructure investments. This can be a background about identifying which policy to adopt for the mobilization of the financial resources for broadband internet expansion investments. It can also be noted that the network expansion for access as broadband internet service supply (the 1st and the 2nd issue) and content development that benefits the internet users (the 3rd issue) as creating demand for broadband internet service are supplementary each other. From the forerunner countries of the internet adoption in the world, Falch and Henten (2017) analyzed some successful countries such as Denmark, South Korea, and Sweden that

have given significant emphasis for the content and applications development and adoptions with the respective the governments' support.

Igari (2013) provides a comparative analysis of Denmark and Japan, where it is stated that, while Japan has been very successful in their promotion of network facilities, they have been much less successful in developing public content and ICT usage. Denmark is mentioned as a country with the emphasis on content development. Denmark had announced in the mid-1990s about their information society plan (info 2000) that focused on the service demand side and the public sector already took the lead in this development.

Most of the time, South Korea is mentioned as the forerunner with regard to the encouragement of network investments. An important part of the story is that the government has combined a strong push for network building that is the supply side with demand stimulating measures such as improvement of IT literacy (Choudrie & Lee, 2004).

Sweden has a practical government intervention policy for the development of broadband internet. The gov't intervention goes beyond the financial investment on broadband, out of 290 municipalities in the country, 175 of them have made the investment on broadband, and they have their own fiber networks (Forzati & Mattsson, 2014). In France, the developmental policy initiative goes beyond the mere buying share as a public private partnership in the incumbent operator of the telecommunication services (Henten, Skouby, & Falch, 1996), local municipalities have been allowed to be engaged on network investment and operation, too.

The US is often seen as the primary example of a regulatory state. With regard to telecom, the incumbent operators have always been private, and starting from the beginning regulation has been a crucial element in governance. However, the US has a tradition of taking developmental initiatives as well. The universal service obligation (USO) has some developmental aspects although it formally is a regulatory tool. In the US, it is about affordability and connection of social institutions such as schools, health, and community centers. Several programmes, which are required to be addressed for broadband internet adoption, the issues have been covered by universal service funds (Egan, 2014). Furthermore, the individual states implement their own developmental initiatives supporting local operators for creating broadband access and facilitating digital inclusions. In many aspects, the US has been the leading country with regard to the development of new services and contents having

private companies such as Facebook, Netflix, YouTube, and Google.

From the aforementioned analysis, it can be substantiated that the government policy plays an important role in bridging this supply and demand gaps (Andersen, 2006). When we discuss the e-Government initiatives, it is not only about designing smart IT policies or about functional systems, but it is also about coordination between the many projects that go on at all levels of individuals, businesses, and government to develop contents that can add value. Servon (2002) indicated in his study that, “Partnerships between government bodies and other actors would be critical to fruitful policies. Governments at all levels can play a critical role by creating incentives for the stakeholders, which are individually addressing the digital divide by working together.” Hence, an integrated roadmap for bridging the digital divide should not only help in reducing the supply gap but also the focus on demand-related gaps including sorting out the problems why people do not use already available broadband internet infrastructures.

Asia Pacific Economic Cooperation (2002) made relatively comprehensive study, which was more regionally focused and informative than others. The study found that the user access cost (the expenditure of the 3-minute local call), political discretion, income per capita, the ratio of urban-rural population, the portion of the services value added in gross domestic income and adult literacy rate as determinant factors. The income per capita, the urban-rural ratio, literacy, and a significant portion of the service sectors were identified as positively correlated, while access costs and the absence of political freedom were negatively associated.

The policy issues that are being handled by regulatory institutions have been reducing the demand gap, bridging the digital exclusion, and providing appropriate coverage to sparsely populated regions. In particular, to the urban territorial areas, there could be facility-based competition among alternative technologies’, which could have its own role for digital inclusion, cost reduction, and service improvement on internet service delivery. The concern is where the territories have only one service operator and regions that do not have any operator, in particular, rural areas. With respect to the regions with only one service operator, the government intervention is considered as a necessary regulation by most of the respective government agencies. The coverage of rural regions with an insufficient provision of broadband access infrastructures has been identified as a problem to be solved. Therefore, it has been concluded that the population density plays a crucial role regarding infrastructure investments and related regulation of telecommunications technology, especially for

broadband internet usage.

However, most low-income countries have in their strategies focused relatively on the hardware side (the 1st issue). From the above explanation, it can be summarized that the development of the network which is the supply side of the broadband internet usage should be managed concurrently with the facilitation of connections and contents development, as these three areas are complementary each other. Based on the empirical evidences presented on the aforementioned paragraphs, the low-income countries should take the lessons (how to address the 2nd and the 3rd issues) to develop their context associated internet adoption strategies. We have not found any empirical data based research work on analyzing these three issues comprehensively and taking into consideration of the low-income countries, though there are quite a lot of studies on the digital divide side of the domain as reviewed above.

A basic conclusion of the study is that the countries with low-income economies are recommended to apply competition through availing competitive environment in their urban and sub-urban areas by improving the regulations compatible to their own context based on the available alternative infrastructure they possessed. This will bring them a benefit for broadband adoption via reducing the demand gap. Furthermore, they can reduce their countries' demand gap through addressing not only internet access, and its usage but also benefits from its effective usage more comprehensively (e.g., Fuchs, 2009; Selwyn, 2004; Van Dijk, 2005).

Our contribution starts with developing comprehensive determinant factors for internet usage theory; the explanation of the applied method for demand gap analysis, and finally the implications and limitations of this study are discussed.

### **III. The Research Methodology and Hypothesis**

The debate about the digital exclusion in the field of broadband internet has been mainly focused on the service penetration based on the network deployment. As a result, the majority of the existing research findings have focused until now on the need to increase adoption based on wider coverage of telecommunications networks. The underlying premise of this statement is that if the problems on the infrastructure deployment were addressed, the challenge of the digital exclusion would be overcome. Without denying that there is some causal relationship between investment and adoption, it is also important to note that one of

the key variables that explain the digital divide is located on the demand side, rather than being only on the supply side. The purposes of the current study are to identify the determinant driving-factors for the usage of internet and analyze the digital exclusion focusing on the demand-side gap for 120 economies.

The concept of digital demand-side gap is defined as the difference between individuals that are served by broadband but do not purchase the service. From the point of view of network technology, third generation and fourth-generation network coverage should be considered, as they provide the speed necessary to offer efficient access. This type of statistics has not historically been easy to find because technological coverage has not until recently been measured by public entities or regulatory agencies. However, in recent years, numerous national broadband strategies have been implemented, yielding a better understanding of the factors driving the broadband adoption gap. International Telecommunication Union and GSMA have been collecting the data and the past four years data was used for the analysis. Our current study took the covered population based on 3G networks, assuming that LTE networks has been deployed in the same territories, in the case of 4G networks have more coverage we took the greater value from both data.

The supply-side gap was identified based on the analysis of the broadband service coverage versus the percentage of the people unserved for broadband access. In the case of demand-side gap, the comparison was made between the broadband internet coverage and the respective usage of the supplied service usage of internet. This analysis usually gives hints on the identification of the critical determinant factors and challenges for the successful usage of broadband internet. This analysis has significant contribution in addressing the digital exclusion and increasing the internet penetration coverage in the two scenarios that require a different strategy and effort. The supply-side gap case is more serious since it needs the investment for the infrastructure access itself before talking about the internet usage.

After reviewing of the literature works in the previous section, we developed hypothesis and identified the purposes of the current study. The hypotheses identified in the research include-

- 1) Fast urbanization and demographic dividend strengthens the internet usage of individuals.
- 2) The broadband network coverage and its quality strengthens the internet usage of individuals

- 3) Gender income ratio (female to male) improvement strengthens the internet usage of individuals.
- 4) Digital skill improvement strengthens the individuals' internet usage.
- 5) ICT policy and regulation strengthens the internet usage of individual, and business.
- 6) Software piracy weakens the internet usage of individual, and business.
- 7) The availability of energy supply strengthens the internet usage of individuals, and business.
- 8) The availability of digital content strengthens the internet usage of individuals, and business.
- 9) The existence of competitive policy in the economy strengthens the internet usage of individuals and business
- 10) The improvement of internet usage of the individuals reduces the level of demand-side gap of the broadband network.

The purposes of the present study include - 1) to evaluate and identify the determinant influential factors comprehensively on the internet usage and its impact on demand-side gap analysis. 2) To identify the critical determinant factors on reducing the demand-side gap. 3) to identify the moderating variables that have influence on the drivers of internet usage including the demand-side reduction, and 4) to make policy recommendations by identifying the variables that contribute to the broadband internet usage for low-income economies. To address the objectives we raised the basic research question: which statistically significant determinant variables' drive internet usage, and has impacts on demand-side gap reduction based on world data between 2013 and 2016? This further question further raises enquiries such as: (1) how close is supply and subscription of the broadband internet? 2) How should Low and low middle-income countries address the broadband and Internet demand-side gap of the non-adopting population? (3) Are current internet adoption trends homogeneous across different levels of economy, and human development or do we observe a divergence across economies, indicating some advanced nations approaching industrialized country performance, while others lagging? (4) If the internet usage is a critical lever for the reduction of demand-side gap and promote digital inclusion, what are the policies to be implemented by low and low-middle income countries?

To test the hypotheses and answer these questions the authors have developed 44-factor index based on the literature review that were categorized into 16 variables using the principal component analysis. Based on these factors, firstly, the variables are used to assess the level of readiness of the driving factors in low- and low-middle economies compared to developed economies. Secondly, an econometric model is developed to measure the level of influence of the variables on the individuals and business usage of internet. Thirdly, the impacts of these usages on supply- and demand-side gap reduction have been measured. Fourthly, public policies are recommended to increase digital inclusion. Regression models are made to measure the variables impact on usage of internet, and its influence on the reduction of the demand-side gap.

The data published in annual reports of World Economic Forum (WEF), International Telecommunications Union (ITU), the World Bank Group (WBG), and Global System of Mobile Operators Association (GSMA intelligence) for the past four years (from 2013 to 2016) has been taken as main sources of data. It is well known that the United Nations member states are 193 sovereign states that have equal representation in the UN General Assembly. These UN-member countries constituted the population for our study. Out of the data from these countries, the current study used the four-year (2013 -2016) data of 120 countries as a sample to have 480 observations.

#### **IV. Findings of the study**

To evaluate the measurement model and the structural models were tested using Smart PLS software. The factors, which are identified on the research methodology are adopted as inputs for testing the measurement model, except the per capita income for the affordability, of which has been included by the authors.

##### **1. Conceptual background and the hypotheses for data analysis**

We have analyzed the current study model by using the partial least square path-modeling algorithm. This tool estimates study path models using latent variables. Like covariance-based structural Equation Modeling (CBSEM), PLS is a latent variable modeling technique that incorporates multiple dependent constructs and explicitly recognizes measurement error.

According to Fornell and Cha (1994) study, PLS is less restrictive in its distributional assumptions than the CBSEM. Hence, it does not require normally distributed data. Ringle et al (2010C) asserted that this tool is especially employed when there is a need for estimating both measurement model and structural model simultaneously.

The Partial Least Squares (PLS) model has been analyzed and interpreted in three stages. According to Hulland (1999), evaluating the study model on its validity and reliability, the testing of the relationships between the observed variables and the factors, and finally the evaluation of the structural model are the steps should be undertaken systematically. These path coefficients are indicators of the model's predictive ability.

## **2. Measurement Model**

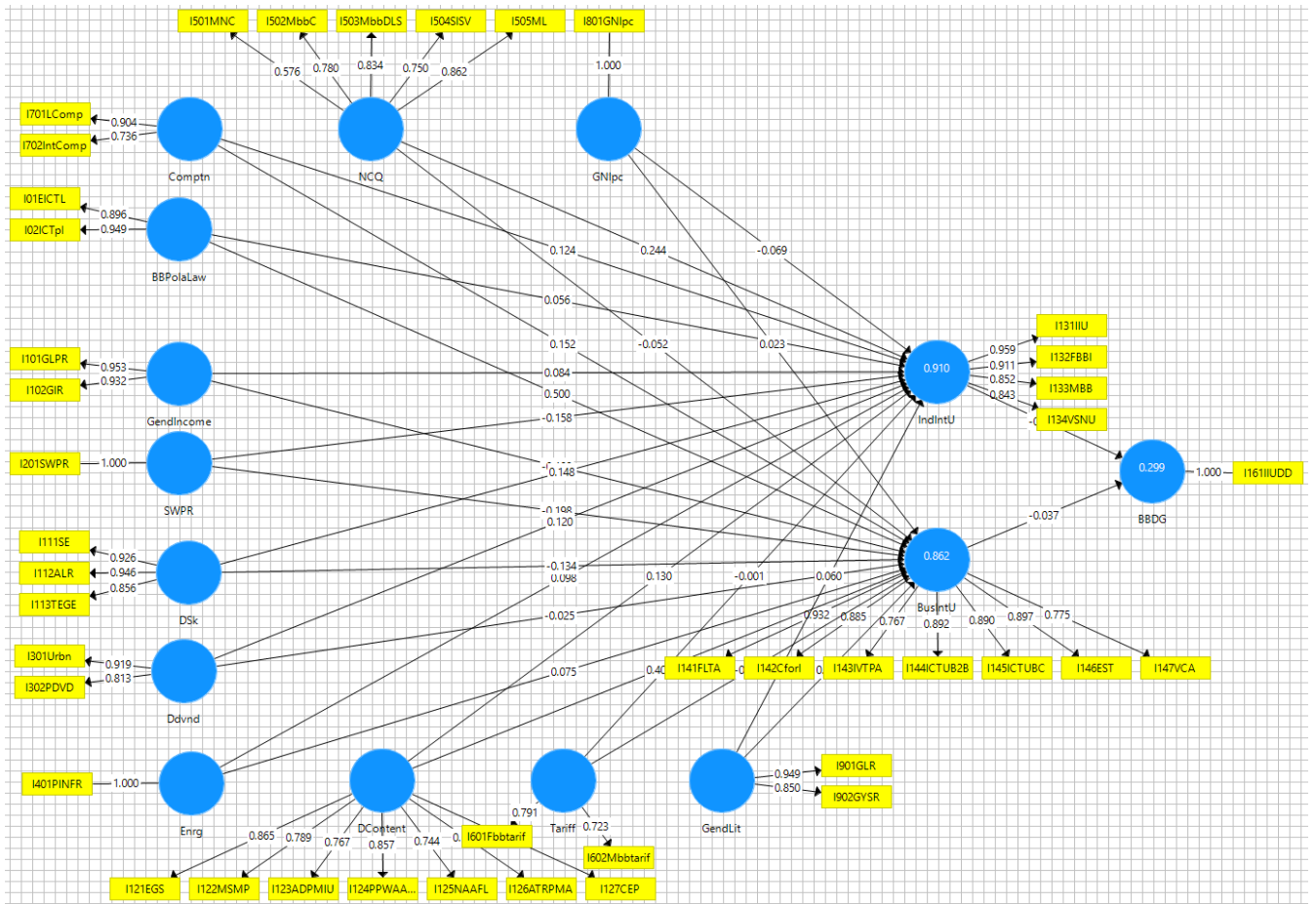
The quality of the measurement how the model is doing on the data analysis can be tested using the individual item and scale reliability followed by the convergent and discriminant validity of constructs' measures. Tenenhaus et al. (2005) introduced three criteria to determine the overall quality of the model. As the authors recommended, a path model can be assessed at three levels that includes the quality of the measurement model, the quality of the structural model, and each structural regression equation used in the structural model.

Based on these rule, the relationships are displayed between the constructs of policy and regulation of ICT, energy infrastructure, gender literacy, software piracy rate, demographic dividend, competition in telecom sector, network coverage and quality, digital content, digital skill, and gender income as drivers and citizens, and business as dependent variables. On the next step, these relationships continued to evaluate demand gap in broadband internet usage. PLS algorithm has been applied and the resultant relationships, coefficients, and values of loadings are shown in Figure 1.

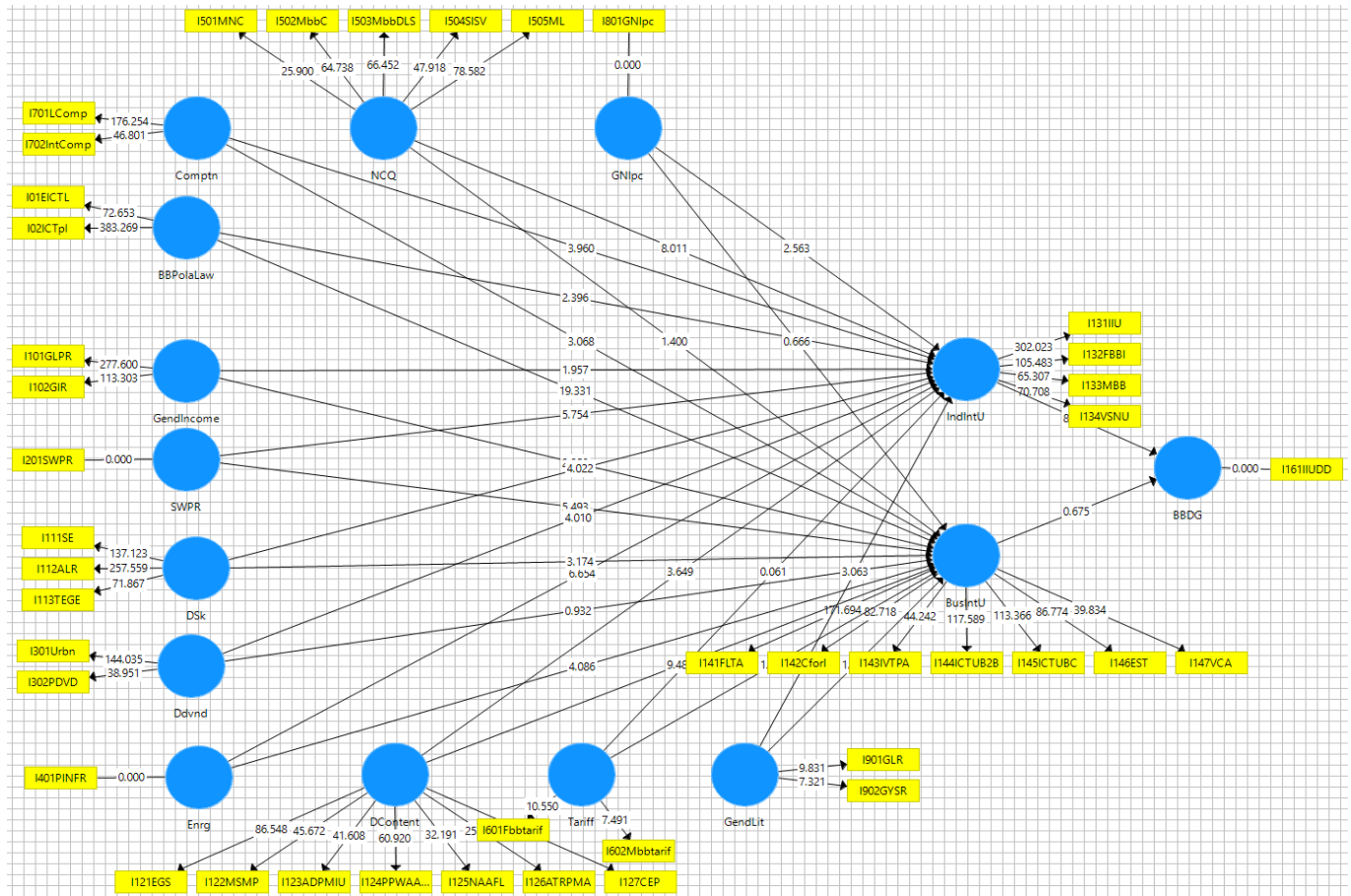
## **3. The research model analysis using the data adopted**

### **3.1. Measurement Model analysis**





**Fig. 1.** Internet usage and demand gap path coefficient analysis of the study model



**Fig. 2.** Internet usage and demand gap bootstrapping path coefficient analysis of the study model.

### 3.2. The research model data reliability analysis

According to Hulland (1999) study, individual factor reliability in PLS can be assessed by examining the loadings of respective factors on their respective latent variables. The higher loadings imply that there is more shared variance between the variables and its factors than the error variance. In the current study, the criterion of 0.50 that is recommended by Hulland (1999) has been adopted for retention of the factors. The factors loadings from PLS measurements are reported in Fig. 2 above. Furthermore, Cronbach's (1951) alpha, and Fornell and Larcker's (1981) studied how to measure the reliability of each variable using composite reliability. From these two studies the Fornell and Larcker's offers a better estimate of variance shared by the respective indicators. This was proved by the study of Hair et al. (2006). In this study, the composite factor reliability coefficients of the constructs ranged from 0.729 to 1.0 as suggested by Fornell and Larcker (1981). The Average Variance Extracted (AVE), composite reliability, R square, Cronbach's Alpha, and communality values

calculated by PLS algorithms are tabulated below in table 1.

**Table 1.** AVE, composite reliability, R square, Cronbach's Alpha, and commonality for the study model

Construct and Validity	Reliability	R Square	Cronbach's Alpha	rho_A	Composite Reliability	AVE
<b>BBDG</b>		0.302	1	1	1	1
<b>BBPolaLaw</b>			0.83	0.9	0.92	0.851
<b>BusIntU</b>		0.866	0.943	0.947	0.954	0.748
<b>Comptn</b>			0.545	0.62	0.807	0.679
<b>DContent</b>			0.86	0.891	0.895	0.557
<b>DSk</b>			0.896	0.898	0.935	0.829
<b>Ddvnd</b>			0.682	0.753	0.858	0.753
<b>Enrg</b>			1	1	1	1
<b>GNipc</b>			1	1	1	1
<b>GendIncome</b>			0.875	0.896	0.941	0.888
<b>GendLit</b>			0.782	0.932	0.896	0.812
<b>IndIntU</b>		0.912	0.914	0.928	0.94	0.797
<b>NCQ</b>			0.821	0.839	0.875	0.588
<b>SWPR</b>			1	1	1	1
<b>Tariff</b>			0.26	0.262	0.729	0.574

### 3.3. The study model convergent validity

Convergent validity refers to the degree of agreement in two or more measures of the same variable (Camines and Zeller, 1979). Evidence of convergent validity has been assessed by inspection of variance extracted for each factor (Fornell and Larcker, 1981). According to Fornell and Larcker (1981), convergent validity is established, if the variance-extracted value exceeds 0.50. The current study results indicated that the variance extracted for four scales ranged from 0.557 to 1.0 (Table. 1). This shows that the scales used for policy and regulation of ICT, energy infrastructure, gender literacy, software piracy rate, demographic dividend, competition in telecom sector, network coverage and quality, digital content, digital skill, and gender income as drivers and citizens, and business as dependent variables including the demand gap possessed convergent validity.

### 3.4. The study model discriminant validity

Discriminate validity is the degree to which any single construct is different from the other constructs in the model (Carmines and Zeller, 1979). Discriminant validity has been assessed by the test provided by Fornell and Larcker (1981) in which the pair-wise correlations between factors obtained were compared with the variance-extracted estimates for the constructs making up each possible pair. As it was recommended by Chin (1998), when constructs have an AVE loading greater than 0.5 meaning that at least 50% of measurement variance was captured by the construct, it becomes adequate. In addition, discriminate validity is confirmed if the diagonal elements are significantly higher than the off-diagonal values in the corresponding rows and columns. The diagonal elements are the square root of the AVE score for each construct (i.e., affordability, business use, demand gap, gov't use, individual use, infrastructure, and skill). These values are shown in Table 2. The results in the table below revealed that all the constructs possess discriminant validity.

*Table 2. Showing the Discriminant Validity Results*

	BBPolaLaw	BusIntU	Comptn	DContent	Dsk	Ddvnd	Enrg	GNlpc	Gendlncome	Gendlit	IndlntU	NCQ	SWPR	Tariff	
BBDG	1														
BBPolaLaw	-0.405	0.923													
BusIntU	-0.458	0.859	0.865												
Comptn	-0.489	0.687	0.768	0.824											
DContent	-0.33	0.587	0.747	0.74	0.747										
Dsk	-0.378	0.562	0.653	0.748	0.861	0.91									
Ddvnd	-0.293	0.49	0.56	0.708	0.725	0.744	0.867								
Enrg	-0.474	0.462	0.53	0.612	0.44	0.516	0.506	1							
GNlpc	-0.215	0.324	0.426	0.701	0.62	0.65	0.636	0.351	1						
Gendlncome	-0.287	0.501	0.573	0.792	0.779	0.864	0.777	0.457	0.812	0.942					
Gendlit	-0.137	0.119	0.124	0.123	-0.023	0.028	-0.25	0.067	0.038	-0.031	0.901				
IndlntU	-0.549	0.709	0.811	0.849	0.851	0.86	0.74	0.639	0.577	0.785	0.091	0.893			
NCQ	-0.322	0.666	0.745	0.784	0.827	0.805	0.654	0.598	0.52	0.726	0.082	0.891	0.767		
SWPR	0.514	-0.729	-0.816	-0.746	-0.727	-0.691	-0.532	-0.511	-0.354	-0.554	-0.112	-0.814	-0.751	1	
Tariff	0.002	-0.187	-0.219	-0.198	-0.317	-0.302	-0.293	-0.19	-0.173	-0.311	0.149	-0.26	-0.251	0.113	0.758

### 3.5. Structural Model Analysis:-

In Partial Least Squares (PLS) method, structural model and hypothesis are usually tested by computing path coefficients ( $\beta$ ). Because PLS does not require a normally distributed data, it is evaluated with the R-squared calculation for dependent latent variables (Cohen, 1988) and the average Variance extracted (Fornell & Larchner, 1981). The first item that PLS provides to determine how well the model fits the hypothesized relationship is the squared multiple correlations ( $R^2$ ) for each dependent construct in the model. The  $R^2$  measures a construct's

percent variation that is explained by the model (Wixom & Watson, 2001).

The quality of the structural model for each endogenous block can be assessed by the redundancy index. Redundancy is the “capacity of the model to predict its manifest variables from the indirectly connected latent variables” (Chantelin, Vinzi, and Tenenhaus, 2002).

Since the objective of PLS is to maximize variance explained rather than fit, therefore prediction-oriented measures such as  $R^2$  are used to evaluate PLS models (Chin, 1998). As it indicated by Chin’s (1998), to evaluate the statistical significance of each path coefficient, a bootstrapping procedure using 300 subsamples was performed. Table 3 shows hypothesized path coefficients along with their bootstrap values, ‘T’ values.

**Table 3.** Showing the path Coefficients along with their bootstrap values, ‘T’ Values for the present study Model

<i>Paths</i>	<b>Coefficients of the paths</b>	<b>St Dev</b>	<b>T Stat</b>	<b>P Values</b>
<i>BBPolaLaw -&gt; BusIntU</i>	0.5	0.026	19.331	0
<i>BBPolaLaw -&gt; IndIntU</i>	0.056	0.023	2.396	0.017
<i>BusIntU -&gt; BBDG</i>	-0.037	0.055	0.675	0.5
<i>Comptn -&gt; BusIntU</i>	0.152	0.05	3.068	0.002
<i>Comptn -&gt; IndIntU</i>	0.124	0.031	3.96	0
<i>DContent -&gt; BusIntU</i>	0.403	0.043	9.484	0
<i>DContent -&gt; IndIntU</i>	0.13	0.036	3.649	0
<i>DSk -&gt; BusIntU</i>	0.134	0.042	3.174	0.002
<i>DSk -&gt; IndIntU</i>	0.148	0.037	4.022	0
<i>Ddvnd -&gt; BusIntU</i>	-0.025	0.027	0.932	0.352
<i>Ddvnd -&gt; IndIntU</i>	0.12	0.03	4.01	0
<i>Enrg -&gt; BusIntU</i>	0.075	0.018	4.086	0
<i>Enrg -&gt; IndIntU</i>	0.098	0.015	6.654	0
<i>GNipc -&gt; BusIntU</i>	0.023	0.034	0.666	0.505
<i>GNipc -&gt; IndIntU</i>	0.069	0.027	2.563	0.011
<i>GendIncome -&gt; BusIntU</i>	0.108	0.048	2.259	0.024
<i>GendIncome -&gt; IndIntU</i>	0.084	0.043	1.957	0.051
<i>GendLit -&gt; BusIntU</i>	0.029	0.019	1.503	0.134
<i>GendLit -&gt; IndIntU</i>	0.06	0.019	3.063	0.002
<i>IndIntU -&gt; BBDG</i>	-0.519	0.061	8.527	0

<i>NCQ -&gt; BusIntU</i>	0.052	0.037	1.4	0.162
<i>NCQ -&gt; IndIntU</i>	0.244	0.03	8.011	0
<i>SWPR -&gt; BusIntU</i>	-0.198	0.036	5.493	0
<i>SWPR -&gt; IndIntU</i>	-0.158	0.027	5.754	0
<i>Tariff -&gt; BusIntU</i>	-0.026	0.016	1.675	0.095
<i>Tariff -&gt; IndIntU</i>	-0.001	0.016	0.061	0.951

## V. Discussion

The current study identified determinant causes, which improve internet usage and the causes that have significant effect on reducing the demand gap. The difference on the usage of the supplied and used network facility (demand gap) in this paper has been defined as the network facilities that are available with near the communities, but they are not being used because of various reasons. To identify these reasons, three objectives are identified in the current study. Firstly, identifying the determinant factors that have effect on individual and internet usage of the organization; secondly, identifying critical variables, which have greater impact in relative to the other variables on digital demand reducing the difference; and thirdly, making policy recommendation through identifying variables that contribute better use of internet and minimize the demand gap.

It can be noticed that we took four-year data of 120 countries as sample that gave us 480 observations. Based on the smart PLS analysis that we used, path coefficients findings measured the predictive ability of the determinant indicators based on the model, which we developed.

Accordingly, we have not found any established empirical pieces of evidence of the correlation of fast urbanization and demographic dividend with internet usage of individuals. The current study hypothesis found the result with  $\beta = 0.12$  and  $t = 4.01$  ( $P < 0.01$ ), explaining that the urbanization and demographic dividend factors have significant correlation with the internet usage of the individuals. The internet usage of the individuals changes with the direct correlation to the urbanization and demographic dividend with a coefficient of 0.12. This clearly indicates that a 100 points direct change in affordability will bring 12 points direct change in the internet usage of individuals. This explains the urbanization and demographic dividend have strong effects on the internet usage individuals.

Testing the path relationship of network coverage and the quality of the network and internet usage of the individuals has been made in the second step, and the result supported to accept the hypothesis with  $\beta = 0.244$  and  $t = 8.011$  ( $P < 0.01$ ), explaining that the network coverage and its quality indicators have significant correlation with the internet usage of individuals. It means that the network coverage and the quality of service have the greater impact on internet usage of the individuals. The gender income and individual internet usage relationship has been tested in the third step and showed the significant result with  $\beta = 0.084$  and  $t = 1.957$  ( $P < 0.05$ ) indicating that the gender income improvement has the direct influence on the individual internet users. The individual internet usage changes in direct proportion to the female income improvement with a coefficient of 0.084.

The correlation of the digital skill and individual internet adoption has also been tested on the fourth step, and we found a significant result with  $\beta = 0.148$  and  $t = 4.022$  ( $P < 0.01$ ). This indicates that the digital skill has the positive outcome of the internet usage of the individuals and these changes in direct proportion to the digital skill improvement with a coefficient of 0.148. This in return can be explained by the presence of the strong impact of the digital skill improvement on individual internet adoption.

The broadband policy and regulation and its correlation with individual and business internet usage have been tested in the fifth step. The result found to be significant with  $\beta = 0.056$  and  $\beta = 0.5$  with  $t = 2.396$  ( $P < 0.05$ ) and  $t = 19.331$  ( $P < 0.01$ ) respectively indicating that the broadband policy and regulation have the direct positive influence on the individual and business broadband internet usage. The justification is that the better the ICT policy environment, the better the improvement of the individual and the business internet usage with a coefficient of 0.056 and 0.5 respectively. The sixth relationship that was tested is software piracy rate, the individuals, and the business internet usage. The finding showed the significant result with  $\beta = 0.158$  with  $t = 5.754$ , and  $\beta = -0.198$  with  $t = 5.493$  for individual and business internet usage respectively to the proposition, which we forwarded. Based on the finding, it can be indicated as the higher the software piracy rate, the weaker the internet usage by individuals and business become.

The seventh correlation of internet usage of individuals and business with power supply. We found that this relationship is significant with  $\beta = 0.098$  with  $t = 6.654$  ( $P < 0.01$ ), and  $\beta = 0.075$  with  $t = 4.084$  ( $P < 0.01$ ) respectively, indicating that the power supply improvement has

significant effect on the internet usage of the individuals and business. This means that the skill has the strong impact on gov't internet adoption improvement. The eighth relationship between digital content with individuals and business internet usage that is significant with  $\beta = 0.13$  with  $t = 3.649$  ( $P < 0.01$ ), and  $\beta = 0.403$  with  $t = 9.484$  ( $P < 0.01$ ) indicating that the digital content has the direct positive influence on the individual and business broadband internet usage. The individual and business internet usage changes in direct proportion to the digital content skill with a coefficient of 0.13 and 0.403 respectively. It means that the digital content has the strong impact on individual and business internet usage.

The ninth relationship between competition in the internet business with individuals and business internet usage that is significant with  $\beta = 0.124$  with  $t = 3.96$  ( $P < 0.01$ ), and  $\beta = 0.152$  with  $t = 3.068$  ( $P < 0.01$ ) indicating that the competition in the sector has the direct positive influence on the individual and business broadband internet usage. The individual and business internet usage changes in direct proportion to the level of the competition in the internet business with a coefficient of 0.124 and 0.152 respectively. It means that the competition has the strong impact on individual and business internet usage.

The tenth relationship that was tested is the individual internet usage, and its impact on demand-side gap reduction in internet usage. The test result was statistically significant with  $\beta = -0.519$  and  $t = 8.527$  ( $P < 0.01$ ) that supported our proposed hypothesis. The justification is that the better the individual internet adoption is, the minimum the demand gap becomes (reducing the unutilized broadband facilities and improving the internet subscriptions) with a coefficient of -0.519. It means that the individual internet adoption has a very strong impact on decreasing the broadband internet demand gap.

Whereas, researchers such as Di Gregorio et al. (2005) identified the major determinant factors of internet usage as infrastructure, human resource, institutional space, path dependence, entrepreneurial activity, and regional differences. Our finding has substantiated the infrastructure, the human skill, and the entrepreneurial activities with empirical pieces of evidence. The difference between the previous study and the current study has substantiated by four-year data from 120 countries whereas the existing study was based on the conceptual analysis.

The digital exclusion's variables that were studied by Dewan et al. (2005), could also be enumerated as economic (GDP; and technology cost), demographic (urban population), and



environmental (telephone lines; and trade in goods) factors. The study of these scholars in the case of income, technology cost (affordability), telephone line, and business transactions have been substantiated by the present study too. In relative to the existing, the present study considered more variables and quantitative analysis to test the hypothesis.

In addition, in terms of IT adoption and digital exclusion, Shih et al. (2008) studied that investment, synergetic assets (IT facility and skill) and having the best experiences from other countries were indicated to be the three determinant factors. The research of these authors and our paper come to the same conclusion. However, in the current study, the propositions are supported by quantitative analysis to accept the hypothesis whereas in the existing research it was logically analyzed based on the qualitative analysis.

To sum up, our ten hypotheses have been supported by the empirical evidences to be accepted. These relationship paths as each of them explained above have been supported by the empirical pieces of evidence. These findings can be basic knowledge backgrounds to develop a comprehensive policy for how to make digital inclusion and bridging the digital divide in low-income countries.

## **VI. Conclusion**

In this study, we conclude that there are some determinant factors, which are more important than the other determinant causes to improve the internet subscription rate and its use. These variables, are such as ICT network for individual internet use, individual internet use on the demand gap reduction, content, energy supply, completion and ICT policy environment have been supported by the empirical data analysis about their statistical significant impact on making the improvement on individual and business internet usage and then the national broadband subscription. The telecommunication service operators and low-income countries leadership should understand that these determinant factors have influence on the internet subscription extension plans. The main objective of the paper has been how to increase individual internet usage by reducing the demand gap on the network facilities already supplied. Therefore, low-income countries have been recommended to have a comprehensive policy and strategic roadmap that can help them to make practical changes on the variables that are identified on this study to have digital inclusion.

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