Effects of Information and Communication Technologies on Financial Inclusion in Emerging Countries

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This study assesses the impact of information and communication technologies (ICT) on the financial inclusion through access and usage. Panel dataset from 35 emerging countries in the period between 2009-2018 is gathered and analyzed with a system GMM estimator. The results highlight the significance of ICT development, particularly mobile phones, internet users, and ATMs, to promote financial inclusion in emerging countries. As more people join the financial system, bank accounts and deposits will increase to support their economic activities. Hence, while the banking industry has generally utilized the ICT to serve the well-off customers, it can be expanded to reach the unbanked population. Similar to ICT, the socio-economic factors also play an essential role in building ecosystems within the financial system, particularly employing the improvement of the standard of living as indicated by the Human Development Index (HDI). It is therefore essential for emerging countries to construct policies that will increase the access and usage of financial products and services as well as enhance socio-economic factors to stimulate financial inclusion efforts. It is of utmost importance then for governments to provide the basic infrastructures needed to facilitate secure and sustainable technologies for financial transactions.

Keywords: Financial inclusion, ICT, Socio-economic.

1. Introduction

Information and communication technology (ICT) is prevalent in many socio-economic activities, from household life to office and government activities. Those activities include the financial services sector, which has increasingly use ICT in its various activities. In the banking industry, ICT is oriented to provide services and fulfill customer needs as a delivery channel that can be accessed anytime and anywhere. The use of ICT in banking has broad characteristics in which customers can access all banking services through a collection of e-banking in one location (digital branch) and/or in a bank/customer device (omnichannel). With e-banking, bank customers can obtain information, communicate, and make transactions through various electronic media, such as Automated Teller Machines (ATM), SMS banking, electronic fund transfers, internet banking, and mobile banking, in a multichannel manner.

Technology-based product and service innovations in banking is now seen as an innovative technology to provide financial services for existing customers. It is also important to expand product supply and banking services to people who do not have a bank account (unbanked). According to McKinsey Global Institute (Manyika et al., 2016), digital finance is used in financial inclusion programs by providers of financial services that are not only banks, but payment providers and other financial institutions, telecoms companies, financial technology (fintech) start-ups, retailers, and other businesses.

The people's ability to easily access financial products and services (accessibility) is one of the main driver for financial inclusion. Accessibility is reflected when people are close to access points - branches, agents, ATMs, and outlets or other devices - to enable them to select and use various financial products and services easily. Ozili (2018) has found that digitalization, when applied to the lives of low- income and/or poor people, can increase their access to basic financial products and services, leading to greater financial inclusion. Kanobe et al.(2017) finds digitalization particularly beneficial in rural areas because mobile devices are becoming an essential tool for financial inclusion in developing countries.

The 2017 McKinsey's Asia Personal Financial Service survey results show that approximately 55 to 80% of customers in Asia consider opening an account with a branch-less digital-only bank. Those customers would be willing to shift between 35 to 40% of their money to the digital account (Barquin et al., 2019). This finding implies that the more accounts opened in a branch-less digital-only bank, the more opportunities for saving, borrowing, and transferring money can be executed through branchless banking services. The benefits of increasing financial inclusion are not only significant for individuals or societies but also the economy as a whole. Many studies confirm that encourage economic growth is one of the positive impacts of financial inclusion. Loukoianova et al. (2018) illustrates that an increase in the financial inclusion index in low-income development countries by 1% can raise GDP per capita growth by 0.14%. Hariharan and Marktanner (2012) finds an increase in financial inclusion by 10% has the potential to increase income per worker by 1.34% onaverage.

Beyene Fanta & Makina (2019) concludes that the most significant driver for financial inclusion is the technology in which ATMs and internet technology affect financial access and use of financial services. Mushtaq and Bruneau (2019) specifies that using information and technology as an instrument to increase financial inclusion can accelerate economic growth and reduce poverty as well as inequality. The increase in financial inclusion will also positively contribute to sustainable economic development at local and national level, and support the

stability of the financial system (Robert et al., 2014).

This study contributes to examine the relationship between information technology and financial inclusion through the facilitation of banking services in emerging countries. The analysis particularly assesses the impact of ICT, socio-economic, and bank network related factors upon two indicators that are commonly used to measure financial inclusion, i.e., access and usage.

The rest of the paper is organized as follows. Section 2 provides a brief literature review on the relationship between ICT and financial inclusion, particularly the factor determinants. Section 3 describes the theoretical framework for the basis of this study, while section 4 explains our data and methodology to assess the issues raised in the paper. Section 5 shows the results of the analysis, and section 6 concludes the paper.

2.   Literature Review
2.1.   ICT in the Banking Industry

ICT is consisted of two aspects: (1) information technology that covers all matters relating to information processing; and (2) communication technology that is related to tools to process data and transfer data from one device to another. These two aspects cannot run properly without ICT infrastructures support, including a telecommunication network. Thus, the ICT infrastructures in the banking industry take part as the backbone in data and information processing and delivering within the bank and/or with their stakeholders.

The use of technology in activities can undoubtedly facilitate the exchange of information and data. The most visible development in the use of information technology is processing the data into information in a fast and accurate way. Tcheng et al. (2007) illustrates that ICT development is increasingly considered as an engine for growth, in which the technology is omnipresent in most business sectors for continuous improvement process, cost reduction, and new product and processes innovation.

The high need for and the penetration of digital devices in various aspects of human life has directly created a big industry in technology and involves almost all major nations globally, with business values increasing from day to day. Recently, people can shop anywhere at any time without leaving home by using electronic commerce platform. For the payments for purchasing and selling through e-commerce platforms, the payment system has its genesis in the banking sector. Over the last three decades, banks have transformed their business from paper-based systems to fully integrated ICT- enabled systems to serve various customers' needs, including payment systems. Since e-commerce has become so ubiquitous in some economies, cash is now almost superfluous.

In a cashless ecosystem, where people pay goods and send money from their bank accounts through many available delivery channels to the recipients' accounts, money is used for only the smallest transactions. Even these "small money cash transactions" are poised to be replaced by a "micropayments" service in some countries where consumers pay for small items through their mobile phone or a value-carrying smart card. Previous studies have found that ICT is positively associated with higher productivity growth in both developed (Dedrick et.al., 2013; Yousefi, 2011) and emerging markets (Sassi & Goaied, 2013).

European Banking Federation (2015) finds that in the banking industry the rapid uptake of digitalization has led banks to accelerate the rethinking of their traditional business model, including their brick-and-mortar branches. IT systems have become more important, and it is clear that banks need to respond quickly and efficiently to customer demands while keeping services safe and simple to use. The development of digitization in many areas brings banks to understand that banking is no longer about banking money but about banking data and keeping data secure for customers' protection while trying to satisfy customers' needs. There is an obvious need to define more clearly the certain effect of the use of technology on the products and services used by customers and potentialcustomers.

IT systems have become more important for banks to align their goals with the ways they operate their businesses. ICT is no longer a supporting factor for a bank's going concern. Banks are enhancing their application to enable customers to do their financial transactions independently through mobile and internet banking. Some of them even creating online onboarding system to grab potential customers. The end state is to give customers and potential customers complete autonomy inactions, allowing customers and potential customers to provide services for themselves, increase perceptions of control, and increase the speed of access to available services.

The front-end experiences provided by either the bank itself or their third-party partners, can be used both by customers and potential customers to increase access to services and to save costs incurred while using the services. At the same time, banks using integrated technology within their bank-wide operation can reduce labor costs and/or the ability to move employees to more productive activities, reduce branch network costs and expand market share even in remote areas. This expansion can be done through an electronic delivery channel used by customers and potential customers or by the bank's agents.

For some banks, by implementing new technologies in their IT architecture, more parties are involved in servicing their customers and potential customers. For example, an application programming interface (API) will allow the bank to acquire new customers from people who registered through the e- commerce platform. Collaborations between bank and fintech companies in electronic – know your customer (e-KYC), and digital signature will bring down cost and time and simplify the authentication phase. At the same time, it will increase the ability of customers and potential customers to grasp access and to get quicker transactions processing.

Along with the introduction of financial technology and democratization of financial services, the banking industry does help reduce the cost for people's transactions and fosters the development of innovative services greater than what can be offered by banks before. Unfortunately, most banks only have one channel, which is a branch network. The ATM, call center, mobile channels, internet channels were built as layers of cake and created when the physical branch was the foundation (Skinner, 2014). This will bring difficulty to some banks in some countries where many populated areas are so remote and very isolated, which is consequently tricky and high cost to have a physical branch in such areas. Ultimately, it is crucial to build the right framework to facilitate financial inclusion and innovation and ensure that consumer protection, trust, security, and competition are maintained.

2.2. Financial Inclusion

Being excluded from the formal financial system means that individuals and businesses who do not have bank accounts have to rely on informal mechanisms such as saving money under the pillow/bed mattress, sending money through a remittance company or relatives, and borrowing money from pawnbrokers or loan sharks, that are often unsafe, extremely expensive and unreliable. Moreover, their economic activity might be hampered by their positions, which are out of the financial system. This situation can be irony in today's world: the people with the most limited resources pay the highest fees for financial products and services. Therefore, providing access to affordable financial products to the unbanked and underbanked has tremendous potential to help them unleash their financial transaction in supporting the economic activities among those people. This is similar to the reasoning from the World Bank on why financial inclusion matters. Financial inclusion is not an end in itself, but a means to an end - there is growing evidence that it has substantial benefits for individuals. Studies show that when people participate in the financial system, they can better start and expand the business, invest in education, manage risk, and absorb economic shocks (Demirguc-Kunt et al., 2015).

According to the World Bank's 2011 and 2014 Global Findex Survey, financial inclusion was measured in many countries based on account ownership by adult people (above 15 years old), an account that can be used to store money and receive payments (Demirguc-Kunt et al. 2015). From the survey questions, it is known that accounts should be within formal institutions, which are different from one country to another regarding their laws and regulations regarding formal institutions. With this definition, globally, about 2 billion adults in 2014 and 1,7 billion adults in 2017 remainunbanked-without an account at a financial institution or through a mobile money provider. Globally, the World Bank Financial inclusion surveys showed an increase in the financial inclusion rate (Findex), from 51% of adults who have an account in 2011 to 62% in 2014 and 69% in 2017. In their effort to increase financial inclusion, many countries expand account ownership among the unbanked people. In 2018, the World Bank improved the approach to measuring financial inclusion using access to financial products and services that are useful and affordable in meeting the community and business's needs, in this case, transactions, payments, savings, credit, and insurance that are used responsibly and sustainably (World Bank, 2018).

Every country has a definition of financial inclusion and a specific goal of increasing inclusion, which differs from another. Still, the purpose of financial inclusion is to include all public members in a country's financial system to enable all financial transactions to be carried out quickly and accurately. Besides, with an inclusive financial system, state policies can be appropriately transmitted through the system. The community's ability to easily access financial products and services or accessibility is one of the main drivers of financial inclusion.

The World Bank and many international bodies believe that financial inclusion is a key enabler to reducing poverty and boosting prosperity. This is due to their reports and studies' results that an inclusive financial system helps increase economic capacity and pave the way out of poverty and reduce economic inequality. In most developing countries, financial inclusion is intended to provide financial services to people who do not have access. It can be done by opening accounts at formal financial institutions so that they can carry out financial activities that ultimately eradicate poverty and accelerate economic growth (Beck, Demirgüç-Kunt, et al.,

2007). This means an inclusive financial system can be achieved by increasing access and usage to financial services. Thus, the increasing of financial inclusion is an essential component in social inclusion and economic inclusion that plays a role in promoting economic growth, creating financial system stability, supporting poverty reduction programs, and reducing gaps between individuals and regions.

An inclusive financial system has several merits. It facilitates the efficient allocation of productive resources and can potentially reduce the cost of capital. Besides, access to appropriate financial services can significantly improve the day-to-day management of finances.

It helps reduce the growth of informal credit sources (such as money lenders), which are often to be found exploitative. (Sarma & Pais, 2008). Massey (2010) said that financial institutions in a developing country are vital in promoting financial inclusion.

As many countries reveal potential development benefits from financial inclusion, many policies and strategies were taken by the government of developing countries to use account ownership as a vehicle to deliver their programs, such as digitizing cash transfers in the Government assistant program to poor people (G2P) and others. From this kind of activity, there are two broad categories of opportunities for expanding financial inclusion. Firstly, expanding account ownership among the unbanked and secondly increasing the use of accounts among those who already have one. Technology drives financial inclusion, as financial inclusion is a key enabler to reduce poverty and boost prosperity.

From the Word bank Findex database, it is known that account ownership in some developing countries but stagnated in others. For example, the Findex 2011, 2014 and 2017 for India and Indonesia are 35%, 53%, 80% and 20%, 36% and 49%, while for Pakistan and Philippine
are 12%, 13%, 21% and 26%, 31% and 34%. All countries have their own National Financial Strategy, which is hoped to be suited to each country's characteristics. Yet, the progress of the inclusion process was different from each other. Based on Patwardhan et al. (2018), the common limitations and frictions in expanding financial inclusion are:

1. access which the availability of financial services can be limited by basic problems with access, for example, where they are only distributed through branches that are not available in rural areas;
2. product market fit, existing and available financial products do not address the needs of large segments of consumer demographics;
3. affordability, prices need to be affordable, and hence the cost to the providers must be sufficiently low so that the services can be offered at a profit despite the limited revenues.

2.3.   ICT in Banking and Financial Inclusion

The advancement in information technology has brought about the banking industry's evolution, which has revolutionized how commercial banks conduct their business. The delivery of financial services has experienced significant changes during the past few years. Technology allowed banks to provide existing customers with easy access to financial services and other benefits and expand product supply and banking services to people who do not have a bank

account (unbanked). The technology could help overcome barriers that unbanked adults say prevent them from accessing financial services. Thus, to ensure that people benefit from digital financial services requires a well- developed payments system, good physical infrastructure, appropriate regulations, and vigorous consumer protection safeguards. (Demirgüç-Kunt et al., 2017).

An appropriate banking environment is considered a key pillar as well as an enabler of Financial inclusivity (Koivu, 2002). Internet and mobile banking have made financial organizations provide banking services online and via mobile phone and provided the customer with easy access to financial services and other benefits. Agbola (2006), during his study, witnessed an increase in the adoption of ATMs, EFT, smart cards, electronic home, and office banking and telephone banking. He indicates that the adoption of ICT improves the banks'image and leads to a broader, faster, and more efficient market. Jenkins (2008) shows that reduced transaction costs from highly innovated ICT favor trade. It gives developing countries opportunities to tap into global markets and remittances and increase the financial inclusion landscape.

Kendall et al. (2010) investigate the relationship between deposit, loan, and bank branch penetration with other variables and find significant associations of deposit and loan penetration with per capita income, physical and financial infrastructure, and macro-economic stability but found an insignificant association with policies that have financial inclusion as a central goal. Oruo (2013) found that economic growth strongly correlated with Financial Inclusion, especially the banking sector's branch networks, mobile money accounts, and users. While Mushtaq and Bruneau (2019) stated a positive association of ICT diffusion with financial inclusion and a negative relationship with poverty & inequality. Furthermore, the results of the study indicate the poverty-reducing effects of financial inclusion measured either way.

Andrianaivo and Kpodar (2012) confirm that mobile phone development contributes significantly to African countries' economic growth. Part of the positive effect of mobile phone penetration on economic growth comes from greater financial inclusion. Daniel, (2015) study found that mobile money transfer services have a positive impact on financial inclusion in Kenya. The study further found that mobile banking services have contributed significantly to deepening financial markets, mostly from financial products related to mobile money. Mobile banking services were also found to have contributed significantly to financial access in Kenya. As reported by the World Bank (2012), three-quarters of the world population have access to mobile phones. Mobile phones are also widely accessed by the poor in developing countries.

Besides mobile phones, there are many other electronic devices that banks can use to expand their services in reaching unbanked and underserved people, such as EDC mini ATM and web site or internet banking. With electronic devices, banks (directly or using bank agents) could serve people in remote, isolated areas and previously were unreachable with their existing physical branches. The utilization of information technology has given the ability to conduct financial transactions anytime, anywhere using a personal computer or mobile device saves both time and money by eliminating the need to visit a physical bank branch (Lenka & Barik, 2018).

Initiatives to increase financial inclusion in developing countries recently have started to rely increasingly on the use of technology – mobile banking, electronic payments, or financial

technology start-ups (De Koker & Jentzsch, 2013). According to Mushtaq & Bruneau (2019), a growing literature in ICT and growth indicates the significance of ICT's role in social and economic uplifting over the last ten years. Their study has shown a Positive association of ICT diffusion with financial inclusion and a negative relationship with poverty & inequality. Furthermore, the results of the study indicate the poverty-reducing effects of financial inclusion measured either way. It was also observed that the ICT dimensions, when used as instruments for financial inclusion, accelerate economic growth, and reduce poverty & inequality (Mushtaq & Bruneau 2019).

The results of Beyene Fanta & Makina (2019) study clearly show how the ATM and internet technologies affect financial access and usage of financial services. On the other hand, mobile and telephone subscriptions are positively related to financial services, although the relationship is not significant. Thus, overall, the study observe a significant positive relationship between financial inclusion and technology. Andrianaivo & Kpodar (2012) utilizes only onedimension of financial inclusion-usage. It found that the combination of IT and mobile telephone has emerged as a viable solution for greater financial inclusion because it minimizes the need for setting up physical branches by banks. Increased mobile phone penetration increases financial access. Better ICT infrastructure is supposed to favor financial markets, economic growth, and poverty reduction (Adrian Alter, 2015).

In some countries, banks are not the sole provider for financial transactions any longer. More financial technology companies (Fintech) play a role in the financial business, such as payment. Digital finance terminology is used for financial inclusion instead of digital banking. According to Manyika et al. (2016), for their research, they defined digital finance as financial services delivered over digital infrastructure—including mobile phones and the internet—with low use of cash and traditional bank branches. Mobile phones, computers, or cards used over point-of-sale (POS) devices connect individuals and businesses to a digitized national payments infrastructure, enabling seamless transactions across all parties. From the reports from many international bodies on the implementation of the financial inclusion program in many countries, it can be said that the utilization of Information Technologies favors financial inclusion while increased access and usage of banks' financial services, which helps economic growth poverty reduction.

Asare and Sakoe (2015) examined the effects of electronic banking on Ghana's financial services using a qualitative research method. The study found out that the advent of electronic banking in Ghana has enhanced accessibility to a wide range of banking products. The delivery of banking services has been made increasingly faster to cover a wide range of customers or people referred by existing customers. Hence, the study revealed that the availability of electronic banking facilities such as automated teller machine (ATM), online banking, and telephone banking does not significantly influence customer's bank choice decision.

From the McKinsey Global Institute study, it can be seen that even many good effects of financial inclusion include boosting the GDP of emerging economies by $3.7 trillion by 2025 and cutting the cost of providing financial services by 80 to 90 percent. But some constraints exist and hamper the effort of banks and Fintech in making technologies as an enabler in their broad-based financial inclusion program. Digital finance needs to be supported by a sustainable business environment that includes banks and other financial institutions and telecom companies, handset manufacturers, fintech companies, and other businesses such as retailers

(Manyika et al., 2016). Better collaboration between government, telecommunication providers, and players in the the financial sector will likely improve digital/mobile banking (Ozili, 2018). From all of the studies above, we could derive a suggestion that policies to promote information and communication technologies and infrastructure, and their utilization could stimulate financial inclusion by promoting digitalfinance.

3. Theoretical Framework

The theoretical framework is the output or result of literature review activities. (Sekaran, 2006) defines the theoretical framework as a conceptual model of how the researcher theorizes the relationship between the factors identified as necessary to the problem. It describes the relationship between one or more variables that are considered integrated with the research dynamics.

3.1.1. Dependent Variables

Sarma and Pais (2008) Financial inclusion refers to a process that ensures the ease of access, availability, and usage of the formal financial system for all economy members. World Bank on Global Financial Index 2014 states that there are three main types of indicators for measuring financial inclusion. First, Access indicators reflect the depth of outreach of financial services, such as the penetration of bank branches or point of sale (POS) devices in rural areas, or demand-side barriers that customers face to access financial institutions, such as cost orinformation.

Then, usage indicators measure how clients use financial services, such as the regularity and duration of the financial product/service over time. Last, Quality, which measures describe whether financial products and services match clients' needs, the range of options available to customers, and clients' awareness and understanding of financial products (Demirgüç-Kunt, Asli, Leora Klapper, Dorothe Singer, Saniya Ansar, 2015). Consultative Group to Assist the Poor (CGAP) also stated that financial inclusion could be measured through Access, Usage, and Quality. According to CGAP, access to financial services can be measure by the percentage of adults with an account at a formal financial institution. Then, usage can be measured by the percentage of adults who used a mobile phone to make a payment. Last, quality can be measured by the average monthly cost to have a basic account, based on the official minimum wage.

Since this study focuses on the supply side of financial inclusion, the third indicator (quality) is not covered. Following Beyene et. al. (2019), financial inclusion in this study is measured through access and usage. Thus, for usage this study only takes the deposits as a percentage of GDP as a dependent variable. This is due to the limited data of Electronic Fund Transfer (EFT) in many emerging countries.

3.1.2. Independent Variable
3.1.2.1. Socio-economic

Social welfare determines the way people behave and make decisions on financial markets (Robert et al., 2014). The population of less developed socio-demographic characteristics is more likely to avoid using financial services, preferring old-fashioned cash, or even barter. The number of people with a bank account will be small (Kabakova and Plaksenkov, 2018).

In the case of the economic dimension, it might affect financial inclusion in specific ways. Empirical evidence shows a causal relationship between financial development and economic growth. Social welfare influence the depth of usage of financial services. It affects the demand side of financial inclusion and hampers its development (Dev, 2006). From many Financial Inclusion reports by international bodies, it is found that financial products that ease people in making payment of their transactions could boost economic growth. Comprehensively, economic growth stimulates financial development and vise versa (Beck and Levine, 2002).

The results of the econometric analysis confirm that higher deposit and/or loan correlation is associated with higher economic and financial development as measured by GDP per capita, the amount

of electricity use, the availability of explicit deposit insurance and better credit environment, etc. (Ardic et al., 2011). Oruo (2013) has investigated the relationship between Financial Inclusion and economic growth in Kenya. It has found that economic growth had a strong positive correlation with Financial Inclusion, especially the branch networks of the banking sector, mobile money accounts andusers.

Chithra and Selvam (2013), attempt to identify and analyze the determinants of financial inclusion, revealed that socio-economic factors like Income, Literacy, and Population were found to have a significant association with the financial level inclusion. Kelly and Rhyne (2013) state that higher-income causes people to demand and utilize financial services. So, GDP per capita can drive the needed financial inclusion (Evans and Alenoghena, 2017). Population density is the number of individuals per unit of geographic area. Iqbal and Sami (2017) mention that factors like population density, rural and remote areas, mobility of the population (i.e., highly mobile people with no fixed or formal address), etc., also affect financial access services. Gupta et al. (2014) found that the index of financial inclusion and the Human Development Index are positively correlated. The Human Development Index (HDI) summarize the measurement of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable, and have a decent standard of living (Morse and Morse, 2019). World Bank (2018) states that population density and per capita income are two key factors that are systematically correlated with financial inclusion.

From all findings in the above studies, for this study, it can be assumed that socio-economic dimension's impact on financial inclusion is measured through population density, gross domestic product, and Human Development Index (Ali Said and Rihab Grassa, 2013; Beyene et. al., 2019; Daniel, 2015; Kendall et. al., 2010; Mushtaq and Bruneau, 2019; Ozili, 2018; Sarma and Pais,2008).

H1: Socio-Economic variables have a positive impact on financial inclusion.

3.1.2.2. Information Technology

Automated teller machines (ATMs) and mobile phone transactions have been around for quite some time as electronic banking. In more recent times, it has been transformed by the internet— a new delivery channel that has facilitated banking transactions for both customers and banks. E-banking implies the provision of banking products and services through electronic delivery channels (Nitsure, 2003). In this study, instead of classifying ATM as the independent variable from the Information technology side, it was treated as an independent variable from the Bank Network side. This classification controls and maintains the ATM's availability and readiness to be used by customers in the bank's hand, not in the customer's hand.

Moreover, customers and potential customers can use the mobile phone if the application for opening an account through a mobile phone is available. The downloading and using the application is relatively easy for targeted people. The wider prevalence of mobile phones in some developing countries can explain that people in those countries have no access to alternative communication modes such as the internet and fixed-line telephones.

Mobile phones and the Internet to provide financial services has become a new way to offer unbanked people more opportunities to participate in the formal financial system. Jenkins (2008) shows that reduced transaction costs from highly innovated ICT favor trade because it gives developing countries opportunities to tap into global markets and remittances and increase financial inclusion landscape. From many journals and reports, it is seen that if the efficient way of transactions continues, with ICT favor financial inclusion, the increased access and usage to finance will helps poverty reduction and economic growth. In short, ICT diffusion is measured through Mobile cellular subscriptions, Internet users, Fixed telephone lines subscriptions (Andrianaivo & Kpodar, 2012; Beyene Fanta & Makina, 2019; Sarma & Pais, 2008; Sassi & Goaied, 2013). H2: Information Technologies have a positive impact on financial inclusion.

3.1.2.3. Bank Network

While new technologies in principle are available globally, their adoption and use for financial inclusion may have been uneven across countries. There has also been significant variation in whether technologies have been pioneered by the traditional financial sector or other players. Financial access can surely improve the financial condition and living standards of the poor and the deprived section. So, the banking sector has been continuously stimulating to extend the banking network by setting up new branches and installing new ATMs (Dangi & Kumar, 2013).

World Bank (2018) states that if measured in terms of access to bank accounts, financial inclusion is an increasing function of a country's per capita income. The economies of scale largely explain it in countries such as Bangladesh, India, and Indonesia. High population densities have been an enabling condition for financial inclusion through traditional bank branches despite low per capita income levels. Nkuna et al. (2018) found some suggestive evidence that transaction costs and distance barriers limit accounts' usage. Furthermore, in exploiting reasons for dormancy in a no-frills account, it was mostly distance that was a major

barrier. The respondents were willing to pay for convenient banking services closer to home (Alphina et al., 2011). Nkuna's research was done in Malawi, while Alpina's was done in Tamil Nadu. Both are developing countries, where people are still feeling convenient to go through the bank's channels that show the bank's identity in a real form for their financial transactions.

The measurement of financial inclusion worldwide has focused on density indicators, such as the number of bank branches or automatic teller machines (ATMs) per capita (Beck, Demirguc- Kunt, et al., 2007). The Global Partnership for Financial Inclusion (GPFI) has the following G20 Basic Set of Financial Inclusion Indicators to help countries set financial inclusion targets and monitor progress, Bank Branches are the measurement for points of service (World Bank, 2015). Bank Branches measure geographical access to formal financial providers. It will represent a proxy to show that the average number of people having access to financial services counted with each bank's physical outlets. It is understandable why ATM and Bank branches are among the factors surveyed periodically by the IMF Financial Access Survey (FAS). From the IMF website, near-global coverage, two FAS indicators— number of commercial bank branches per 100,000 adults and number of automated teller machines (ATMs) per 100,000 adults—have been adopted to monitor Target 8.10 of the 2030 United Nations' Sustainable Development Goals (SDGs). The UN stated that for Target 8.10 of SDG, which strengthens the capacity of domestic financial institutions to encourage and expand access to banking, insurance, and financial services for all, the indicator 8.10.1 are Number of commercial bank branches per 100,000 adults and number of automated teller machines (ATMs) per 100,000 adults. In conclusion, Bank's network is measured through the number of bank branches and ATM (Beyene Fanta & Makina, 2019; Demirgüç-Kunt, Asli, Leora Klapper, Dorothe Singer, Saniya Ansar, 2015; Demirgüç-Kunt et al., 2017; Nkuna et al., 2018).
H3: Bank's Network variables have a positive impact on financial inclusion.

4. Data and Methodology
4.1. Data

In developing countries, access to formal financial services for the poor majority population remains limited. Availability of data on chosen parameters for each country has taken into account while deciding which countries will be sampled. The potential sampled countries include emerging countries from the list of emerging marker such as in the S&P Dow Jones Indices, and list ofdeveloping economies in the IMF world Economic Outlook. The data used in this study are secondary data from 35 emerging countries on Table 4-1 list as a sample of research in the period 2009-2018.

Table 4-2. Emerging Countries

No.	Country	Financial Inclusion Index*)	Emerging markets **)	Emerging markets & developing economies ***)
1	Argentina	49 %	O	V
2	Bangladesh	50 %	-	V
3	Brazil	70 %	V X O	V
4	Brunei Darussalam	-	-	V
5	Czech Rep.	-	X O	-
6	Chile	74 %	V X O	V
7	China	80 %	V X O	V
8	Colombia	46 %	V X O	V
9	Egypt	33 %	V X O	V
10	Greece	85%	X O	-
11	Haiti	33%	-	V
12	Hungary	75 %	V X	V
13	India	80 %	V X O	V
14	Indonesia	49 %	V X O	V
15	Kenya	82 %	-	V
16	Malaysia	85 %	V X	V
17	Mexico	37 %	V X O	V
18	Morocco	29%	O	V
19	Mozambique	42%	-	V
20	Myanmar	26 %	-	V
21	Nigeria	40 %	O	V
22	Pakistan	21 %	V X	-
23	Peru	43 %	V X O	V
24	Philippines	34 %	V X O	V
25	Poland	87%	X O	V
26	Qatar	-	X O	V
27	Rwanda	50 %	-	V
28	Saudi Arabia	72%	-	V
29	South Africa	69 %	V X O	V
30	Thailand	82 %	V X O	V
31	Turkey	69%	X O	V

32	Uganda	59%	-	V
33	Ukraine	63 %	-	V
34	United Arab Emirates	88%	X O	V
35	Vietnam	31 %	-	V

*) Based on World Bank 2017 survey.

**) V: Based on Global - S&P Dow Jones Indices, S&P Emerging BMI – Equity, Fact sheet – as of October 30, 2020.

   X: based on Morgan Stanley Capital International Emerging Market Index, thestreet.com

   O: based on Emerging Market Economies in 2019-Economic outlook, Focus-Economics.com.

***) Based on World Economic Outlook: Global Manufacturing, Downturn, Rising Trade Barriers, Table A.4. Emerging Market and Developing Economies: Real GDP, IMF, October 2019.

The panel data was analyzed and showed an overview of the effect of information technology in the banking industry to increase financial inclusion by measuring access and finance usage. The dependent variables are Bank Account as a measure for financial inclusion – access and Financial system deposits to GDP as a measure for financial inclusion – usage.

The list of variables with their definition and data sources used in this study is shown in the following table.

Table 4-3. Variable Definition

Variable	Notation	Definition	Source
Bank Account	LBankAc c	Number of deposit accounts with commercial banks per 1,000 adults– natural algorithm	International Monetary Fund
Financial system deposits to GDP	dep	Demand, time, and saving deposits in deposit money banks and other financial institutions as a share of GDP	World Ban
Mobile Subs	mob	Mobile cellular subscription per 100 people	International Monetary Fund
Fixedline Subs	tele	Fixed-telephone lines per 100 people	International Monetary Fund
Internet	int	Individuals using the Internet percentage of population	World Bank
Density	dens	Population density people per sq. km of land area	World Bank
ATM	atm	Automated teller machines (ATM) per 100,000 adults	World Bank
Bank Branches	bbranch	Commercial bank branches per 100,000 adults	World Bank

LnGDP	lgdp	Gross Domestic Product – natural algorithm	World Bank
Human Development Index	HDI	Summary measure of average achievement in key dimensions of human development	UNDP

In conducting this research, after determining the data needed, choose a method to process data that can explain these variables and process the data that has been obtained into the required variables. This research framework came up for this study as drawn in the following picture based on what has been explained in the literature review:
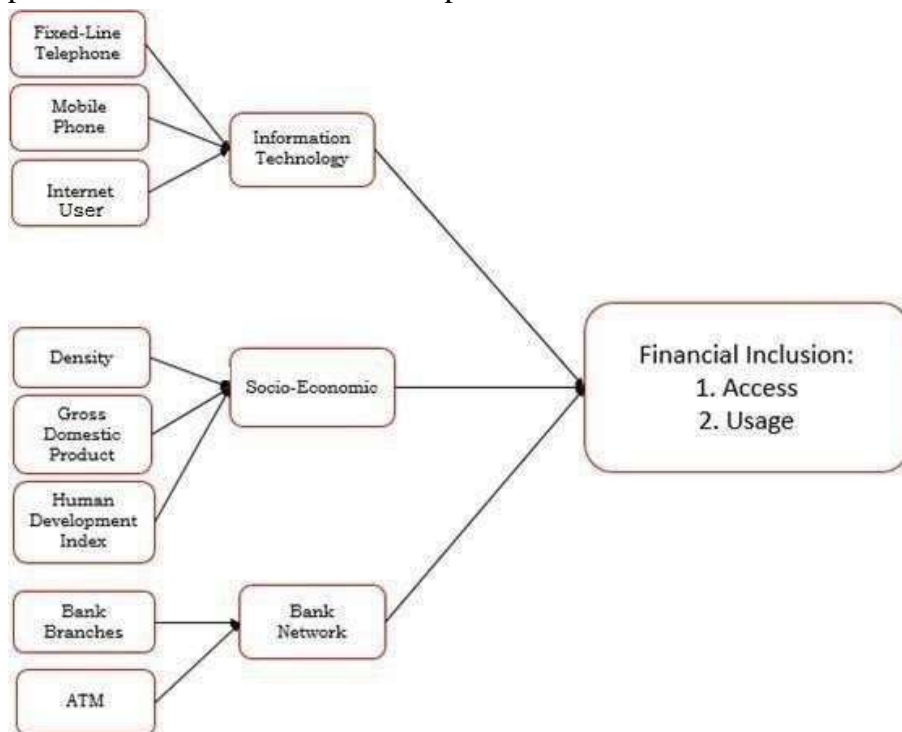

Figure 4-1. Research Framework

4.2. Methodology

The regression model built in this study is based on research conducted by Beyene Fanta & Makina (2019) in The Relationship Between Technology And Financial Inclusion with modification of variables. After considering many variables used in other research, this study eliminates Secondary school enrollment and inflation variables and adds some new independent variables; Gross Domestic Product and Human Development Index. So that the model used in this study are as thefollowing:

Access model:

$$\ln BACC = \alpha_0 + \beta_1 \, \text{LnBankACC}_{-1} + \beta_2 \, TELE + \beta_3 \, MOB + \beta_4 \, NT + \beta_5 \, D_m + \beta_6 \, ATM +$$
$$\beta_7 \ln GDP + \beta_8 HD + \varepsilon$$

Usage Model:

$$DEP_n GDP = \alpha_0 + \beta_1 \, DEP_n GDP_{-1} + \beta_2 \, TELE + \beta_3 \, MOB + \beta_4 \, NT + \beta_5 \, D_m + \beta_6 \, ATM +$$

$$\beta 7 \ln GDP + \beta 8\,HDI + \beta 9\,Bbranch_i + u_i$$

Where natural algorithm of BankAcc is a dependent variable used to measure the accessibility of financial services using bank deposit accounts per 1000 adults. DeptoGDP represents the dependent variable to measure financial service - usage using deposits as a percentage of GDP. Another variable that can be used as a measurement of financial services usage is EFT or the electronic funds' transfers (Beyene Fanta & Makina, 2019). Still, due to the data's availability, the variable cannot be applied to this study.

In terms of Independent variables, Tele denotes telephone infrastructure; Mob denotes mobile phone penetration rate; Int denotes internet user; ATM denotes ATM outreached; Bbranch denotes bank branches per 100,000 adults; LnGDP denotes natural algorithm of GDP ratio; last, HDI denotes Human Development Index. This study decided not to use Bank Branches as the independent variable in the Access equation model. One of the reasons is the argument from World Bank that the penetration of

bank branches could be one of the indicators to reflect the depth of outreach of financial services (dependent variable of Access).

The analysis method used in this research is descriptive quantitative analysis. Descriptive analysis is conducted to get a picture of information technology's effect in the banking industry and socio-economics variables to increase financial inclusion. Quantitative analysis is carried out using secondary financial and macroeconomic data previously obtained. Then the data processed using Microsoft Excel 2013 and STATA 14.0 software.

This research used panel data with dynamic panel Generalized Method of Moment (GMM). According to Arellano & Bond (1991) and Blundell & Bond (1998), the dynamic panel GMM is better than conventional estimators (multiple regression) due to its ability to corrects potential endogeneity, heteroscedasticity, and autocorrelation in panel data. The model is appropriate to the existing economic problems as the relationship of economic variables is dynamic, that is, determined by the variables at the same time and determined by the variables at the last time. Hall (2007) stated by minimizing the criterion function through a weighted matrix, GMM is the right method used in the study where the time dimension is characterized by the use of time-series data and cross-sectional data.

Efficiency is one of the most critical problems in statistics and econometrics. In the widely- used GMM framework, it is standard practice to employ a two-step procedure to improve the GMM estimator's efficiency and the associated tests' power (Hwang & Sun, 2018). Based on findings by (Windmeijer, 2005) finite-sample correction to the reported standard errors in two-step estimation, the two-step system GMM introduced adequate control over the instrument matrix. It offered automatic difference-in-Sargan/Hansen testing for instrument subsets' validity; support for observation weights and the forward orthogonal deviations transform, an alternative to differencing proposed by Arellano & Bover (1995) that preserves sample size in panels with gaps. To overcome the estimator's potential downward bias, we use the system GMM two-step robust standard error by Windmeijer (2005).

5. Result

The study period covers from 2009 to 2018 for Financial Inclusion – Access model and 2009 to 2017 for Financial Inclusion – Usage model with annual frequency data. Table 4.1 shows the summary statistics of the data variables used in the study. The distribution of the variables data in this study is relatively high, as seen from these variables' standard deviation. This is because this study uses a sample of 35 countries that might have different characteristics. In another study Bhattacharyay (2012) states that countries with different characteristics make very high data distribution.

Table 5-1 Descriptive Statistic

Variable	Observation	Mean	Std. Dev.	Min	Max
LBANKACC	341	6.728569	1.028106	2.773205	9.17871
DEPTOGDP	315	49.17168	27.52856	7.26091	128.839
TELE	347	12.59289	11.00197	0.0525094	54.75146
MOB	349	105.1718	37.5242	0.9990076	212.639
INT	346	43.13296	25.23514	0.22	99.65285
DENS	350	167.0859	208.5757	12.38797	1239.579
ATM	342	43.27658	31.5789	0.0906179	122.7815
BBRANCHES	347	11.93158	7.893641	0.4337687	42.28505
LGDP	350	26.09403	1.529104	22.4627	30.26254
HDI	350	0.6961257	0.1384493	0.1384493	0.891

The Table 4-2 exhibits the correlation matrix of variables chosen for the model used in this study. It shows that the independent variable is not correlated with each other. The correlation matrix value between all of the independent variables used are not exceed the rule of thumb multicollinearity test by Gujarati (2009). According to Gujarati, multicollinearity is indicated when the correlation value is more than $|0.9|$.

Table 5-2. Correlation Matrix – AccessModel

	LBankAcc	TELE	MOB	INT	DENS	ATM	LGDP	HDI
LBankAcc	1.0000							
TELE	0.4622	1.0000						
MOB	0.5237	0.4881	1.0000					
INT	0.4518	0.6261	0.7350	1.0000				
DENS	-0.177	-0.3847	-0.2983	-0.3594	1.0000			
ATM	0.5117	0.5913	0.6318	0.5995	-0.4053	1.0000		
LGDP	0.058	0.2846	0.3265	0.2344	-0.1114	0.3708	1.0000	
HDI	0.5383	0.7676	0.7459	0.8251	-0.3323	0.7035	0.3775	1.0000

Table 5-3. Correlation Matrix – Usage Model

	DeptoGDP	TELE	MOB	INT	DENS	ATM	BBRANCHES	LGDP	HDI
DeptoGDP	1.0000								
TELE	0.2644	1.0000							
MOB	0.4171	0.5213	1.0000						
INT	0.3467	0.6324	0.7420	1.0000					
DENS	-0.0865	-0.3836	-0.3190	-0.3719	1.0000				
ATM	0.3925	0.6027	0.6274	0.5971	-0.415	1.0000			
BBRANCHES	0.4220	0.6394	0.3601	0.5133	-0.2047	0.4506	1.0000		
LGDP	0.2067	0.2833	0.3611	0.2589	-0.1217	0.4057	0.2795	1.0000	
HDI	0.3914	0.7682	0.7572	0.8239	-0.3356	0.6887	0.5997	0.3810	1.0000

After getting a general overview of descriptive statistics data and the correlation among underlying variables then move a step further was taken. The Two-step system GMM estimations of the Financial Inclusion - Access and Financial Inclusion - Usage analysis model are presented in Table

4.4. The result shows the model in each dependent variable (Bank Account and Financial

Deposit ratio) with a robust standard of error. The independent variable in that model consists of Fixed-line telephone, Mobile Phone, Internet penetration, Density, Gross Domestic Product (GDP), and ATM, Bank Branches, and Human Development Index in the period 2009 - 2018.

Table 5-4. The Two-step system GMM estimations.

Variable	Financial Inclusion Access - Bank Account	Financial Inclusion Usage – Financial Deposit to GDP Ratio
TELE	-0.0009838	-0.47439***
	(-0.000598)	(0.062195)
MOB	0.0004527***	0.142197***
	(-0.0001447)	(0.00931)
INT	0.0059014***	-0.18655***
	(-0.0002175)	(0.023558)
DENS	0.0003001**	-0.02077
	(-0.0001579)	(0.015093)
ATM	0.0045079***	-0.01942
	(-0.0006204)	(0.033619)
BBRANCHES		-0.09565
		(0.083353)
LGDP	0.0385637***	-0.55738
	(-0.0092388)	(0.619085)
HDI	3.105002***	42.99833***
	(-0.2418799)	(10.15268)
Constant	2.9564***	-5.850205
	(-0.1929112)	(11.18829)
Prob(F-statistic)	0.000000	0.000000

Notes: The dependent variables are i) Bank Account and ii) Financial Deposit to GDP Ratio. Robust standard errors are reported in parenthesis. ***,** and * represent significance at the 1%, 5% and 10%.

The Fixed-line telephone variable shows an insignificant effect on Financial Inclusion Access. Differently, it shows a significant negative impact on financial services usage with a coefficient of - 1.179193. This result is in line, as shown in Beyene Fanta & Makina (2019). The fact that higher Fixed- line penetration is related to lower use of financial services can suggest that a rapid increase in mobile penetration in developing countries is more exist compared to the fixed-line telephone penetration.

The Mobile Phone variable has a significant positive relationship on both Financial Inclusion - Access and Financial Inclusion – usage with coefficients 0.0004527 and 0.142197. It shows that higher mobile telephone penetration corresponds to higher bank account ownership and usage of financial services. The shifting of cash payments to cashless payments using bank accounts represents an enormous opportunity to increase the use of accounts and make payments more convenient. Thus, the use of technology as mobile phones or point-of-sale terminals could increase these payments'efficiency on both sides (Demirgüç-Kunt et al., 2015)

The Internet variable has a positive significance on Financial Inclusion- Access with coefficient 0.0059014. It shows that the increasing internet users can increase financial access as the internet may reach unbanked people by served an opening bank account without going to a bank office physical branch. On the other side, for Financial Inclusion – Usage, the Internet

variable shows negative significance with coefficient -0.1865459. A negative relationship shown in the model used in this study was predicted due to the use of the country's Financial Deposits to GDP as a proxy for Financial Inclusion-Usage in the study. Sabater and Garrity (2011) on The Global Information Technology Report stated that as more citizens in emerging economies go online, and connectivity levels approach advanced economies, the global shares of Internet activity and transactions will increasingly shift toward these economies. So it is understandable if this study found that the increase in internet user activity might cause a decrease the country's Financial Deposits.

As technology, which is also a bank network, ATM has a positive significant coefficient with a coefficient of 0.0045079 in Financial Inclusion - Access. This implies that ATM's existence has the ability to increase financial inclusion through access to the bank's financial service. This implication suggests that ATMs' presents may encourage people to have a bank account to enable them to do financial transactions through the ATM near the home or workplaces. The Bank branches, which measured as the bank's outreach, show insignificant in increasing the bank's Financial Inclusion-Usage use. This result indicates that branches' existence might no longer be the main channel for customers doing their transactions in the mid of the digitalization era. The bank branches variable was not used in the access model since, according to World Bank, it could be one of the indicators to measure financial inclusion – Access and bank account (World Bank, 2015). The socio-economic variable, such as population density, shows a significant and positive coefficient of 0.0003001 in the Financial Inclusion - Access model. It implies that a higher population density in emerging countries corresponds to higher bank account ownership. On the other side, the population density shows negative but statistically insignificant on Financial Inclusion – Usage model. The natural algorithm of Gross Domestic Product (GDP) has positive significance on Financial Inclusion Access with coefficient 0.0385637, which implies that a higher GDP corresponds to higher bank account ownership. In this study, the GDP variable's result in line with the IMF study that a 1% increase in Findex could increase GDP per capita by 0.14% (Loukoianova et al., 2018). According to Allen, Demirguc-Kunt, Klapper, and Peria (2016), their study focuses on factors that influence the choice to own a bank account and savings account, concentrating on individual and country characteristics across 123 countries. It shows that higher income level and higher education is positively associated with greater financial inclusion.

Human development index (HDI) as a measure of economic development and economic welfare also has a strong positive significance on both Financial Inclusion-Access and Financial Inclusion – Usage model with a coefficient 3.105002 and 42.99833. The higher the HDI level, the greater opportunity to increase Financial Inclusion, better access to educational and health opportunities makes people aware of availing the benefits of financial extension facilities (Datta & Singh,2019).

6. Conclusions

This study examined the impact of technology use in banking on increasing financial inclusion in emerging countries. Previous studies have investigated the effect of technology on financial inclusion. However, the impact of technology used in the banking industry on increasing financial inclusion in emerging countries chosen in this study is relatively a new subject. Even though the direct link between technology and financial inclusion is somewhat hard to determine, this study focused on the effects of technology and socio-economics

variables that impact increasing financial inclusion. This research contributes to the literature on the relationship between technology and financial inclusion. Where technology has the ability to provide financial services to people wherever and whenever someone needs it.

The present study's findings highlight the significance of ICT development, particularly mobile phone and internet penetration, which can promote financial inclusion through access and usage in emerging countries. This study examines the impact of ICT, socio-economic and bank network related factors on the two indicators to measuring financial inclusion, i.e., (i) Access and (ii) Usage, using the panel data set. The technology variables in both models show a different result. Internet penetration has a significant positive relationship on Financial Inclusion -Access and negative significant Financial Inclusion – Usage. The study used the financial deposits to GDP as an indicator of usage. The negative relationship means that higher Internet users might lead to higher internet activity and transactions resulting in a decrease ratio of financial deposits to GDP. Last, the mobile phone, which is positively significant on both Access and Usage models, means ICT utilization can increase financial access and usage. As more citizens in emerging economies go online, and the connectivity levels continue to increase, it supports the result that technology allows an enormous opportunity to increase financial access and usage.

The bank network variables show various results. ATM shows a significant and positive effect on the financial inclusion-Access model. ATM's existence can increase financial inclusion through its function in accessing the bank's financial service. The bank branches that capture the bank's outreach show an insignificant impact on increasing financial inclusion through usage.

The socio-economic variables, such as population density, show a significant and positive impact on the financial inclusion Access model. Followed by the natural algorithm of Gross Domestic Product (GDP), which has positive significant Financial Inclusion Access, a higher countries' economic affect financial development through Access. Last, the Human development index (HDI), which has a strong positive effect on both access and usage, the improvement of a long and healthy life, being knowledgeable, and having a decent standard of livingmake people aware of availing financial services.

From all findings, it can be concluded that to increase financial inclusion, it is imperative to build an ecosystem within the financial system which take technology adoption into account that enables the financial service provider to serve the public, including unbanked people, as well as allow people to utilize the technology for their needs. The ecosystem that carried the improvement of welfare, health, and education as have a decent standard of living Access to bank service network also open access to many things that might increase the quality of human living. Moreover, the ecosystem could be improved if socio-economic factors develop more economic activities that require better, safer, and faster transaction settlement within the financial system. The implication of this need is the urgency for regulators to set- up policies, regulations, or by-laws that enforceable for making the payment system, banking system, and infrastructure within both systems working progressively but yet prudent toward the better ecosystem.

Access to bank service networks must be extended to most people, including unbanked people living in remote areas and unbankable people due to their economic condition. A more suitable product should be designed to allow product fit to these segments targeted. The extension using technology could not only ATM or bank network but also in mobile banking

and internet banking for customers and bank agents. The connectivity of the internet does play a role in overcoming challenges due to remoteness.

Improving awareness about technology and enhancing the population's financial capability are also equally important tasks. As technology plays an essential role in enhancing the bank's financial services to increase access and usage, this study found that technology is a significant driver of financial inclusion besides the socio-economic factor. In order to realize the function of technology as an enabler, a country needs to have policies that could promote information and technology infrastructure. The role of regulators is imperative in order to stimulate the secure and sustainable technology in providing financial services. Improving the utilization of information and technology, in addition to enhancing socio-economic factors, could stimulate the efforts for financial inclusion through increasing the Access and Usage. Therefore, better collaboration between governments, telecommunication providers, and players the financial sector will likely improve digital bankingservices.

From the difficulties experienced during the process of finding a methodology that suitable for the available data and theory, it can be concluded that the completeness of data during the period of analysis plays a significant role in the study. The role of regulators might be important to ensure the availability of data collected by the IMF and World Bank through their surveys. Due to the lack of availability, there are two important data that could not be used in this study as dependent variables but ultimately will make the analysis more rigorous and comprehensive are the number of depositors (since one depositor may have more than one bank accounts) and electronic fund transfer (proven as an active account).

Since this study focused on the supply-side only, further research is needed to cover the demand side of financial inclusion, such as Quality, to measure whether financial products and services match customers' needs. Further research could be done to explore the demand side associated with customers' technology usage, such as the people's readiness, products fitness, and pricing, especially for society's unbanked segment. It could be more interesting if the analysis were done on a specific country to increase the financial inclusion level in that country.

References

Adrian Alter. (2015). *Financial Inclusion and Development in the CEMAC. IMF Working Paper* No. 15/235.

Ali Said & Rihab Grassa. (2013). The Determinants of Sukuk Market Development: Does Macroeconomic Factors Influence the Construction of Certain Structure of Sukuk? *Journal of Applied Finance & Banking*, 3(5), 251–267.

Alphina, J., Denny, G., Shivshankar, V., & Stanley, V. T. (2011). Exploring Reasons for Dormancy in No Frills Savings Accounts In Tamil Nadu. In *MicroSave – Market-led solutions for financial services*.

Andrianaivo, M., & Kpodar, K. (2012). Mobile Phones, Financial Inclusion, and Growth. *Review of Economics and Institutions*, *3*(2), 1–30.

Ardic, O., Heimann, M., & Mylenko, N. (2011). Access to Financial Services and the Financial Inclusion Agenda Around the World: A Cross-Country Analysis with a New Data Set. *World Bank Policy Research Working Paper*, 5537.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Carlo Application to Data : Evidence and an Employment Equations. *Review Literature And Arts Of The Americas*.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*.

Beck, T., & Levine, R. (2002). Industry growth and capital allocation: Dose having a market- or bank- based system matter? *Journal of Financial Economics*, 64(2).

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. *Journal of Economic Growth*, 12(1), 27–49.

Beck, T., Demirguc-Kunt, A., & Martinez Peria, M. S. (2007). Reaching out: Access to and use of banking services across countries. *Journal of Financial Economics*, 85(1), 234–266.

Beyene Fanta, A., & Makina, D. (2019). The Relationship Between Technology and Financial Inclusion: Cross-Sectional Evidence. In *Extending Financial Inclusion in Africa*, 2.

Bhattacharyay, B. N. (2012). Bond Market Development in Asia: An Empirical Analysis of Major Determinants. In *SSRN Electronic Journal*, 300.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*.

Chithra, N. & Selvam, M. (2013). *Determinants of Financial Inclusion: An Empirical Study on the Inter- State Variations in India*.

Dangi, N., & Kumar, P. (2013). Current Situation of Financial Inclusion in India and Its Future Visions. *International Journal of Management and Social Sciences ResearchXplore International Research Journal Consortium*, 2(8), 2319–4421.

Daniel, N. (2015). *Relationship Between Mobile Banking and Financial Inclusion in Kenya*. November. Datta, S. K., & Singh, K. (2019). Variation and determinants of financial inclusion and their association with human development: A cross-country analysis. *IIMB Management Review*, 31(4), 336–349.

De Koker, L., & Jentzsch, N. (2013). Financial Inclusion and Financial Integrity: Aligned Incentives? *World Development*, 44, 267–280.

Dedrick, J., Kraemer, K. L., & Shih, E. (2013). IT and Productivity in Developed and Developing Countries. *Journal of Management Information Systems*, 30(1), 97–109.

Demirgüç-Kunt, Asli, Leora Klapper, Dorothe Singer, Saniya Ansar, and J. Hess (2015). The Global Findex Database 2014: Measuring Financial Inclusion around the World. *World Bank*.

Dev, S. M. (2006). Financial Inclusion: Issue and Challenges. *Economic and Political Weekly*, 41, 4310– 4.

European Banking Federation. (2015). *The digital transformation of banks and the*

Digital Single Market, September, 4–9.

Evans, O., & Alenoghena, R. (2017). Financial Inclusion and GDP Per Capita in Africa: A Bayesian VAR Model. *Journal of Economics and Sustainable Development*, 8(18), 44–57.

Gupta, A., Chotia, V., Rao, N. M. (2014). Financial Inclusion and Human Developoment: a State-Wise Analysis From India. *International Journal of Economics, Commerce and Management*, 2(5).

Hall, A. R. (2007). Generalized Method of Moments. In *A Companion to Theoretical Econometrics*. Hariharan, G., & Marktanner, M. (2012). The Growth Potential from Financial Inclusion. *Atlanta Federal Reserves/GSU International Development Economics Workshop*.

Hwang, J., & Sun, Y. (2018). Should we go one step further? An accurate comparison of one-step and two-step procedures in a generalized method of moments framework. *Journal of Econometrics*, 207(2), 381–405.

Iqbal, B. A., & Sami, S. (2017). Role of banks in financial inclusion in India. *Contaduriay Administracion*, 62(2), 644–656.

Jenkins, B. (2008). Developing mobile money ecosystems. *IFC, World Bank and Harvard Kennedy School of Government*.Kabakova, O., & Plaksenkov, E. (2018). Analysis of factors affecting financial inclusion: Ecosystem view. *Journal of Business Research*, 89, 198–205.

Kanobe, F., Alexander, P. M., & Bwalya, K. J. (2017). Policies, regulations and procedures and their effects on mobile money systems in Uganda. *Electronic Journal of Information Systems in Developing Countries*, 83(1), 1–15.

Kempson, Elaine & Atkinson, Adele & Pilley, O. (2004). Policy level response to financial exclusion in developed economies: lessons for developing countries. *Personal Finance*, September.

Kendall, J., Mylenko, N., & Ponce, A. (2010). Measuring financial access around the world. *Policy Research Working Paper*, March, 1–67.

Koivu, T. (2002). Do efficient banking sectors accelerate economic growth in transition countries? *Bank of Finland Institute for Economies in Transition*.

Lenka, S. K., & Barik, R. (2018). Has expansion of mobile phone and internet use spurred financial inclusion in the SAARC countries? *Financial Innovation*, 4(1).

Loukoianova, E., Yang, Y., Guo, S., Hunter, L., Jahan, S., Jamaludin, F., & Schauer, J. (2018). Financial Inclusion in Asia-Pacific. *The International Monetary Fund Departmental Papers/Policy Papers*, 18(17).

Manyika, J., Lund, S., Singer, M., White, O., & Berry, C. (2016). Digital Finance for All: Powering Inclusive Growth in Emerging Economies. *McKinsey Global Institute*, September, 1–15.

Massey, J. (2010). Role of Financial Institutions in Financial Inclusion. *FICCI's Banking & Finance Journal*.

Morse, S., & Morse, S. (2019). *Human Development Index*. The Rise and Rise of Indicators.

Munoru, M. K. (2013). Effect of Agency Banking on Financial Inclusion in Kenya. *International Journal of Science and Research*, 5(10), 2319–7064.

Mushtaq, R., & Bruneau, C. (2019). Microfinance, financial inclusion and ICT: Implications for poverty and inequality. *Technology in Society*, 59.

Nitsure, R. R. (2003). E-Banking: Challenges and Opportunities. *Economic and Political Weekly*, 38, 5377–5.

Nkuna, O., Lapukeni, A. F., Kaude, P., & Kabango, G. (2018). The Role of Commercial Banks on Financial Inclusion in Malawi. *Open Journal of Business and Management*, 6(4), 813–832.

Oruo, J. (2013). The Relationship between Financial Inclusion and GDP Growth in Kenya. *Department of Finance and Accounting School of Business, University of Nairobi*.

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul*

Review, *18*(4), 329–340.

Paramasivan, C. and Ganeshkumar, V. (2013). Overview of Financial Inclusion in India. *International Journal of Management and Development Studies*, 2, 45-49.

Paramasivan, C. and Kamaraj, R. (2015). Commercial Bank's Performance on Pradhan Mantri Jan Dhan Yojana. *International Journal of Scientific Research and Education*, 3, 3595–36.

Patwardhan, Anju; Singleton, Ken; Schmitz, K. (2018). Financial Inclusion in the Digital Age. *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 1: Cryptocurrency, FinTech, InsurTech, and Regulation*, *March*, 57–89.

Raihanath, M. and Pavithran, K. (2014). Role of Commercial Banks in the Financial Inclusion Programme. *Journal of Business Management & Social Sciences Research*, 3.

Robert, C., Tilman, E., & Nina, H. (2014). Financial inclusion and development: Recent impact evidence. *Focus Note*, 92, 1–12.

Sarma, M., & Pais, J. (2008). Financial Inclusion and Development: A Cross Country Analysis. *In Annual Conference of the Human Development and Capability Association, New Delhi*, 168(10– 13), 1–30.

Sassi, S., & Goaied, M. (2013). Financial development, ICT diffusion and economic growth: Lessons from MENA region. *Telecommunications Policy*, *37*(4–5), 252–261.

Skinner, C. (2014). *Digital Bank, Strategies to Launch or Become a Digital Bank, Marshall Cavendish Business*. Times Publishing Ltd.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*.

Yousefi, A. (2011). The impact of information and communication technology on economic growth: Evidence from developed and developing countries. *Economics of Innovation and New Technology*, 20(6), 581–596.