MOBILE MONEY AGENT NETWORK: KEY TOWARDS DIGITAL FINANCIAL INCLUSION

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DECLARATION

We hereby declare that:

(1) This undergraduate FYP is the end result of our own work, and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the FYP.

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ATM	Automated Teller Machine
DFI	Digital Financial Inclusion
DFS	Digital Financial Services
EMDE	Emerging Markets and Developing Economies
Fintech	Financial technology
GDP	Gross Domestic Product
MFS	Mobile Financial Services
SEA	Southeast Asia
TFI	Traditional Financial Inclusion

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PREFACE

With the rise of digitalization, the adoption of e-payment services has been widely embraced all around the world, same goes to us. We use e-wallets to pay when transactions are being carried out, and this seems to become the new norm being prompted by the Covid-19 pandemic, in which we try to avoid unnecessary interactions while handling paper note. Also, the innovation and continuous improvements of digital and mobile banking have made us wonder how strong this trend of digitalizing financial services is influencing every corner of the world. Only then, it made us realize there are still portions of population who faced trouble accessing formal financial services even though digital financial services exist nowadays. We dare not imagine what consequences would have been brought out to the society if this issue remains unsolved. With money being the necessity during every transaction, it made us wonder what could be the factors that connect the unbanked population with proper financial services, henceforth prompted us to look into this matter.

ABSTRACT

Whilst the word advancing towards digital empowerment, unbanked and underbanked individuals still exist. Therefore, this study is conducted to investigate the digital-focused determinants that aid in boosting DFI. Particularly, we focus on two key variables which we suspect them playing major roles in boosting DFI, namely internet bandwidth and mobile money agent. This is a quantitative study using secondary data extracted from International Monetary Fund (IMF) Working paper, World Development Indicators, International Telecommunication Union (ITU), Global Findex data and Financial Access Survey (FAS). OLS and Quantile regression are used to estimate the data. To conclude, our findings suggested that mobile money agent is the main contributor of countries achieving high DFI index. Then, followed by internet bandwidth also playing a significant role in elevating DFI.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

With the world advancing towards digitalization, products and services offered by every sector are keeping up with the trend as well, especially within the financial sector. Whilst many digital financial products and services were offered to the public, yet financially excluded population still exists. Therefore, this study focuses on the role of digital connectivity in promoting financial inclusion (DFI) where "Digital financial inclusion" is referred as the digital access and usage of formal financial facilities by the excluded and underprivileged group (Layman & Lauer, 2015). This chapter provides an overview of the research background, research problem, research objectives and questions as well as research significance.

1.1 The Rise of DFI

Money has always been the centre of all transactions, serving its purpose from being as a medium of exchange to a store of value. Without money, the modern economy could have stopped functioning since money makes the world go around. People use cash on a daily basis, and over 90 percent of transactions require the medium of cash. In developed countries such as the United States, it is reported that 94.6 percent of households falls under the "banked" category in 2019, indicating that at least one person in every household has the access to formal financial services (Federal Deposit Insurance Corporation, 2019). On top of that, some countries are even becoming cashless societies after the pandemic struck, for example, China, South Korea, Norway and Sweden. However, zooming into emerging countries, unbanked populations remained high in proportion, with the region of Middle East

and Africa topping the chart, where half of its population remains unbanked, followed by Central and South America standing at 38 percent, whereas 24 percent and 33 percent representing Asia Pacific, and Eastern Europe and the former Soviet republics respectively (Ventura, 2021).

Be that as it may, the rapid evolution of digitization in electronic transactions has alleviated the rate of financial inclusion in developing countries since lower market segments face difficulties in accessing money via traditional financial services. Yet, if there is a silver lining in these unfortunate circumstances, the growth of digital and mobile banking may be the answer to overcome the issue of unequal access to financial services. One of the successful examples where rapid financial inclusion became the reality is within Kenya and India, in which access to accounts has grown at a fast pace over the last 10 years (Rahwa, 2021).

In this modern-day, digitalization is the new phenomenon that happens in every corner of the world, acting as a catalyst in transforming the landscape of the financial services industry. The rise of financial technologies has been fuelling the innovation of a wide variety of digital financial services (DFS) to be offered in the market. With this being said, the emergence of DFS has made its continuous contribution to expanding financial inclusion to the wider community. Traditionally, financial inclusion aims to provide accessibility of formal financial services to individuals and companies inexpensively, fairly, and securely, which usually takes account of banking indicators (The World Bank Group, 2022). However, technological advancement nowadays has surged worldwide internet usage and mobile cellular ownership which paves a virtual direction in improving financial accessibility for the people with increased convenience and at a more affordable cost than traditionally (CGAP, 2015).

Digital financial inclusion (DFI) is introduced as the extension of traditional financial inclusion (TFI) with the differential term “digital”. DFI is levelled from multidimensional perspectives similarly to TFI, but mainly focuses on the digital

aspects of access and usage indicators in relation to the rising Fintech development (Khera et al., 2021). Defining DFI, is said to be a method of reaching financially underserved groups who do not have proper access to formal financial services, specifically in a cost-effective digital manner (The World Bank Group, n.d.).

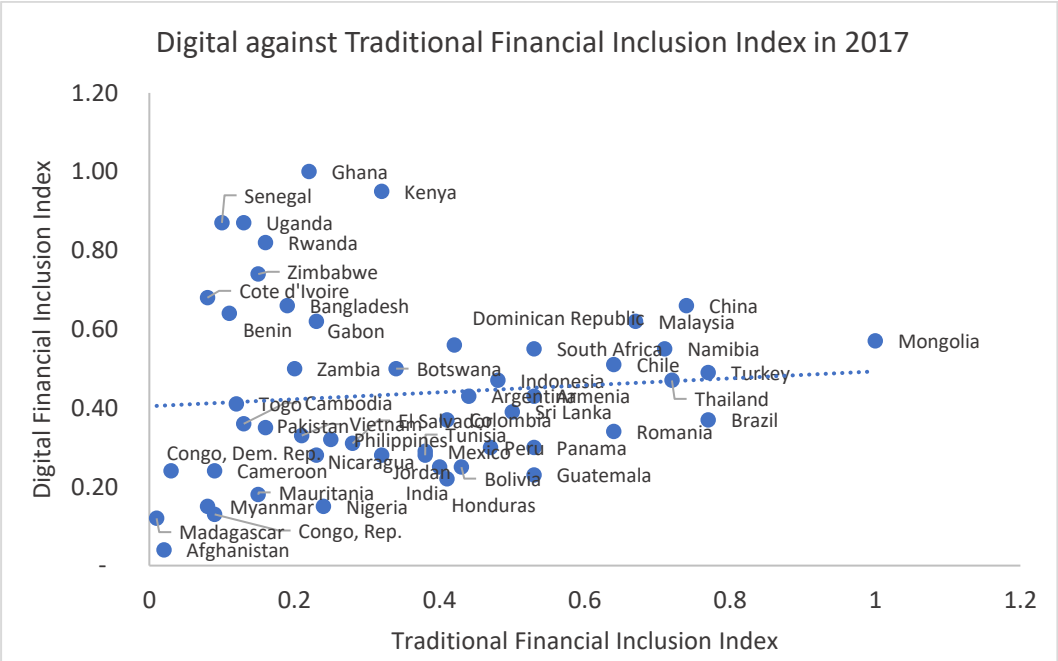


Figure 1.1 Digital Financial Inclusion Index Against Traditional Financial Inclusion Index of 52 Emerging Markets and Developing Economies (EMDE) Countries in 2017. Adapted from Khera et al. (2021). *Measuring Digital Financial Inclusion in Emerging Market and Developing Economies: A New Index.* International Monetary Fund.

Figure 1.1 displays both DFI and TFI index of 52 Emerging Market and Developing Economies (EMDE) countries in 2017. It is observed that there are certain EMDE countries that fall under the lower range of TFI index such as Ghana, Kenya, Senegal, Uganda, etc. holding a high DFI index point over 0.80. Conversely, the countries that are high in TFI may not necessarily be highly financially included in a digital way. Overall, this explains that the indicators of DFI could improve

primitive financial inclusion by overcoming the issue of TFI and reaching better access and usage via DFS.

Along with digital transformation, Mobile Financial Services (MFS) are among the key drivers of digital finance. The escalating adoption of mobile phones and access to the internet has prompted the supply of MFS which allows individuals to utilize their mobile money accounts at ease. The boom of MFS is proven by its impactful outcome based on the innovation of bKash (one of the successful mobile money systems available in Bangladesh) that caters for the long distancing and unbanked issue among the underprivileged group via mobile phone and mobile agents to perform monetary transactions; hence, increasing financial inclusion digitally in the nation (DhakaTribune, 2021).

DFI's main selling point is its ability to provide formal financial services to excluded and underserved populations at an affordable cost digitally. DFI runs by three key components namely, a digital transactional platform, retail agents, and the usage of a device by clients and agents to conduct transactions via the platform, most frequently known as a mobile phone. While mobile money centralises the transactions, a "cash merchant" or "agent" is still needed for the cash-in and cash-out process to transform the electronic value into cash, vice versa. With agents acting as intermediaries for mobile money users, it eases the hassle to seek for costly financial services.

A successful example can be seen in Kenya which has a high DFI index due to the success of its mobile money application, M-Pesa. It is also mentioned in Stuart and Cohen (2011, as cited by Donovan, 2012) research that the poor are more willing to send value via mobile money with a network of agents. Through this, households are able to access to financial services with higher remittances at a lower transaction cost (Suri & Jack, 2011, as cited by Donovan, 2012). Up until now, M-Pesa already has over 160,000 agents distributed country wide to serve their users

(Safaricom, n.d.). The emergence of mobile money agents in rural areas has become the influenced the increment of financial inclusion.

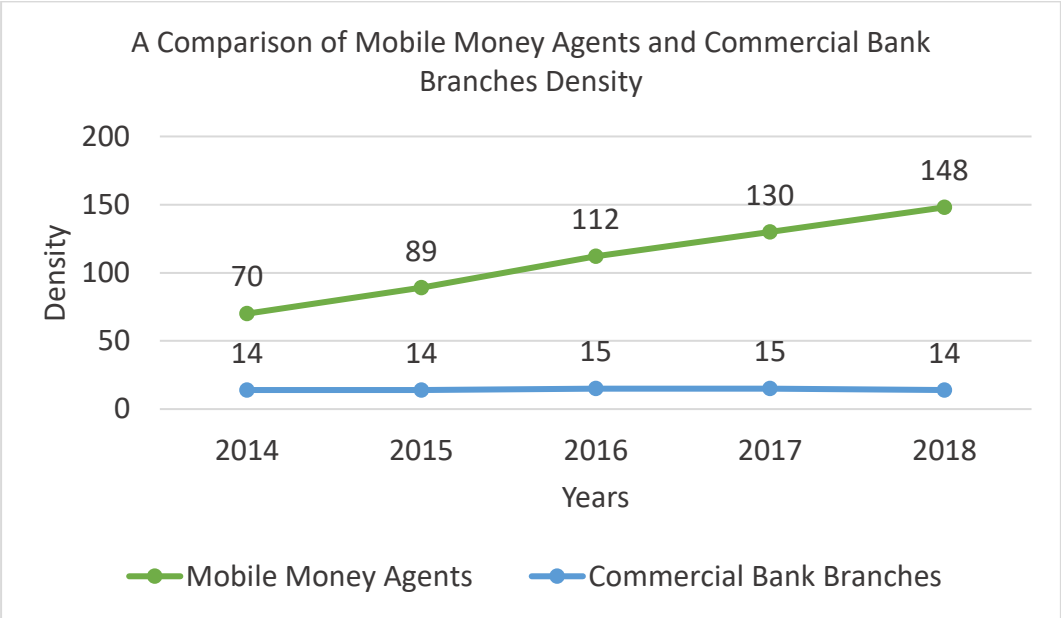


Figure 1.2 The Density of Mobile Money Agent and Commercial Bank Branches. Adapted from Caputo, S. (2019). *The pivotal role of mobile money agents in driving financial inclusion*. GSMA.

Figure 1.2 clearly shows the comparison of how mobile money agent density grew against physical banking branches, indicating the influence of agents in this matter. In the year 2018, there is an average of 148 active mobile money agents per 1,000 sq km, which is over twice as much as the figure of 2014, whereas we can barely see any changes in the density of brick-and-mortar banking across these 5 years. Surprisingly, the registered mobile money outlets are 10 times more than physical banks in about 66 percent of those markets. It is no doubt that the agent network has played its pivotal role as a liaison between mobile money services and banks, expanding financial services to the underserved population as the agent network can now be reached at 20 times that of bank branches and 7 times of ATMs (Aker, 2020). Essentially, more and more financially excluded are now

able to be financially included digitally with the adoption of mobile money and the distribution of agents.

To conclude, mobile money is a form of MFS which enables cashless transactions among people. Prompted by Covid-19, cashless dealings have been boosted by DFS around the globe. Beginning in 2014, various DFS stated above could be carried out just with the ownership of a mobile phone and access to the internet. With that, not only adoption rate of mobile phones has reached a total of 67.1 percent in the year 2022, DFS has also prompted internet usage up to 62.5 percent globally (DataReportal, n.d.). Hence, it can be said that mobile phones and the internet were the main intermediaries that bridged the gap in allowing people to perform online transaction and access DFS virtually (Manyika et al., 2016).

1.2 Why Financial Excluded Population Still Exists?

Reducing inequalities is one of the vital goals to be achieved under the United Nations' Sustainable Development Goals (SDG), as it encompasses unequal access to financial products and services, education, health services, job opportunities, necessities, etc. (United Nations, n.d.). The issue of unbanked has been revolving around since 2014 with an extensive figure of 2 billion unbanked people. Although there was a slight improvement in the statistic moving on to 2017, yet there are still 1.7 billion adults remaining unbanked. According to *Figure 1.3*, there are still portions of the population that do not own access to and acquire financial services around the globe in 2021, especially in regions of the Middle East and Africa where about half of the people is unbanked.

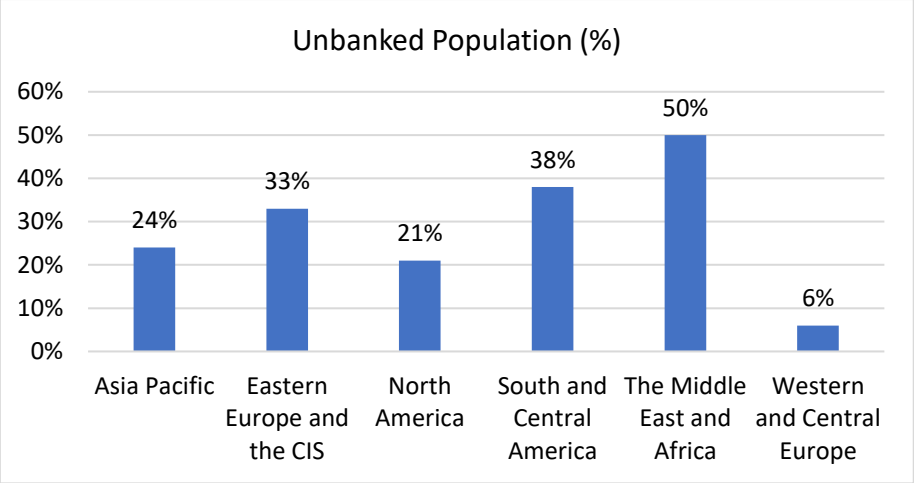


Figure 1.3 The Unbanked Population around the Globe 2021. Adapted from Merchant Machine (2021). *The Countries Most Reliant on Cash In 2021.*

Furthermore, the unbanked tend to concentrate around poorer households where the main barrier to account ownership is lack of money. Almost two-thirds of the adults were in a situation where they do not have money to own a bank account. The population of unbanked is still relatively high even financial inclusion through the primitive way is rising in each country. Besides, the traditional approach is often higher in cost, especially to those low-income and low-density populations. An example can be seen is from the study by Unnikrishnan & Larson (2019), which it highlighted that traditional cash in and out services via ATM and bank branches are too expensive as compared to cash in and out money via a mobile money agent. Not to mention that physical distance is also one of the barriers (Caputo, 2019).

Therefore, here is why digitalization kicks in and illustrates that technology may be used to promote universal financial inclusion in digital ways. The combination of digital payment technologies and mobile phone technology could enable the re-engineering of financial systems and coming with a possibility to strip 90 percent of transaction costs. What is more, digital platforms can extend up to tens of millions of transactions every single day if only digital payments are being made. This has also stripped the cost of financial services by 80 to 90 percent via

virtual access through the internet; therefore, enables more underprivileged group to enjoy DFS (Manyika et al., 2016). To add on, the rise of digital technologies is heightening the possibility for almost two-thirds of adults in emerging countries to access basic financial services who are previously excluded from the system (Pazarbasioglu & Mora, 2020).

As the world continues to develop, over 90 percent of transactions require the medium of cash, according to a study made by Mastercard and World Bank on developing countries (Unnikrishnan et al., 2019). Cash-free transactions via cards, mobile phone, QR payment and e-wallet have been aggressively adopted by the Southeast Asia (SEA) countries, and taking Malaysia as an example, it is claimed to be advanced five years forward in cashless dealings throughout the outbreak (Visa, 2021). Real-life cases from Bangladesh (bKash) and Kenya (M-Pesa) have proven to us that the integration of digital technology into financial services possesses the potential to shape an economy where everybody can access payment systems more efficiently. While transaction costs are being reduced, this indirectly encourages use and access by the poor (Peric, 2015).

Although DFI could be the key solution in tackling the issue of unbanked as some may suggest people staying in rural areas to access financial services digitally, yet this way is only applicable provided the households have access to digital infrastructure and internet. The rising high internet dependency and worldwide internet user outlay that internet connectivity is a crucial factor that channels digital financial services to the people, especially while utilizing mobile money applications. Not only high internet penetration ensures the accessibility of digital financial services, but broadband speed has also become an issue concerning timely financial transactions (ET Bureau, 2021). This is because user interfaces (UIs) to access DFS are said to be highly influenced by the type of mobile coverage provided since DFS is defined as the financial services accessible via mobile phone. However, a major challenge could be seen in many DFS-focused countries as most of the mobile coverage offered in rural areas is mainly characterized by low speed ‘second

generation' (2G) 'narrowband' technologies, for example Uganda and Rwanda (Perlman & Wechsler, 2019).

Since the lack of proper digital infrastructure in certain countries is regarded as one of the major barriers in accessing DFS, the mobile money agent network could be the secret ingredient in bridging the gap between the unbanked and financial services. Evidence is shown in *Figure 1.4* which is obtained from our sample data where we can observe huge disparities in comparison between the density of agent outlets against the density of ATMs and non-branch retail agent outlets of commercial banks, especially in quantile 4 where countries hold the highest of DFI index. With this being said, we are proposing agent network is the key driver in promoting DFI in countries who lacked access to quality internet accessibility. Not to forget, the agent network is also deemed as a cost-effective manner while being compared to traditional financial services, such as ATMs, in which the distribution is relatively low in certain areas. In short, agent network could be the backbone in promoting DFS, especially in emerging countries.

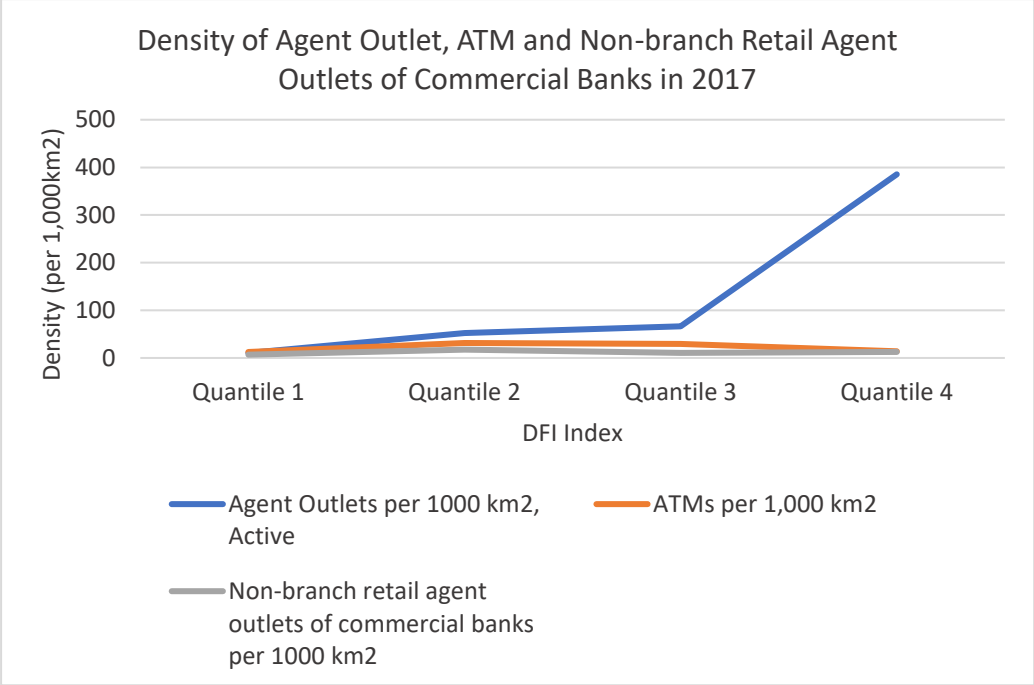


Figure 1.4 Density of Agent Outlet, ATM and Non-branch Retail Outlets of Commercial Banks According to DFI Index Quantile in 2017 (where data from Bangladesh is removed as an outlier).

1.3 Research Objectives & Research Questions

1.3.1 General objective

DFI through the emergence of DFS has been promoting financial inclusion in achieving the Sustainable Development Goals (SDG) in reducing inequality and unbanked problem in recent years. This study aims to identify the key drivers of DFI by emphasizing how internet bandwidth and mobile money agent network can potentially enhance DFI. Focusing on 45 emerging countries in the year 2017, this study employs the IMF-computed DFI index and the Global Findex 2017 database to see how the key drivers create impact across different degrees of DFI through quantile regression estimation.

1.3.2 Specific objectives

1. To identify the key digital-focused (access and usage) determinants of DFI for emerging countries.
2. To examine the role of digital connectivity in promoting DFI.
3. To examine the role of the mobile money agent network in promoting DFI.

1.3.3 Research questions

1. What are the key digital-focused (access and usage) determinants of DFI for emerging countries?
2. What is the role of digital connectivity in determining DFI?
3. What is the role of the mobile money agent network in determining DFI?

1.4 Significancy of the Research

Besides helping consumers in accumulating, increasing, and protecting their wealth, financial inclusion helps in reducing income inequalities which indirectly leads to reduction in societal issues. Significant improvement could be seen in people with limited income if they were granted access to all kinds of financial services that could be found in the market, for example, payments, insurance, loan, and accounts. However, despite how great the potential could be, the market remains inefficient in serving the poor. This is due to certain deficiencies that prevented most of the traditional financial systems from rolling out into rural and poor communities. Infrastructure with a mix of slow innovation cycles and costly connections could be the reason behind this phenomenon. For the most part, it affects payments, which are the most basic financial service of all, as traditional payment systems mostly require the possession of accounts that requires extra time and incur fees that made them inaccessible for the poor.

Therefore, it is stated by Bain & Company et al. (2019) that DFI is the key factor for paving the unbanked society towards access to digital finance with its future revenue being forecasted to reach up to $38 billion (Bain & Company et al., 2019). Though literatures did mention how digital connectivity contributes to DFI,

yet it remains questionable on the relation of internet bandwidth and its influence towards DFI as it is not concentrated in most of the literature reviewed. Since internet bandwidth is defined as the amount of information that could be transmitted between connected devices that are measured in megabits per second (Mbit/s), we are proposing the idea of greater internet bandwidth will lead to wider DFI. Hence, our research incorporates internet bandwidth as the new indicator to identify its significance towards DFI as to fill the gap of previous studies.

Apart from digital connectivity, multiple past studies from Mas and Morawczynski (2009) and Unnikrishnan and Larson (2019) have portrayed how mobile money agent network plays its pivotal role in promoting DFI. Acting as a DFI driver that requires low setting-up and maintenance cost, the network of mobile money agent has grown extensively with evidence from Bangladesh where the country itself has over 420 million agent outlets per 100,000 adults recorded in 2017. This fact is believed to be the recipe behind the success of bKash as agent network is one of the major pillars of MFS. Moreover, bKash's aim to serve the poor has distinct features from those TFS that requires higher transaction costs, allowing it to tackle the population of unbanked. Accordingly, our study has in view to examine how significantly agent network plays its role in explaining DFI, specifically in emerging countries.

After all, our research intends to provide a better insight into the importance of DFI by highlighting the benefits and importance of enhancing DFI. As mentioned, one of the greatest impacts that DFI could offer is promoting inclusivity, aiding more people to be financially included, in a sense which then leads to reduced poverty, inequality and elevating nation's GDP. With that, we aim to raise awareness among the public, especially policymakers on the current status of the nation's financial inclusion and pay attention to the determinants that would greatly contribute to promoting DFI. For instance, infrastructure investment should be encouraged as to increase the internet coverage, particularly to rural poor areas. By highlighting the importance of achieving DFI, it is hoped that better policies will then be introduced so that barriers will be removed for the unbanked.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

In chapter 2, we will present the literature reviewed based on existing research knowledges. Based on past studies, financial inclusion has been the centre of attention for so long until DFI came to light, which in turn became the topic of discussion for recent studies. Therefore, firstly, we will be providing the conceptual framework that explains how DFI differs from TFI. Then, we will provide some work which highlighted the importance and contribution of DFI to society and, proceed with discovering and understanding the key determinants that took part in influencing DFI. Lastly, the limitations found from these pieces of research will then be brought out, and from there, we will explain how these gaps will be eventually filled up with our study.

2.1 Conceptual Framework: Understanding DFI

Financial inclusion is defined for any person to approach and utilize financial facilities including monetary dealings and borrowings for daily necessity (The World Bank Group, 2022). Deriving from the theory of supply and demand, the dimensions of access and usage of financial services through financial development (Nagadevara, 2009) as shown in *Figure 2.1* have been used as common indicators to measure DFI of a nation.

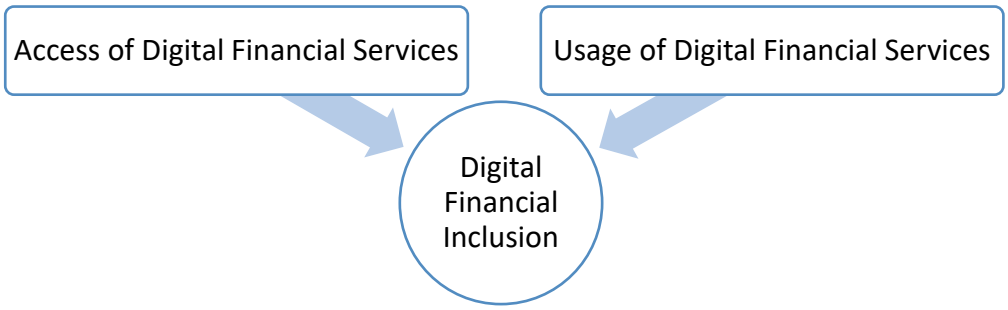


Figure 2.1 Dimensions of DFI. Adapted from Khera et al. (2021).

In the literature, most studies have been conducted based in the conventional manner by adopting the banking determinants as the measurement for financial inclusion. For instance, the access was estimated by the variables: the number of bank branches and Automatic Teller Machine (ATM) among the population; the usage was estimated by the variables: the number of bank accounts, debit and credit card ownership among the population (Sarma, 2012; Sahay et al., 2015; Loukoianova et al., 2018). Also, there are studies that offer new dimensions in demonstrating financial inclusion. As reviewed, Cámara and Tuesta (2017) proposed a new barrier dimension considering the distance, affordability, documentation, and trust issue as new variables for measuring the financial inclusion index.

Technology advancement over the century has led to Fintech development and directed new methods in determining financial inclusion other than the primitive way. Some research has pointed out digital factors that influence financial inclusion positively; however, less inclusive in considering both access and usage dimensions as the only single factor is being considered. Adapting from the benchmark criterion of financial inclusion, the IMF has presented DFI by compiling a new set of digital-focusing indicators including variables from both access and usage dimensions such as the mobile and internet user, mobile money agent in the population, mobile account user, usage on mobile and internet transaction (Khera et al., 2021). Thus, we decided to pursue the definition by IMF's working paper.

Table 2.1:

Definitions of DFI

Author	**Definition**
The World Bank (n.d.)	Digital financial inclusion entails the use of cost-effective digital means to provide societies that are currently underserved and financially excluded with a variety of formal financial services that are delivered at a cost-effective manner for customers and durable for providers.
Lauer and Lyman (2015)	The access and usage of formal financial services through the digital way by the excluded and underserve population.
International Telecommunication Union (ITU) (2016)	A sustainable process with affordable financial services that aids the poor to be financially included
Geng and He (2021)	A new financial development that can overcome geographic barriers in traditional financial inclusion by using internet and big data technology to reduce financing cost and at the same time empowering small firms

2.2 The Roles of DFI

Multiple journals offered their reviews on the importance of financial inclusion in which it has contributed to financial stability, economic growth, as well as the lessening of income inequality (Sahay et al., 2015; Khera et al., 2021; Ratnawati, 2020). In Brazil, studies have been applying the Delphi method to determine that Fintech induces financial inclusion as it can provide services to the unbanked, lower the cost of Fintech users and deliver financial services to those in the distant geographical areas (Joia & Cordeiro, 2021).

On a macroeconomic scale, the enhancement of financial inclusion helps households to overcome unforeseen shocks as people have access to saving services which plan out a seamless consumption. Concurrently, country-level research on financial inclusion carried out by Sahay and Čihák (2020) has concluded that inequality and poverty tend to be reduced when there is a higher financial inclusion in payments, especially among lower income household. Subsequently, improving financial inclusion is most likely to boost GDP growth on a 2 to 3 percentage point.

2.3 Digital-Focused Determinants: Influencer of DFI

Banks and financial services have been an essential to all in daily life now. Despite living in the 21st century with various of digital products and various financial products being offered in the market, yet there are still 46 percent adults who does not own a bank account. Many prefer to save their money informally such as keeping at home or buying at liquid asset instead of storing in bank. Yet, this informal way of storing money may be inconvenient, costly, and most of all risky to them. Nevertheless, governments and authorities still believe that it is optimal for one to adopt formal banking as it is associated with a variety of benefits, ranging

from a country's growth and development, reduced poverty, financially included, and many more (Dupas et al., 2018). Whilst digitalisation kicks in, more and more DFS and MFS have been introduced and financial products and services are being offered at a lower cost. It is said that with these newly offered DFS and MFS, more people can be financially included in a digital way.

In the digitalized era, basically everyone owning at least one electronic gadget aids people in accessing DFS. This is also supported by Rizzo and CGAP (2014) where it mentioned the underlying theory of digital finance and financial inclusion having a positive relation. As defined, digital finance is represented by the access to financial services via mobile phone, internet, or card. Moreover, Perlman and Wechsler (2019) mentioned that DFS provided through mobile phones can provide basic financial services to the unbanked and underserved. With all other things being equal, financially excluded population can be financially included through DFS, provided they have a mobile phone and internet connectivity (Ozili, 2018).

According to Yesmin et al. (2018), the introduction of Mobile Financial Services (MFS) has filled the gap of rural people reaching financial services. One of the popular MFS introduced is bKash by BRAC bank which provides banking facilities through the mobile phone. Ever since, there has been a revolutionary growth in the MFS industry where more than 8 percent of total registered mobile money accounts in a short period (Khan et al., 2019). Similarly, surveys conducted in Zimbabwe with a sample derived from 262,493 rural households found that mobile money supplies have improved the financial accessibility and usage for remittances at lower expenses, dictating a positive impact in financial inclusion in the nation's rural region (Thulani et al., 2014).

Payment made via the internet is categorized as digital payment which is one of the major functions of digital finance. Research has highlighted that by linking digital payment to the bank accounts for online financial transaction

promotes financial inclusion among low-income household as the cost required is lowered in a digital context (Ozili, 2018). This is further supported by a report from Klapper and Miller (2021) which stated Covid-19 has catalysed digital payments; thus, accelerates DFI.

In addition, ICT innovations on telecommunication devices such as mobile phone have not only been widely used as individual daily communication tools, but also transformed into an important component of financial system development (Alshubiri et al., 2019). ICT development serves as the medium for access and usage of DFS. Bank branches were the traditional way for people in accessing financial services. Yet, this only benefits people living in urban area as compared to rural area as most bank branches are concentrated in the urban areas. Hence, to be financially included in the digital context for all people, one of the key components to access to DFS is the ownership of mobile phone (Layman & Lauer, 2015).

Besides, there is a significant result showing mobile phone and internet penetration induced financial inclusion in the South Asian Association for Regional Cooperation (SAARC) countries from 2004 to 2014 (Lenka & Barik, 2018). The variables adapted: internet users per 100 people and mobile cellular subscriptions per 100 people are found linearly related to financial inclusion using the fixed effect model (Lenka & Barik, 2018). Furthermore, based on the study carried out by Barbesino et al. (2005), the internet in Europe has emerged as a widely recognized distribution channel for the finance industry that includes traditional and new players. However, research using cross-sectional data from eleven post-communist Europe countries has identified both the positive and negative relationship between the mobile phone and internet consumption towards financial institution and market access (Bayar et al., 2021).

Moreover, D'Andrea and Limodio (2019), in paper confirmed how high-speed internet has led to a large-scale adoption of financial technologies as the

transaction costs are being lowered down. Also, Perlman and Wechsler (2019) have proposed when mobile phones are now being used as the main access mechanism for DFS, the quality and degree of mobile coverage are said to have a significant effect on the access to DFS. This is because mobile broadband with a higher speed can put smartphone to better use, as better graphical user interfaces could be accessed. On the other hand, taking 4G as an example, its poor coverage negatively impacts the utilization of mobile phones since higher data speeds are required for media-rich applications, signifying that higher broadband speed leads to a better user experience. In short, we are surmising that people who lives in countries that fall far behind in the development of digital infrastructures and expansion of internet penetration evenly across the countries may still encounter the issue of accessing DFS efficiently.

To reiterate, MFS such as mobile money that is categorized under DFS can enhance digital finance. Based on the research carried out in seven developing regions in Africa within the period from 2013 to 2017 which claims that financial inclusion is induced by the introduction of mobile money, where it is indicated by the registered subscriber ratio and active subscriber ratio (Mahmoud, 2019). By using the country-focused characteristics, regulatory factors, and service provision characteristics as the independent variables, it concludes that the number of mobile money suppliers, mobile money regulations index score, bank account ownership, and education are linearly significant towards the usage of mobile money.

While mobile money bridges the gap of financial excluded, a mechanism is still needed for mobile money users to cash in and out their money. And this is why mobile money agents come in, where their main role is to act as an intermediary for mobile money users to perform cash in and out physical cash transactions (Unnikrishnan & Larson, 2019). According to them, the agent model has been surging rapidly in developing markets since the last 15 years, especially in the regions of South Asia and sub-Saharan Africa. A successful example can be seen in the research by Mas and Morawczynski (2009), where the mobile money service in Kenya, M-Pesa has gained its trust and popularity among citizens, amounting to

over USD 1.6 billion transactions after its launch back in the year 2007. In line with this growth of customer base, its agent network has also surge over the years, proven to be a key enabler for the operations of DFS. Through an authorised M-Pesa agent, users are able to easily cash in and out from their M-Pesa account as users can easily locate those agents using the special agent number.

Commonly in developed countries, bank branches and ATMs are the providers of cash-in and cash-out services. However, brick-and-mortar branches are high in cost of setting up which requires high capital investments, not to forget the costly maintenance required. Hence, the rising of the bank agent model has promoted cost efficiency as well as assisted customers in ways that ATMs could not, particularly in communities with a lower rate of technological literacy. Since the agent model is categorized as a low-cost approach, this major benefit has sped up the network expansion in South Asia and Latin America. For example, India's banks in both private and public sectors have portrayed a high dependency upon the agent model while complying with the government's policy on financial inclusion (Unnikrishnan & Larson, 2019). Thus, we are suspecting that the agent network possesses high potential to bring the unbanked and financial services closer when the factor of internet penetration is absent.

2.4 Conclusion

Concluding the works of literature, it manifests that DFI is the continuation of TFI in correspond to digital evolution and ascending development of Fintech. With the mentioned digital-focused determinants above, it has clearly shown that all of them are playing a crucial role in promoting DFI, and especially internet connectivity and mobile money agent. While most of the crucial determinants were covered in the literatures above, yet it is not mentioned how internet bandwidth plays a vital role in facilitating financially excluded populations in accessing financial services as internet bandwidth may vary according to areas, and it might be hard to access in

remote areas. Therefore, our research contains internet bandwidth as our new indicator to further discover whether a relationship between internet bandwidth and DFI exists, and most importantly how it aids in driving DFI. Besides that, although mobile money agent is proven to be effective in driving DFI in certain countries, however it still lacks evidence in which the agent network could be a major driver towards DFI, specifically in emerging countries where their digital infrastructures are poorly developed. Hence, our study will further investigate how the agent model carry out its pivotal role in promoting DFI in developing countries.

CHAPTER 3: METHODOLOGY

3.0 Introduction

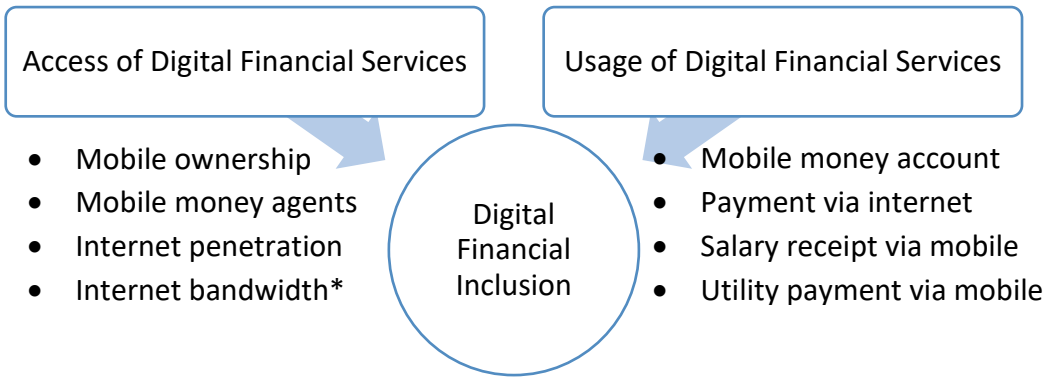
In chapter 3, we will explain the methodology equipped in the outline of research design, theoretical framework of DFI, empirical model (model estimation and quantile regression) and data collection. The research design is progressed in a quantitative method based on the theoretical model to estimate the effect of access and usage variables on DFI in the 45 EMDE countries.

3.1 Research Design

DFI is presumably performing well among the developed countries, and surprisingly it is found to be blossoming in certain developing countries such as Ghana and Kenya too. To investigate the underlying potential drivers of DFI among the emerging countries; thus, sample data from 45 EMDE countries is collected via secondary resources. By zooming into the developing countries, the research is designed to verify the expected hypotheses via a preliminary analysis to understand the characteristics of the sample data. After data collection, we will observe the DFI index and the relationship of the two key variables (internet bandwidth and the number of mobile money agent) with the DFI through boxplot and scatterplot analysis to clarify the primary prediction on the presumed hypotheses. Subsequently, the OLS estimation with the assumption of classical linear regression. Hence, the heteroskedasticity test, autocorrelation test and normality test will be carried out to ensure the robustness of OLS estimation. Lastly, we will execute the quantile regression analysis to validate the significancy of the access and usage variables in determining DFI index at specific quantiles.

3.2 Theoretical Framework of DFI

DFI is the extension or development of TFI where it is driven by the forces of supply and demand. It is explained by the dimension of access and usage which is derived from the theory of supply and demand on financial services through financial development (Nagadevara, 2009). Generally, the access of the DFI is defined as approaches to the DFS such as the internet connectivity available to execute digital payments. In contrast, the usage is the demand for the utilization of DFS, for instance to use the internet to make digital payment. To achieve effective DFI, it is supported by the equilibrium for both supply and demand perspectives in providing and utilizing of digital financial services (Upadhyay & Reddy, 2021). Deriving from the model by Khera et al. (2021), a newly added variable (internet bandwidth) is proposed in the conceptual framework built (refer *Figure 3.1*).



Note. * Represents the new determinant variable proposed

Figure 3.1 Key Digital-Focused Determinants of DFI. Adapted from Khera et al. (2021). *Measuring Digital Financial Inclusion in Emerging Market and Developing Economies: A New Index*. International Monetary Fund.

Our study implies the importance of being financially included through incorporating digital means to reach out to current financially excluded and

underserved populations with a range of cost-saving financial services. According to a study published by Perlman and Wechsler (2019), DFS provided could equip the underserved and unbanked with basic financial services. As permitted by regulatory innovations, even non-banks can now offer financial services to fill up these gaps. This section proposed the two key elements in explaining DFI, where we measure it through the access and usage of DFS.

3.3 Empirical Model

Based on the model by Khera et al. (2021), we will construct the econometric model according to the dimensional of access and usage of DFI as in equation (1) where positive relationships are expected to be shown in results between the dependent variable and independent variables, meaning to say DFI index should be positively associated with all the independent variables in terms of access and usage:

$$DFI_i = Access_i + Usage_i + \varepsilon_i \qquad (1)$$

To quantify equation (1), a multiple linear regression model (2) is extended using the concept of access and usage. Subsequently, the logarithm is inserted in the model to linearize the variables.

$$LNDFI_i = \beta_{0i} + \beta_{1i}LNMOB_i + \beta_{2i}LNINT_i + \beta_{3i}LNINTB_i + \beta_{4i}LNMMAGN_i + \beta_{5i}LNMMACC_i + \beta_{6i}LNINTPAY_i + \beta_{7i}LNMOBREC_i + \beta_{8i}LNMOBPAY_i + \beta_{9i}LNINTINTB_i + \beta_{10i}DUM_{LOW} + \varepsilon_i \qquad (2)$$

The DFI_i represents digital financial inclusion index while β_{0i} is the intercept. In light, the access is represented by the mobile phone ownership, MOB_i (per 100 people); internet penetration, INT_i (internet user % of population); the numbers of mobile money agent, internet bandwidth, $INTB_i$ (Mbit/s) and; $MMAGN_i$ (per 100,000 adults). On the other hand, the usage is represented by the mobile money account ownership, $MMACC_i$ (% of aged 15 or above); payment via internet, $INTPAY_i$ (% of aged 15 or above); receipt of salary via mobile phone, $MOBREC_i$ (% of aged 15 or above); and payment of utility via mobile phone, $MOBPAY_i$ (% of aged 15 or above). Also, the interaction term between internet penetration and internet bandwidth, $INTINTB_i$ and an additional control variable that is dummy variable for low-income group country, DUM_{LOW} are included in the model. Lastly, ε_i is the error term.

3.3.1 Model Estimation

The model is estimated using the Ordinary Least Square Method (OLS) to identify the relationship between the access and usage determinants variables in affecting DFI with the key assumptions of linearity, independent variables are independent of error term, constant variance for error term, and normality of error term (Gujarati, 2019).

To ensure the classical linear regression model assumptions are fulfilled, the diagnostic tests namely heteroskedasticity test, autocorrelation test, normality test are carried out to ensure the robustness of our estimation. The heteroskedasticity test (Breusch-Pagan test) is utilized to test whether the error term is normally distributed in the dataset. The general decision applied is if the p-value obtained is less than the significance level ($\alpha = 0.05$), the null hypothesis is rejected and indicated the error term is not normally distributed. The autocorrelation test (Breusch-Godfrey Serial Correlation

LM test) is defined as a test for autocorrelation in the errors of a regression model. To be exact, it serves the purpose of identifying the presence of serial correlation to avoid incorrect conclusions from being drawn. The normality test (Jacque-Bera test) refers to a goodness-of-fit test to identify whether the kurtosis and skewness matches a normal distribution. If result is far from zero, it signifies that the data is not normal distributed.

3.3.2 Quantile Regression

The OLS regression is sensitive towards the extreme value in the sample data as the conditional mean is estimate in a model (The International Benchmarking Network, n.d.). The appearance of outliers in the data distribution could affect the accuracy of the estimation outcome due to the extreme value alteration of outliers. Besides, the OLS assumes homoskedasticity where all the error terms have constant variance from the mean value (Gujarati, 2019); however, it is suspected of behaviour differences across the DFI index quantile. Hence, in the case of heteroskedasticity, OLS estimation is less fit in determining the relationship between the determinant variables and the DFI index.

Overcoming the limitations, the **quantile regression model** is extended for a greater flexibility in the research as less assumption is exerted compared to linear regression model (Petscher, & Logan, 2013). Rather than estimating the conditional mean, the **quantile regression** estimates the conditional median which increased the reliability of the result in investigating a more specified effect of the explanatory variables towards DFI index across different degree level (quantiles) (Wenz, 2018). Additionally, it is less sensitive towards outliers which clearly shows the effect of explanatory variables towards DFI index at different quantile (Huang et al., 2017). With less susceptible to outliers, it clearly

demonstrates the impact of the access and usage of the explanatory factors on DFI index at various quantiles. Supported by the data obtained for DFI index is in continuous figures the model is applicable in this research to identify the degree of DFI index across different quantiles.

To understand how every dependent variable impact and contribute across the degree of DFI index; therefore, equation (1) can be expressed in equation (3) as follow:

$$Q_{\tau}(DFI_i) = (\tau)Access_i + (\tau)Usage_i + \varepsilon_i \qquad (3)$$

Corresponding to equation (2), the significancy of each access and usage variables are examined according to quantile as shown in equation (4):

$$Q_{\tau}(LNDFI_i) = \beta_{0i}(\tau) + LN\beta_{1i}(\tau)MOB_i + LN\beta_{2i}(\tau)INT_i + LN\beta_{3i}(\tau)INTB_i + LN\beta_{4i}(\tau)MMAGN_i + LN\beta_{5i}(\tau)MMACC_i + LN\beta_{6i}(\tau)INTPAY_i + LN\beta_{7i}(\tau)MOBREC_i + LN\beta_{8i}(\tau)MOBPAY_i + LN\beta_{9i}(\tau)INTINTB_i + \beta_{10i}DUM_{LOW}(\tau) + \varepsilon_i \qquad (4)$$

Where τ = 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, and 90th quantile.

Where DFI_i is digital financial inclusion index, β_{0i} is the intercept; MOB_i is mobile phone ownership (per 100 people); INT_i is internet penetration (internet user % of population); $INTB_i$ is internet bandwidth (Mbit/s); $MMAGN_i$ is mobile money agent (per 100,000 adult); $MMACC_i$ is mobile money accounts ownership (% of aged 15 or above); $INTPAY_i$ is payment via internet (% of aged 15 or above); $MOBREC_i$ is receipt of salary via the mobile phone (% of aged 15 or above); $MOBPAY_i$ is payment of utility via mobile phone (% of aged 15 or above); $INTINTB_i$ is the

interaction term; DUM_{LOW} is the dummy variable for low-income group countries or the control variable and; ε_i is the error term.

3.4 Data Collection

As for data collection, we rely on quantitative data retrieved from respondents to quantify attitudes, attributes, and other defined variables by contextualizing the data obtained through secondary sources. Cross-sectional data from 52 EMDE countries in 2017 is collected in this research to observe the variables without time influence. Subsequently, the data is filtered to 45 EMDE countries due to the incomplete data for 7 countries namely Chile, China, Columbia, Dominican Republic, Peru, Vietnam and South Africa (refer *Table* 3.1 for the list of sample countries). As for our variables, we have sourced from IMF working paper, World Development Indicators, International Telecommunication Union, Global Findex Data, Financial Access Survey to be incorporated within our sample data (refer *Table* 3.2 for the sources of data).

Table 3.1:

List of 45 Emerging Markets and Developing Economy (EMDE) Countries

Afghanistan	Cote d'Ivoire	Malaysia	Romania
Argentina	El Salvador	Mauritania	**Rwanda**
Armenia	Gabon	Mexico	**Senegal**
Bangladesh	Ghana	Mongolia	Sri Lanka
Benin	Guatemala	Myanmar	Thailand
Bolivia	Honduras	Namibia	**Togo**
Botswana	India	Nicaragua	Tunisia

Brazil	Indonesia	Nigeria	Turkey
Cambodia	Jordan	Pakistan	**Uganda**
Cameroon	Kenya	Panama	Zambia
Congo, Dem. Rep.	**Madagascar**	Philippines	**Zimbabwe**
Congo, Rep.			

Note. Country named in bold is categorized as the low-income group country.

Table 3.2:

Sources of Data

Variables	**Description**	**Sources**
DFI Index	Digital financial services provided through digital means, including mobile money operators, fintech companies, others newly entering the financial sector, as well as internet and mobile banking offered by traditional banks.	International Monetary Fund (IMF) Working paper
Mobile ownership	The subscriptions of mobile cellular telephone per 100 adults.	World Development Indicators
Internet penetration	Internet users measured in percentage of population.	
Internet bandwidth* (International bandwidth)	The sum of used capacity for the country's internet traffic exchanged measured in in megabits per second (Mbit/s).	International Telecommunication Union (ITU)

Mobile money agents	The number of registered agent outlets per 100,000 adults.	• Global Findex data • Financial Access Survey (FAS)
Mobile money account	The percentage of individual aged 15 above who personally utilising mobile money service in the past 12 months.	
Payment via internet	The percentage of individual aged 15 above who pay bills via internet in the past 12 months.	
Salary receipt via mobile	The percentage of individual aged 15 above who receiving salary or wages from an employment via mobile phone in the past 12 months.	
Utility payment via mobile	The percentage of individual aged 15 above who personally making regular utility payments in the past 12 months via mobile phone.	

3.5 Conclusion

In conclusion, chapter 3 has outlined the research which adopts 45 EMDE countries as the sample data to examine the driving factors of DFI Index among the emerging countries. Using secondary data from the IMF, Global Findex, FAS, World Development Indicator and ITU, for the access (mobile phone ownership, internet penetration, the numbers of mobile money agent and internet bandwidth) and usage

(mobile money account ownership, payment via internet, receipt of salary via mobile phone and payment of utility via mobile phone) variables. Referring to Khera et al. (2021), a linear regression model is designed from the perspectives of access and usage and estimated using the OLS to determine the significancy of each access and usage variables affect DFI index. Also, quantile regression is carried out to study the how the access and usage variables act as an influencer in specific DFI index quantiles.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

In chapter 4, the research analysis is processed using the sample data of 45 EMDE countries to seek the relationship and significance of each access and usage variables on DFI index. Analysis and discussion focusing on the two key variables: internet bandwidth and mobile money agent network will be made on the results generated using EViews software and Microsoft Excel. This chapter will be presented in two main components which are the descriptive analysis on 45 EMDE countries and the empirical result of the multiple linear regression model of DFI.

4.1 Descriptive Analysis of 45 EMDE Countries

The descriptive analysis will describe the behaviors and characteristics on both the DFI index and access and supply variables among the 45 EMDE countries by displaying the main data point: mean, median, standard deviation, minimum and maximum.

Table 4.1 (a)

Descriptive Statistics

Variables	**DFI**	**MOB (Per 100 adults)**	**INT (% of population)**	**INTB (Mbit/s) (‘000)**	**MMAGN (Per 100,000 adults) (‘000)**
Mean	0.430	104.508	35.087	931.616	15263.264
Median	0.370	99.156	31.700	161.625	0.010
Maximum	1.000	175.597	80.140	9756.456	687000.000
Minimum	0.040	34.143	8.100	3.500	0.000
Std. Dev.	0.236	29.874	19.994	1855.830	102000.000
Skewness	0.704	0.029	0.569	0.003	0.006
Kurtosis	2.744	2.927	2.223	0.013	0.043
Jarque-Bera	3.838	0.016	3.556	0.246	3.319
Observations	45	45	45	45	45

Note. DFI (digital financial inclusion index), MOB (mobile cellular ownership), INT (internet penetration), INTB (internet bandwidth), MMAGN (number of mobile money agent).

Table 4.1 (b)

Descriptive Statistics (Cont')

Variables	MMACC (% age 15+)	INTPAY (% age 15+)	MOBREC (% age 15+)	MOBPAY (% age 15+)
Mean	0.157	0.074	0.028	0.052
Median	0.071	0.054	0.014	0.028
Maximum	0.729	0.326	0.134	0.371
Minimum	0.007	0.003	0.000	0.000
Std. Dev.	0.167	0.065	0.032	0.064
Skewness	1.457	2.007	1.472	3.003
Kurtosis	4.671	7.480	4.830	14.700
Jarque-Bera	21.156	67.846	22.537	324.292
Observations	45	45	45	45

Note. MMACC (mobile money account), INTPAY (payment via internet), MOBREC (salary receipt via mobile), MOBPAY (utility payment via mobile).

The descriptive statistics shows the DFI index (DFI) among the 45 EMDE countries ranged between 0.04 and 1.00 where the maximum is Ghana while minimum is Afghanistan. The standard deviation displays a 0.236 dispersion from the mean value is reflected from the extreme values recorded in the sample data where the top three performer of DFI index are Ghana, Kenya and Uganda reporting 1.00, 0.95 and 0.87 while the three worst performers of DFI are Afghanistan, Madagascar and Congo Republic reporting 0.04, 0.12 and 0.13 DFI index respectively. On average, it is observed that median of the sample data is at 0.37 DFI index level which is below the average index level of 0.43 indicating half amount of the 45 EMDE countries has yet to achieve the average DFI index level. Also, the positive skewness of 0.704 displays that most of the 45 countries are still among the range of low DFI.

Based on previous literatures, the internet speed and agent network are claimed to be the drivers of DFI (D'Andrea & Limodio, 2019; Thulani et al., 2014). Linking to the sample data, India tops the highest internet bandwidth at 9756.456 Mbit/s and has no agent network in the country performed at 0.25 DFI index level. However, it is observed that Bangladesh who performed at 0.66 DFI index has the strongest agent network with 687,000,000 number mobile money agent per 100,000 adults and 577,162 Mbit/s. Hence, this led to the examination on driving factors of DFI in the following regression analysis.

4.1.1 Boxplot Analysis on DFI According to Income Group

The box plot analysis in *Figure 4.1* presents DFI index of 45 EMDE countries which are classified according to the income group of low income, lower middle income and upper middle income which ranged from 0.04 to 0.87, 0.13 to 0.68 and 0.29 to 0.62 respectively disregarding the two outliers (Ghana and Kenya) in the lower middle-income group.

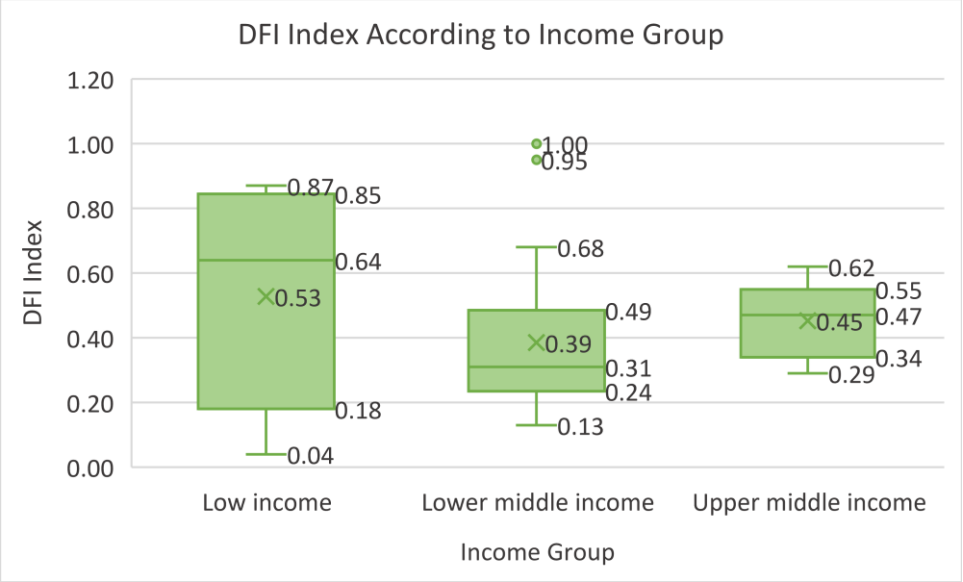


Figure 4.1 Boxplot of DFI index According to Income Group Among 45 EMDE countries

Among the low-income group countries, the lower quartile countries are 0.46 index away from the median and 0.67 index away from the upper quartile countries. This is showing a wide gap between the high DFI performer (such as Afghanistan and Madagascar) and the low DFI performer (such as Senegal and Uganda). The median of 0.64 is higher than the mean value of 0.53 which displays that over half of the low-income countries are performing above the average DFI index level. Compared to the lower middle income and upper middle-income countries with average DFI index level at 0.39 and 0.45 respectively, the low-income group countries appear to have the highest mean value. Hence, this implies that the low-income group countries such as Zimbabwe, Rwanda, Senegal and Uganda having DFI index ranged between 0.74 to 0.87 are well-performed in DFI which reflects with literature evidencing the low-income country among emerging countries are well-performed in DFI as the substitute to the poor traditional financial access (Khera et al., 2021).

4.1.2 Boxplot Analysis on Internet Bandwidth According to Quantile Group of DFI

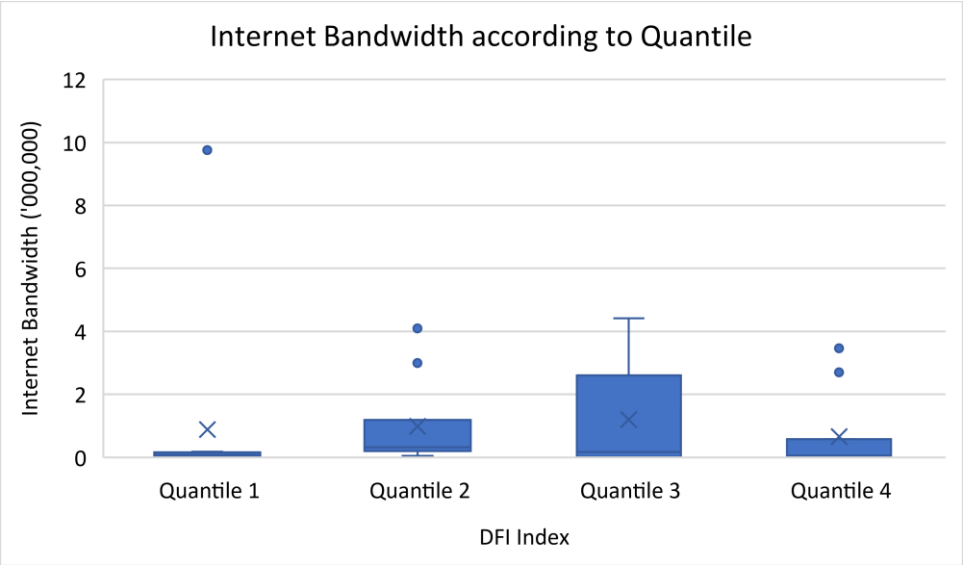


Figure 4.2 Boxplot of Internet Bandwidth According to Quartile Group of DFI Among 45 EMDE countries

Table 4.2

Average Internet Bandwidth According to DFI Quantile

Quantile	Average Internet Bandwidth (Mbit/s)
1	881882
2	988079
3	1202224
4	658800

Note. Figures portrayed are rounded up to the nearest whole number.

According to a few research previously mentioned in chapter 2, it highlights that a large adoption of MFS is due to the availability of high-speed internet. With higher speed being provided to the public, it enhances the utilization

of mobile to better access to MFS, which indirectly increases DFI (Perlman & Wechsler, 2019).

This assumption can be further shown in *Figure 4.2*, as we can see that generally internet bandwidth has a linear relationship with DFI. DFI index tends to increase when internet bandwidth increases. Up until quantile 3, which contains countries with DFI index ranging from 0.39 to 0.57, it shows that these countries have a high usage on internet bandwidth to carry out financial transactions.

However, the usage of internet bandwidth plunged at quantile 4, which consist of the highest DFI index's countries. Since internet bandwidth does not show prominent significancy in the countries with highest DFI, therefore it is suspected that mobile money agent could be the catalyst of achieving high DFI index. As such, we proceed to calculate the average of mobile money agent per 100,000 adults for all quantiles, in order to verify our assumption.

4.1.3 Scatterplot Analysis between DFI against LNMMAGN

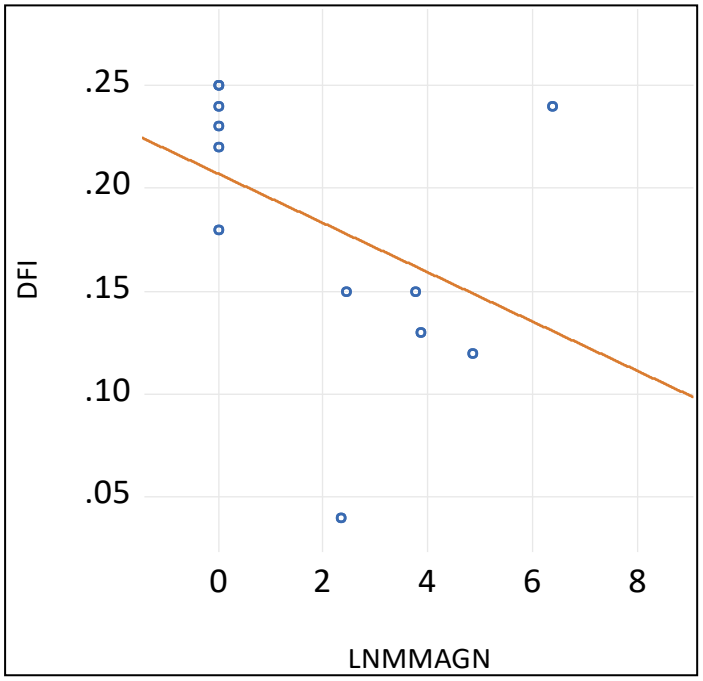


Figure 4.3 Scatter Plot of DFI against LNMMAGN in Quantile 1

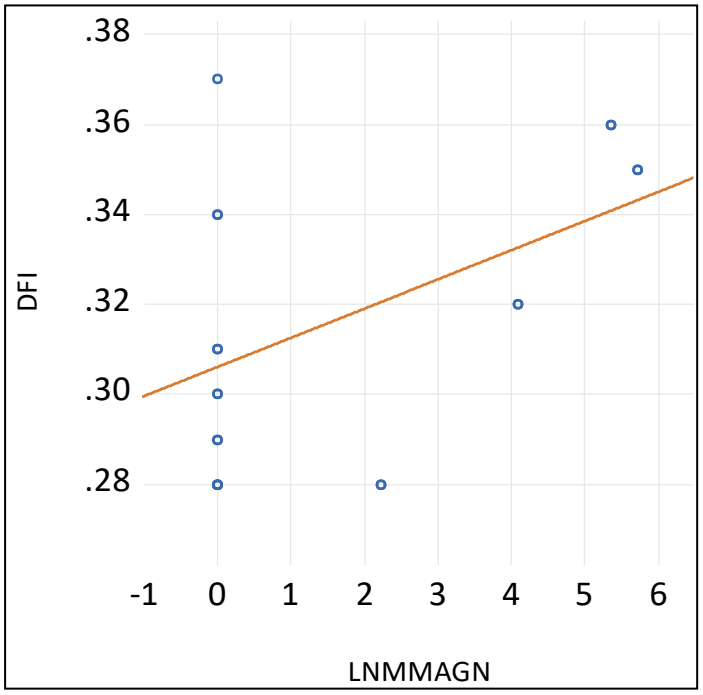


Figure 4.4 Scatter Plot of DFI against LNMMAGN in Quantile 2

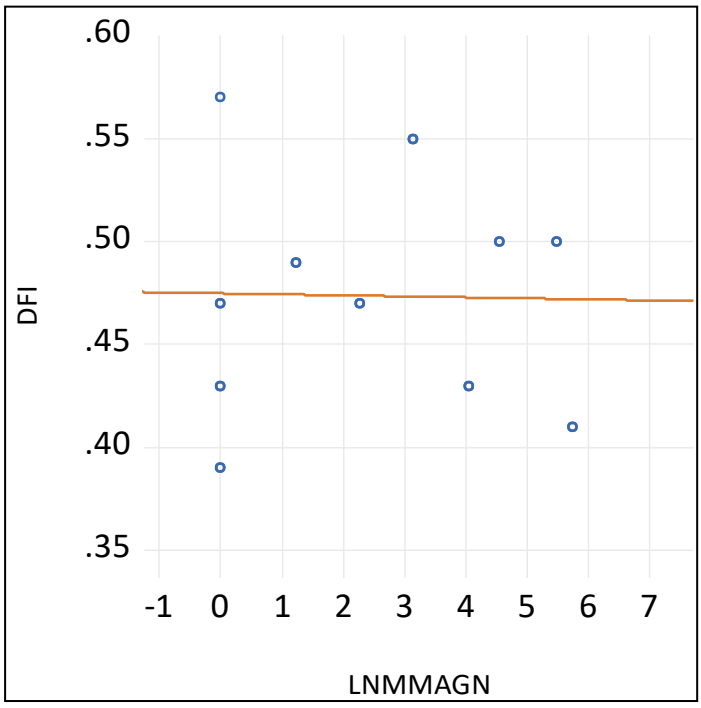


Figure 4.5 Scatter Plot of DFI against LNMMAGN in Quantile 3

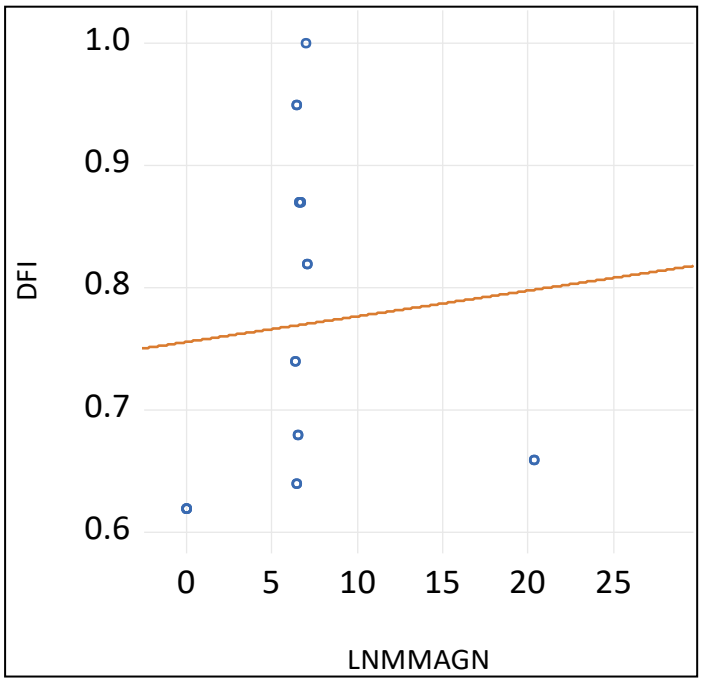


Figure 4.6 Scatter Plot of DFI against LNMMAGN in Quantile 4

Table 4.3:

Average Number of Mobile Money Agent according to DFI Quantile

Quartile	Average Mobile Money Agent (per 100,000 adults)
1	69
2	53
3	66
4	62440431

Note. Figures portrayed are rounded up to the nearest whole number.

As multiple studies have shown that mobile money agent network plays a significant role in promoting DFI, especially in emerging countries, the agent network is said to be serving its purpose acting as a liaison between mobile money services and banks. This also means that people who stay in rural areas where physical distance keeps them from accessing formal financial services (Caputo, 2019), the agent network that is spread out widely bridges the connection between unbanked population and financial services.

The scatterplots show the relationship between the DFI and LNMMAGN in each quantile. There is an inverse relationship between the DFI and LNMMAGN in quantile 1 and quantile 3. This indicates as the outlet of mobile money agent increases, the DFI level decreases. To explain this finding, the agent network may not be entirely the key to increasing DFI for the countries included. However, in quantile 2 and 4, a positive relationship is identified which exhibits that mobile money agent plays an important factor as the DFI level of the countries increases along with the increment in LNMMAGN.

Segregating according to quantile, the average of the mobile money agent is the highest in the fourth quantile, which amounts to 62,440,431 agents per 100,000 adults due to the presence of an outlier (Bangladesh) with a high concentration of mobile money agent distribution, all thanks to bKash that is very popular among Bangladeshis. Also, since Bangladesh is classified as a lower-middle income country, the result shown portrays as evidence for our hypothesis where DFI increases when mobile money agent increases in emerging countries. Moreover, this result has testified our assumption where mobile money agent acts as the key determinant in promoting DFI among countries holding the highest DFI index.

4.2 Empirical Result of the Access and Usage Variables on DFI

To estimate the multiple linear regression, the Ordinary Least Square Method **(**OLS) method is adopted to determine the relationship between the explanatory variables and DFI using sample data of 45 EMDE countries. *Table* 4.4 (a) and (b) shows the estimation result on how the independent variables affect the DFI.

Table 4.4 (a)

Consolidated Result Table

Variable	OLS	Q10	Q20	Q30	Q40
C	-6.556	-6.909	-8.259	-7.854	-8.467
	(1.613)***	(2.978)**	(2.620)***	(2.248)***	(2.365)***
LNMOB	0.750	0.894	0.900	0.660	0.719
	(0.223)***	(0.361)**	(0.430)**	(0.259)**	(0.290)**

LNINT	0.753	0.894	1.099	1.199	1.268
	(0.486)	(0.641)	(0.588)*	(0.564)**	(0.613)**
LNINTB	0.281	0.305	0.383	0.388	0.383
	(0.139)*	(0.191)	(0.214)*	(0.163)**	(0.171)**
LNMMAGN	0.032	0.059	0.042	0.041	0.044
	(0.018)*	(0.036)	(0.034)	(0.023)*	(0.023)*
LNMMACC	0.267	0.173	0.213	0.178	0.1387
	(0.103)**	(0.273)	(0.335)	(0.189)	(0.1619)
LNINTPAY	0.248	0.543	0.375	0.280	0.255
	(0.103)**	(0.196)***	(0.340)	(0.232)	(0.234)
LNMOBREC	1.5494	-8.537	-6.107	-3.396	1.8099
	(3.030)	(9.094)	(10.311)	(8.746)	(4.1874)
LNMOBPAY	-1.343	2.075	1.298	1.050	-0.256
	(1.668)	(3.274)	(3.729)	(3.330)	(2.389)
LNINTLNINTB	-0.063	-0.081	-0.095	-0.096	-0.097
	(0.040)	(0.054)	(0.059)	(0.047)**	(0.050)*
DUM_LOW	0.442	0.495	0.500	0.532	0.573
	(0.160)***	(0.220)**	(0.3202)	(0.264)*	(0.257)**
Sample Size (N)	45	45	45	45	45

Note. ()*, ()**, ()*** represents the rejection of null hypothesis at 10%, 5% and 1% significance level. The standard error is written in the parentheses. The terms are represented as: C (the intercept), DFI (digital financial inclusion index), MOB (mobile cellular ownership), INT (internet penetration), INTB (internet bandwidth), MMAGN (number of mobile money agent), MMACC (mobile money account), INTPAY (payment via internet), MOBREC (salary receipt via mobile), MOBPAY (utility payment via mobile), DUM_LOW (dummy variable for low-income

country as control variable) and INTINTB (interaction term between internet penetration and internet bandwidth).

Table 4.4 (b)

Consolidated Result Table (Cont')

Variable	Q50	Q60	Q70	Q80	Q90
C	-7.863	-5.282	-4.391	-4.590	-6.563
	(4.676)	(2.251)**	(2.461)*	(2.114)**	(2.211)***
LNMOB	1.051	0.941	0.851	0.815	0.788
	(0.365)***	(0.463)**	(0.405)**	(0.341)**	(0.341)**
LNINT	0.503	-0.156	-0.424	-0.278	0.482
	(1.529)	(0.854)	(0.869)	(0.732)	(0.849)
LNINTB	0.203	0.050	-0.064	-0.023	0.200
	(0.369)	(0.214)	(0.234)	(0.198)	(0.255)
LNMMAGN	0.038	0.030	0.062	0.061	0.026
	(0.020)*	(0.019)	(0.033)*	(0.031)*	(0.022)
LNMMACC	0.157	0.208	-0.007	0.003	0.103
	(0.137)	(0.173)	(0.268)	(0.225)	(0.149)
LNINTPAY	0.137	0.067	0.037	0.052	0.070
	(0.172)	(0.177)	(0.169)	(0.138)	(0.103)
LNMOBREC	3.105	1.713	2.189	2.098	9.280
	(4.489)	(3.533)	(3.330)	(2.759)	(5.994)
LNMOBPAY	0.021	1.756	4.764	4.272	-1.446
	(2.251)	(5.562)	(7.021)	(5.841)	(2.865)

LNINTLNINTB	-0.040	0.008	0.032	0.020	-0.042
	(0.104)	(0.060)	(0.064)	(0.054)	(0.066)
DUM_LOW	0.607	0.687	0.667	0.656	0.522
	(0.346)*	(0.247)***	(0.262)**	(0.229)***	(0.200)**
Sample Size (N)	45	45	45	45	45

Note. ()*, ()**, ()*** represents the rejection of null hypothesis at 10%, 5% and 1% significance level. The standard error is written in the parentheses. The terms are represented as: C (the intercept), DFI (digital financial inclusion index), MOB (mobile cellular ownership), INT (internet penetration), INTB (internet bandwidth), MMAGN (number of mobile money agent), MMACC (mobile money account), INTPAY (payment via internet), MOBREC (salary receipt via mobile), MOBPAY (utility payment via mobile), DUM_LOW (dummy variable for low-income country as control variable) and INTINTB (interaction term between internet penetration and internet bandwidth).

As shown in *Table* 4.4 (a) and (b), the OLS estimates reported in column (1) suggest that that the key determinants which statistically significant in explaining DFI are mobile ownership, internet bandwidth, mobile money agent, payment using internet and mobile money account ownership that portrays an expected positive relationship as stated in previous literatures. Also, our result display that low-income countries have an average 0.422 higher DFI index than the other income group. This is explained as those low-income countries have a high usage of mobile money agents instead of using traditional ATM machines, and it is further supported by the result of the estimation where mobile money agent shows 5 percent significantly in explaining DFI.

As mentioned in chapter 2, mobile phones aid the unbanked and underbanked to access DFS, which implicitly boost DFI (Perlman & Wechsler, 2019). This can be seen in our result generated where ownership of mobile has the highest significancy of 1 percent in explaining DFI. With mobile, one can simply

access to MFS with the ownership of mobile money account. The account ownership is crucial in filling the gap of people who has yet to have access to financial services. As estimated, our result shows mobile money account is vital in defining DFI with a significancy of 5 percent.

Moreover, one of the services offered by MFS is payment services, and this could not be done without the help of internet. Therefore, payment via internet is essential in explaining DFI where it shows a 5 percent significant impact in our estimated outcome. Lastly, internet bandwidth is important as mentioned by D'Andrea and Limodio (2019) where high-speed internet aids in boosting the adoption of financial technologies; therefore, enhances DFI. Similarly, indicated in our result that internet bandwidth is significant in explaining DFI at 10 percent. Overall, the proposed economic model is significant at 1 percentage significance level and 78.28 percent of the DFI index is explained by the independent variables

Nevertheless, in the diagnostic test, the Breusch Pagan Godfrey Test under the OLS estimation has shown a test statistic of 24.610 which detected that the regression suffers from heteroskedasticity problem. As the data of 45 EMDE countries are not normally distributed, so making it no longer the most efficient linear estimator. Therefore, using the OLS regression analysis might not be the best method to estimate our sample data as it is less likely to accurately determine the relationship between the determinant variables and the DFI index. Therefore, quantile regression analysis kicks in to evaluate the specific effect of the explanatory variables in explaining DFI index by considering the conditional median rather than the mean value.

According to the result of quantile regression, the DUM_LOW is positively associated with DFI and shows significancy over the quantiles except for the 20^{th} quantile. It is observed that the magnitude of the DFI to be explained by low-income country increases from the 10^{th} quantile to the 60^{th} quantile then decreases to the 90^{th} quantile. Since poorer household tends to fall under the population of unbanked,

the result fully portrays how DFI has blossomed in low-income countries since they have been encountering major barriers of high cost and physical distance in achieving TFI (Unnikrishnan et al., 2019; Caputo, 2019). The low cost associated with digital payment and mobile phone technologies could be the main reason that fuels the success of DFS.

Next, the LNINT and LNINTB are statistically significant at the 20th, 30th, and 40th quantile, and this indicates that internet penetration and internet bandwidth does play quite an important role in explaining DFI index. This has further confirmed the conclusion obtained from a study published by D'Andrea and Limodio (2019), where high-speed internet has contributed towards the large-scale adoption of financial technologies. This is because faster speed of mobile broadband could enhance graphical interfaces which directly increases users' satisfaction. Although these 2 variables have shown some significancy in certain quantiles, however it may not be the full answer in explaining as one of the key drivers of DFI.

Moreover, internet and the interaction term (between internet and internet bandwidth) which was previously insignificant in OLS estimation now shows significancy at the 30th and 40th quantiles, but negatively correlated to the DFI. This could further confirm our assumptions where there may have been another major key driver in achieving higher DFI.

Therefore, we have directed our focus onto the outlet of mobile money agent which shows significancy across the 30th quantile to 80th quantile (except for the 60th quantile), signifying that DFI index could be explained by the agent network. This result matches past studies where researcher has pointed out how important the role of agent network is in connecting unbanked population to financial services (Caputo, 2019). As the agent model comes at a low cost, agent network is said to be expanding rapidly in Latin America and South Asia, boosting financial inclusion.

Thus, this could be how agent network kicks in, playing a better role in explaining DFI since it shows significancy in more quantiles.

4.3 Conclusion

Out of all 10 variables estimated in chapter 4, there are 7 variables which are adopted from the research paper by Khera et al (2021), while the newly added variables are internet bandwidth, dummy variable of low-income countries and interaction term of internet penetration and internet bandwidth. We started off by running OLS estimation to examine the relationship between dependent and independent variables, and our results have indicated the significancy of internet bandwidth, payment via internet, mobile money agent, mobile money account and mobile money ownership in explaining DFI.

However, after running diagnostic test upon the OLS regression, our finding is found to be suffering from the problem of heteroskedasticity, hence we continued to carry out quantile regression analysis to further evaluate our sample data. Among the 7 variables, our findings suggest that only internet penetration, internet bandwidth, payment via internet, mobile ownership, and mobile money agent displays a significant relationship in explaining DFI in their respective quantile. As for the 3 newly added variable, all shows a significant impact in determining DFI. Hence concluding that, our estimated results align with what we hypothesized.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATION

5.0 Introduction

Concluding our research, it is proven that our estimated result aligns with our hypothesis using the quantile regression where there are two major ways in aiding individuals to be financially included, especially those located in low-income countries. As approaches to TFI are costly as compared to DFI, the assistance of internet penetration supported by high internet bandwidth and further topped with the mobile money agent network are potential boosters for DFI among emerging countries.

5.1 Discussion of Key Findings

To summarize our research, specifically we can come to a conclusion that, among all variables, our results have identified the key digital-focused (access and usage) determinants of DFI for emerging countries. Since OLS regression faced trouble passing the diagnostic test, we have opted the findings obtained from quantile regression. These key factors include internet penetration, internet bandwidth, payment via internet, mobile money agent, and mobile money ownership, whereby they are significant in playing the roles of explaining DFI index from the access and usage perspectives. Hence, these findings have confirmed our hypotheses in which these five explanatory variables are positively associated in determining DFI in emerging countries.

Moving on, our focal point shifts towards the role played by digital connectivity in promoting DFI. Although internet penetration, internet bandwidth, internet payment and the interaction term of internet penetration and internet bandwidth displays a lower significancy, but they remain significant in certain quantile, ranging from the 10^{th} to 40^{th} quantile, which is among countries with low DFI index. An example behind this rationale can be seen from Nigeria who has a low DFI index of 0.15. According to Danbatta, the Executive Vice-Chairman of Nigerian Communications Commission (NCC) (as cited by Adepetun, 2021), technology, internet, and more importantly broadband speed are crucial in aiding Nigeria to achieve the targeted DFI percentage. Since 2015, there has been a considerable growth in broadband penetration, from 6 percent to 42.9 percent as of January 2021, with 81.9 million Nigerians now having access. NCC has also launched a few initiatives to strengthen the country's mobile lines to allow more people to have access to high-speed internet. Coming back to our research, digital connectivity has played quite an important role in promoting DFI, especially in countries with low DFI index, however, this may not be the case for countries with high DFI index.

While we are investigating further to reveal the backbone that boosts country towards high DFI, the mobile money agent network has caught our attention by portraying more significancy in promoting DFI. The variable of mobile money agent shows higher significancy in 30^{th}, 40^{th}, 50^{th}, 70^{th}, and the 80^{th} quantile. Hence, this result has managed to unveil the hidden element in driving emerging countries towards high DFI, in which we can deduce that agent network has exhibited quite an impressive job in promoting DFI. This estimation result also aligns with the research done by International Telecommunication Union (ITU) in Nigeria (as cited by Adepetun, 2021) where they mentioned the major characteristics that represent DFI are usage of mobile for financial transaction and an intermediary like agents for cash in and out purposes. Following up is **mobile ownership** that shows the highest significancy in all quantiles, concluding that regardless of which income group the country is in, ownership of mobile helps them to achieve DFI. Since the agent network cannot work without mobile ownership, these two variables are said

to come in a pair, further confirming our assumptions where agent network has played a crucial role in promoting DFI among emerging countries.

5.2 Implications of the Study

Our studies imply that through the incorporation of digital technology and financial products, it could aid in boosting financial inclusion digitally. This is important to government and financial services and products provider in respective countries as it sets the right direction for them in innovating the right products and services in the future. For instance, it also means that traditional financial products are no longer the key player in achieving financial inclusion. With the power of digitalization, DFI could be a turning point that can be easily outperform TFI in the near future.

Additionally, the findings are hints to policy maker for the improvement of the current financial development blueprint among the emerging countries in facilitating the problem of unbanked, underbanked, or financially excluded people. Especially to those living in distant areas or the low-income countries, they could be financially included with the catalyst of high internet bandwidth to improve the access to DFS as well as the agent network to provide basic financial services to the users. Before digitalization kicks in, the world revolves on TFI, but unbanked population still exist in the 21st century. It clearly shows that there are loopholes in TFI and henceforth DFI is able to blossom. For example, usage of mobile money agent instead of ATM machines would strip off the cost associated previously in traditional financial products, i.e., traveling cost from the user's place to designated ATM outlet and many other costs associated while traveling.

Besides, our research is constructed based on the access and usage of DFS which analyses how different combination of approach and usage of DFS can

enhances DFI. In particular, this research also addresses the lack of attention in how internet bandwidth could affect the usage of DFS, and as such internet bandwidth is added in the research as a new variable for the estimation. While internet and internet bandwidth come in a package, both are mutually exclusive in creating a holistic experience to an internet user. Hence, this is a sign to government or any other related professional bodies to really look into this matter and initiate programs or policies that would enhance access to high-speed internet.

Lastly, as proven in our research that access and usage to financial products and services via the digital way is feasible as most of the digital determinants shows a significancy in explaining DFI. Other than that, using the digital approach is more cost effective especially to those low-income and low-density population as compared to the primitive way. Not only it benefits users, but it also grants financial services provider in easily managing their clients, as normally it is more costly to set up bank branches or ATM branches in comparison to expanding the agent network in all over the country.

5.3 Research Gaps and Recommendation for Future Directions

In spite of remarkable result in our research, we still have several limitations that could potentially improve on in future studies. The major limitation of our research is the lack of comprehensive data. Initially, we intend to conduct research on the evolution of DFI from the 20th century among all different countries. However, the data for explanatory variables to measure DFI index is only available during the 21st century starting from year 2011. Hence, this has limited our research to only look into cross sectional data. Besides, the dependent variable of the research (DFI index) is a new measurement proposed by the IMF in which digital aspects of inclusion

are incorporated. Henceforth, DFI index is only available for 52 EMDE countries which has limited our sample size.

Furthermore, the data for the explanatory variables extracted from the Global Findex data by the World Bank is only available every three years (2011, 2014 and 2017). While the data for 2021 is yet to be updated, our research data is extracted from Global Findex data by the World Bank in year 2017. This does not accurately reflect the latest situation of the countries' financial inclusion status, as it does not take into account numerous factors that could possibly speed up the financial inclusion process, i.e., digitalisation driven by the outbreak of covid-19 pandemic.

Moving forward, for future researchers who intend to further research on the key determinants on accelerating DFI could adopt the latest dataset released by The Global Findex Database 2021 from The World Bank. The data includes revised indicators on access to and use of formal and informal financial services as well as digital payments which could provide greater perceptions into behaviours that support financial resilience and enhancing financial inclusion. Moreover, the data contains national representative surveys of over 125,000 adults in 123 economies during the COVID-19 pandemic. Precisely, it also addresses gaps of access to and usage of financial services amongst women and poor adults.

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APPENDICES

Appendix 4.1

DFI Index of 45 EMDE Countries

Countries	DFI	Countries	DFI	Countries	DFI
Afghanistan	0.04	Pakistan	0.35	Rwanda	0.82
Madagascar	0.12	Cambodia	0.36	Senegal	0.87
Congo, Rep.	0.13	Brazil	0.37	Uganda	0.87
Myanmar	0.15	Sri Lanka	0.39	Kenya	0.95
Nigeria	0.15	Togo	0.41	Ghana	1.00
Mauritania	0.18	Armenia	0.43		
Honduras	0.22	Argentina	0.43		
Guatemala	0.23	Indonesia	0.47		
Cameroon	0.24	Thailand	0.47		
Congo, Dem. Rep.	0.24	Turkey	0.49		
Bolivia	0.25	Botswana	0.50		
India	0.25	Zambia	0.50		
Jordan	0.28	Namibia	0.55		
Nicaragua	0.28	Mongolia	0.57		
Tunisia	0.28	Gabon	0.62		
Mexico	0.29	Malaysia	0.62		
Panama	0.30	Benin	0.64		
El Salvador	0.31	Bangladesh	0.66		
Philippines	0.32	Cote d'Ivoire	0.68		
Romania	0.34	Zimbabwe	0.74		

Appendix 4.2

OLS Regression

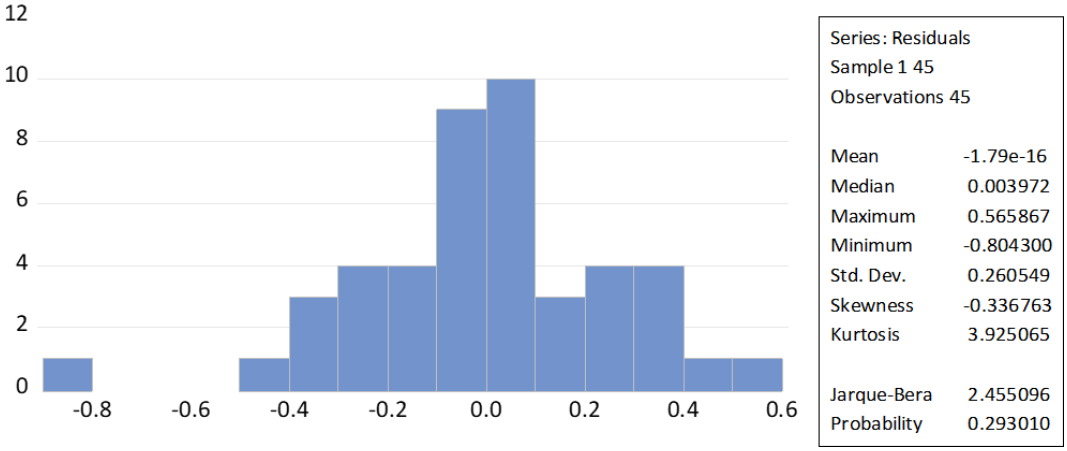
Dependent Variable: LNDFI
Method: Least Squares
Date: 07/09/22 Time: 23:14
Sample: 1 45
Included observations: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DUM_LOW	0.442112	0.160306	2.757923	0.0093
LNINT	0.753081	0.486152	1.549066	0.1306
LNINTB	0.281301	0.138572	2.029996	0.0502
LNINTLNINTB	-0.063160	0.039551	-1.596905	0.1195
LNINTPAY	0.248228	0.102893	2.412496	0.0214
LNMMACC	0.266950	0.102761	2.597779	0.0138
LNMMAGN	0.032435	0.018366	1.766004	0.0864
LNMOB	0.750497	0.222955	3.366136	0.0019
LNMOBPAY	-1.343430	1.668456	-0.805194	0.4263
LNMOBREC	1.549371	3.029612	0.511409	0.6124
C	-6.555784	1.612794	-4.064861	0.0003

R-squared	0.832132	Mean dependent var	-1.011969
Adjusted R-squared	0.782760	S.D. dependent var	0.635924
S.E. of regression	0.296398	Akaike info criterion	0.614361
Sum squared resid	2.986964	Schwarz criterion	1.055990
Log likelihood	-2.823120	Hannan-Quinn criter.	0.778996
F-statistic	16.85405	Durbin-Watson stat	2.095348
Prob(F-statistic)	0.000000		

Appendix 4.3

Normality Test



Appendix 4.4

Autocorrelaton Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.179718	Prob. F(2,32)	0.3204
Obs*R-squared	3.090114	Prob. Chi-Square(2)	0.2133

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 07/10/22 Time: 22:22
Sample: 1 45
Included observations: 45
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DUM_LOW	-0.047674	0.162513	-0.293358	0.7711
LNINT	-0.062210	0.485296	-0.128191	0.8988
LNINTB	-0.007989	0.138001	-0.057893	0.9542
LNINTLNINTB	0.000898	0.039351	0.022811	0.9819
LNINTPAY	0.067680	0.118145	0.572858	0.5707
LNMMACC	-0.065546	0.112921	-0.580459	0.5657
LNMMAGN	0.015126	0.021364	0.707995	0.4841
LNMOB	-0.033432	0.223019	-0.149906	0.8818
LNMOBPAY	-0.317019	1.741208	-0.182068	0.8567
LNMOBREC	1.552931	3.208316	0.484033	0.6317
C	0.398846	1.629932	0.244701	0.8083
RESID(-1)	-0.210329	0.199031	-1.056769	0.2985
RESID(-2)	0.242463	0.229157	1.058067	0.2979

R-squared	0.068669	Mean dependent var	-1.79E-16
Adjusted R-squared	-0.280580	S.D. dependent var	0.260549
S.E. of regression	0.294844	Akaike info criterion	0.632109
Sum squared resid	2.781851	Schwarz criterion	1.154034
Log likelihood	-1.222453	Hannan-Quinn criter.	0.826677
F-statistic	0.196620	Durbin-Watson stat	1.782813
Prob(F-statistic)	0.997689		

Appendix 4.5

Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	4.103829	Prob. F(10,34)	0.0009
Obs*R-squared	24.61041	Prob. Chi-Square(10)	0.0061
Scaled explained SS	20.54742	Prob. Chi-Square(10)	0.0245

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 07/10/22 Time: 22:23
Sample: 1 45
Included observations: 45

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.259995	0.478358	0.543515	0.5903
DUM_LOW	0.069509	0.047547	1.461894	0.1530
LNINT	-0.206910	0.144194	-1.434947	0.1604
LNINTB	-0.073296	0.041101	-1.783318	0.0835
LNINTLNINTB	0.021461	0.011731	1.829413	0.0761
LNINTPAY	-0.096991	0.030518	-3.178151	0.0032
LNMMACC	-0.051473	0.030479	-1.688799	0.1004
LNMMAGN	0.002102	0.005447	0.385800	0.7020
LNMOB	-0.002371	0.066129	-0.035857	0.9716
LNMOBPAY	0.572396	0.494868	1.156665	0.2555
LNMOBREC	1.819796	0.898590	2.025168	0.0508

R-squared	0.546898	Mean dependent var	0.066377
Adjusted R-squared	0.413633	S.D. dependent var	0.114806
S.E. of regression	0.087912	Akaike info criterion	-1.816365
Sum squared resid	0.262772	Schwarz criterion	-1.374737
Log likelihood	51.86822	Hannan-Quinn criter.	-1.651731
F-statistic	4.103829	Durbin-Watson stat	1.907695
Prob(F-statistic)	0.000927		

Appendix 4.6

10 Quantile Process Estimates

Quantile Process Estimates
Equation: UNTITLED
Specification: LNDFI DUM_LOW LNINT LNINTB LNINTLNINTB LNINTPAY LNMMACC LNMMAGN LNMOB LNMOBPAY LNMOBREC C
Estimated equation quantile tau = 0.5
Number of process quantiles: 10
Display all coefficients

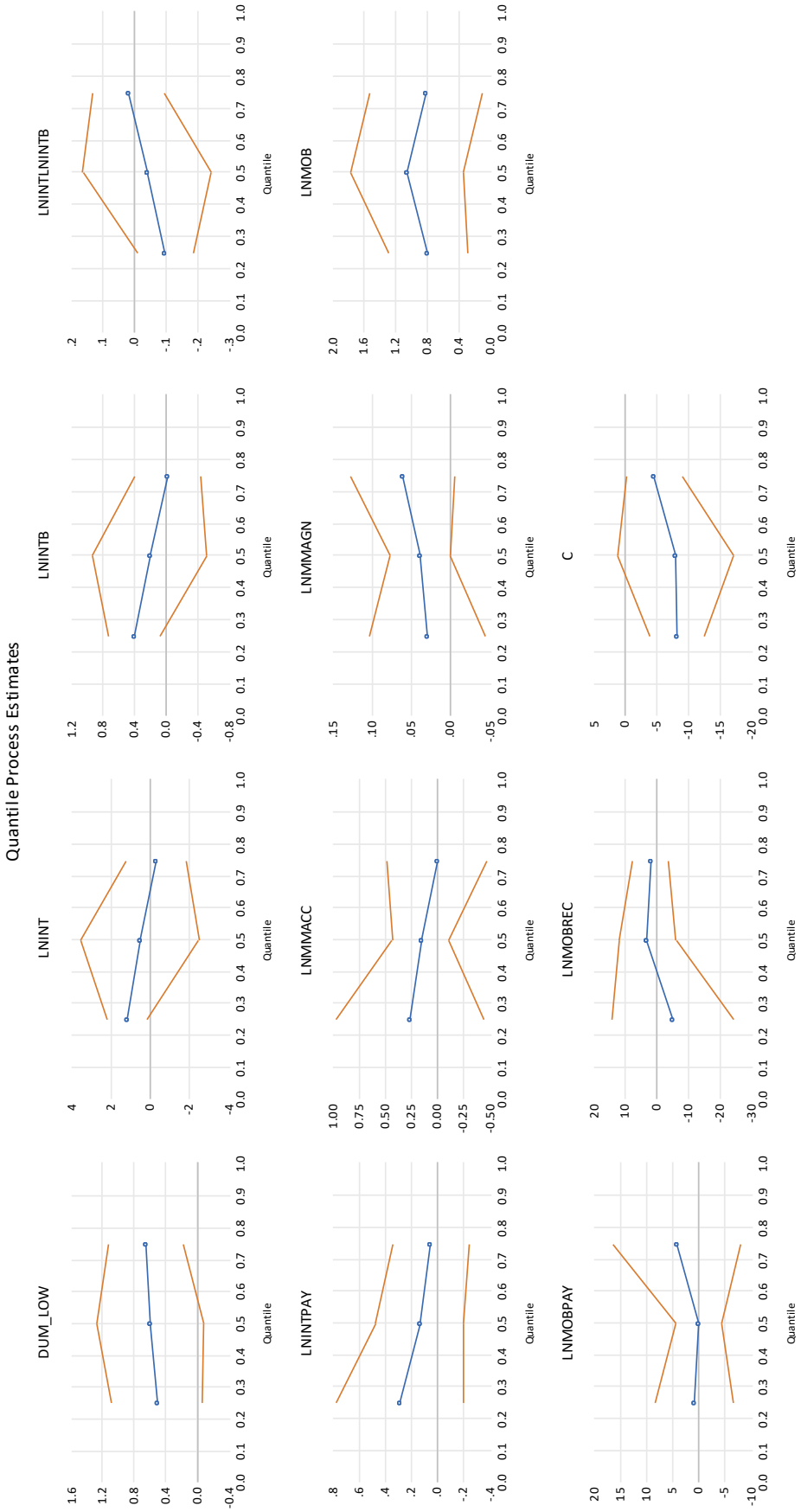
	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
DUM_LOW	0.100	0.495124	0.220028	2.250277	0.0310
	0.200	0.499851	0.320197	1.561070	0.1278
	0.300	0.532331	0.263662	2.018994	0.0514
	0.400	0.573473	0.256792	2.233219	0.0322
	0.500	0.606701	0.345893	1.754013	0.0884
	0.600	0.687341	0.246526	2.788107	0.0086
	0.700	0.667190	0.262309	2.543528	0.0157
	0.800	0.655782	0.228749	2.866818	0.0071
	0.900	0.521668	0.200235	2.605282	0.0135
LNINT	0.100	0.894491	0.641097	1.395250	0.1720
	0.200	1.099089	0.588485	1.867657	0.0704
	0.300	1.198697	0.564382	2.123911	0.0410
	0.400	1.267788	0.613341	2.067020	0.0464
	0.500	0.503154	1.528811	0.329114	0.7441
	0.600	-0.156085	0.854263	-0.182713	0.8561
	0.700	-0.423791	0.868781	-0.487800	0.6288
	0.800	-0.279531	0.731594	-0.382085	0.7048
	0.900	0.482433	0.848823	0.568355	0.5735
LNINTB	0.100	0.305059	0.191156	1.595866	0.1198
	0.200	0.383209	0.214060	1.790198	0.0823
	0.300	0.387648	0.162611	2.383895	0.0229
	0.400	0.382582	0.170625	2.242241	0.0316
	0.500	0.203533	0.368682	0.552056	0.5845
	0.600	0.049983	0.213983	0.233582	0.8167
	0.700	-0.064487	0.234180	-0.275372	0.7847
	0.800	-0.022601	0.197894	-0.114206	0.9097
	0.900	0.199724	0.254563	0.784576	0.4381
LNINTLNINTB	0.100	-0.080988	0.053908	-1.502358	0.1422
	0.200	-0.094774	0.059362	-1.596546	0.1196
	0.300	-0.096109	0.046958	-2.046715	0.0485
	0.400	-0.096570	0.050129	-1.926418	0.0624
	0.500	-0.039880	0.104234	-0.382604	0.7044
	0.600	0.007706	0.060336	0.127713	0.8991
	0.700	0.032123	0.064117	0.501001	0.6196
	0.800	0.019812	0.053961	0.367157	0.7158
	0.900	-0.041746	0.065519	-0.637160	0.5283

LNINTPAY	0.100	0.542857	0.195734	2.773439	0.0089
	0.200	0.375075	0.340252	1.102344	0.2781
	0.300	0.280086	0.232270	1.205863	0.2362
	0.400	0.254808	0.233949	1.089158	0.2837
	0.500	0.137250	0.171758	0.799094	0.4298
	0.600	0.066559	0.177366	0.375266	0.7098
	0.700	0.037203	0.168646	0.220601	0.8267
	0.800	0.052410	0.138107	0.379486	0.7067
	0.900	0.069739	0.103140	0.676159	0.5035
LNMMACC	0.100	0.172983	0.273097	0.633411	0.5307
	0.200	0.213309	0.334639	0.637430	0.5281
	0.300	0.178128	0.188965	0.942651	0.3525
	0.400	0.138727	0.161880	0.856971	0.3975
	0.500	0.156574	0.137139	1.141721	0.2615
	0.600	0.207922	0.172520	1.205204	0.2364
	0.700	-0.006964	0.267878	-0.025997	0.9794
	0.800	0.003503	0.224732	0.015590	0.9877
	0.900	0.102799	0.148730	0.691179	0.4941
LNMMAGN	0.100	0.058911	0.036053	1.634001	0.1115
	0.200	0.042419	0.034495	1.229716	0.2272
	0.300	0.040847	0.023110	1.767509	0.0861
	0.400	0.044394	0.022649	1.960045	0.0582
	0.500	0.038281	0.019725	1.940798	0.0606
	0.600	0.029527	0.018676	1.580965	0.1231
	0.700	0.062460	0.032711	1.909429	0.0647
	0.800	0.060936	0.031113	1.958540	0.0584
	0.900	0.026244	0.021517	1.219705	0.2310
LNMOB	0.100	0.894251	0.361130	2.476254	0.0184
	0.200	0.900519	0.429583	2.096265	0.0436
	0.300	0.660254	0.259450	2.544819	0.0156
	0.400	0.718789	0.290104	2.477691	0.0184
	0.500	1.050722	0.364504	2.882608	0.0068
	0.600	0.941381	0.463009	2.033182	0.0499
	0.700	0.851423	0.405049	2.102023	0.0430
	0.800	0.814535	0.340738	2.390505	0.0225
	0.900	0.787876	0.341312	2.308371	0.0272
LNMOBPAY	0.100	2.075094	3.274048	0.633801	0.5305
	0.200	1.297801	3.728956	0.348033	0.7300
	0.300	1.049561	3.330009	0.315183	0.7545
	0.400	-0.255561	2.389120	-0.106969	0.9154
	0.500	0.021053	2.251235	0.009352	0.9926
	0.600	1.755737	5.561562	0.315691	0.7542
	0.700	4.764075	7.020954	0.678551	0.5020
	0.800	4.271961	5.841054	0.731368	0.4696
	0.900	-1.446085	2.865243	-0.504699	0.6170

LNMOBREC	0.100	-8.537342	9.093674	-0.938822	0.3544
	0.200	-6.107158	10.31136	-0.592275	0.5576
	0.300	-3.396345	8.745705	-0.388344	0.7002
	0.400	1.809911	4.187361	0.432232	0.6683
	0.500	3.105290	4.488992	0.691757	0.4938
	0.600	1.712712	3.532713	0.484815	0.6309
	0.700	2.189069	3.330054	0.657367	0.5154
	0.800	2.098436	2.759449	0.760455	0.4522
	0.900	9.280191	5.994118	1.548216	0.1308
C	0.100	-6.908834	2.978414	-2.319636	0.0265
	0.200	-8.259328	2.619706	-3.152768	0.0034
	0.300	-7.854435	2.248340	-3.493437	0.0013
	0.400	-8.467233	2.365485	-3.579491	0.0011
	0.500	-7.862577	4.676358	-1.681346	0.1019
	0.600	-5.282405	2.250963	-2.346731	0.0249
	0.700	-4.390882	2.460818	-1.784318	0.0833
	0.800	-4.590378	2.114390	-2.171017	0.0370
	0.900	-6.562745	2.210720	-2.968601	0.0054

Appendix 4.7

Quantile Process Estimates



(APPENDIX I)

FACULTY OF BUSINESS AND FINANCE

UNIVERSITI TUNKU ABDUL RAHMAN

Date: 31 August 2022

SUBMISSION OF FINAL YEAR PROJECT

It is hereby certified that Goh Yi Xuan, Mah Sze Hwei and Yunne Chay Yinn Yinn (ID No: 19ABB00341; 19ABB00573; 19ABB00460) have completed this final year project entitled "Mobile Money Agent Network: Key Towards Digital Financial Inclusion" under the supervision of Prof. Dr. Eng Yoke Kee from the Department of Economics, Faculty of Business and Finance.

We understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

YiXuan SzeHwei Yunne

(*Goh Yi Xuan, Mah Sze Hwei & Yunne Chay Yinn Yinn*)

GROUP NO: 22FN19J

FN

(APPENDIX F)

Universiti Tunku Abdul Rahman			
Form Title : Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1of 1

FACULTY OF BUSINESS AND FINANCE

Full Name(s) of Candidate(s)	Goh Yi Xuan; Mah Sze Hwei; Yunne Chay Yinn Yinn
ID Number(s)	19ABB00341; 19ABB00573; 19ABB00460
Programme / Course	Bachelor of Finance (Honours)
Title of Final Year Project	Mobile Money Agent Network: Key Towards Digital Financial Inclusion

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
Overall similarity index: 8 % **Similarity by source** Internet Sources: 6 % Publications: 3 % Student Papers: 3 %	nil
Number of individual sources listed of more than or equal to 3% similarity: 0	

Parameters of originality required, and limits approved by UTAR are as follows: (i) Overall similarity index is 20% and below, and
(ii) Matching of individual sources listed must be less than 3% each, and
(iii) Matching texts in continuous block must not exceed 8 words

Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.

Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Name : Eng Yoke Kee

Date : 30.8.22

Mobile Money Agent Network: Key Towards Digital Financial Inclusion

ORIGINALITY REPORT

8%	6%	3%	3%
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