Does digital financial inclusion affect inequality?

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SIREGAR, Yani Parasti

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Committee in charge:

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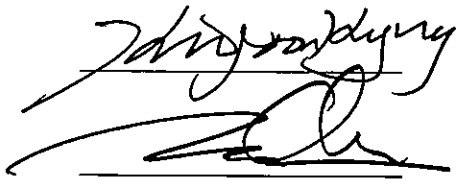
Professor Cho, Man



Approval as of August, 2020

Abstract

Digitalization has influenced the development of financial services. The rise of financial technology or FinTech allows more access for wider group of people to benefit financially. More access to financial services also increases the financial inclusion. This paper attempts to study on how digital financial inclusion have an effect to income inequality. In this research, we used panel data analysis with fixed-effect model to estimate the effect. Sample data utilized 7 high-income countries, 23 middle-income countries, and 1 low-income countries from 2011-2018. The empirical study provides results that every 1 percent increase in mobile cellular subscriptions decreases the Gini coefficient by 4.64 percentage points. Meanwhile, every 1 percent increase of digital financial inclusion tends to increase Gini coefficient by 0.51 percentage points more in middle and low-income countries. While every 1 percent increase of number of mobile and internet banking transactions in high-income countries decreases the Gini coefficient by 0.37 percentage points. The study concluded that, as suggested by Kuznets curve, digital financial inclusion increases the income inequality in the country which is in the early stage of development, and decreases the income inequality of the country which is in the mature stage of development.

Keywords : digital financial inclusion, FinTech, inequality, Kuznets curve

국문초록

디지털화는 금융 서비스 발전에 영향을 미쳤다. 금융 기술이나 핀테크의 증가는 더 많은 사람들이 재정적으로 혜택을 받을 수 있도록 더 많은 접근을 허용한다. 금융서비스에 대한 접근성이 높아지면 금융포함도 늘어난다. 본 논문은 디지털 금융이 소득 불평등에 어떤 영향을 미치는지 연구하였다. 본 연구에서는 고정 효과 모델을 사용한 패널 데이터 분석을 사용하여 효과를 추정했다. 표본 데이터는 2011~2018 년 고소득 7 개국, 중간소득 23 개국, 저소득 1 개국을 활용했다. 본 연구는 실증적 방법을 통해, 휴대 전화 가입이 1% 증가할 때마다 지니계수가 4.64% 씩 감소한다는 결과를 발견하였다. 한편 디지털 금융포용률이 1% 증가할 때 마다 중하위권 국가에서는 지니계수가 0.51%씩 증가하는 경향을 발견하였다. 고소득국가의 모바일과 인터넷뱅킹 거래 건수가 1% 증가할 때마다 지니계수가 0.37%씩 감소한다. 본 연구는 쿠즈네츠 곡선에서 제시된 바와 같이 디지털 금융 포함은 개발 초기 단계인 국가의 소득 불평등을 증가시키고, 개발 성숙 단계인 국가의 소득 불평등을 감소시키는 것을 확인하였다.

키워드 : 디지털 금융포함, 핀테크, 불평등, 쿠즈넷 곡선

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Above all, my journey in South Korea would have been impossible without God's grace and protection. Because I am weak, and You are the strength.

"My sacrifice, O God, is a broken spirit; a broken and contrite heart

you, God, will not despise." – Psalms 51:17

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Chapter 1. Introduction

Digitalization has inevitably transformed financial systems in developed and emerging worlds. Barriers in conventional financial systems keep decreasing and thus, there is an increase in financial inclusion. Financial inclusion is also acknowledged as one of the enablers to advance the goals in 2030 Sustainable Development Goals (Klapper et al., 2016; UNCDF, n.d.). Klapper et al. (2016) also highlight that digital financial inclusion can help business sector and governments to have more opportunities in expanding financial inclusion, especially in middle-income countries. Therefore, digital financial inclusion has become an important discussion in the domestic and international level.

There are several studies on how development in financial services allows more financial inclusion which leads to inequality. Greenwood & Jovanovic (1990) found that economic growth and financial structure are highly linked; where growth has the means to develop the structure of financial system and in turn the structure enables more growth because of more efficiency. However, at the early stage of development, financial structure is more intensive and thus growth becomes rapid. This will widen income inequality. Yet, at the mature stage where the financial structure has fully developed, there will be stable income distribution among people. Dabla-Norris et al. (2015) also conducted a study on financial inclusion and its impact on inequality. They mentioned that there is an accelerating financial deepening in emerging and low-income countries, however, its development does not yet significantly correspond with financial inclusion. This is because the use of financial services such as credit is still concentrated among large firms. Furthermore, they also found that fewer fractions in financial services such as efficient cost of monitoring and credit participation may lead to a decrease in income inequality, especially if low participation cost can attract relatively less-

talented entrepreneurs. This is also supported by their findings which stated that the high fixed participation cost in Malaysia is a significant obstacle for financial inclusion. On the other hand, there are findings which mention that conventional financial services have involved quite a high participation cost. Philippon et al. (2014) find there is an inefficiency in the U.S. financial intermediation, which remains around 2% even after the global financial crisis. This argument is also in congruence with a study by Demirguc-Kunt & Klapper (2012) which found that the most-mentioned reason why people have no account at formal institutions is that people have no money to put in the account (around 30 percent), followed by the high cost of having an account, having a family member with an account, and long distance to the formal institution

Therefore, there is a paradigm shift to the idea that digitalization in financial access can offer more efficiency and lower-cost of financial services (Menat, 2016). The G20 also acknowledges that digitalization in financial inclusion is one of the important pillars to ensure stable economic growth and reduce inequality mainly in the emerging world and least developed countries (GPFI, 2016b). Furthermore, a study also finds that digital finance promotes financial inclusion. The study argues that providing financial services through mobile phones can increase access to finance (World Bank, 2016). An important study on digitalization in financial services also indicates that digital finance could advance GDP growth in the emerging world by $3.7 trillion in 2025 and benefit individuals, businesses, and governments. This impact may happen because of increased time savings for individuals, increased investment in capital, etc. (Manyika et al., 2016). Nevertheless, to the best of our knowledge, there is still little research on the effect of digitalization of financial inclusion on inequality. There are only a few findings on how financial inclusion directly impacts inequality at the country level (Demirguc-kunt et al., 2017; Klapper et al., 2016). Thus, this paper will add to our

understanding of digital financial inclusion. Specifically, we aim to shed light on the effect of digital financial inclusion on inequality.

The following research questions will guide the research paper: First, is there any effect of digital financial inclusion on inequality? Then, is there any effect of digital financial inclusion on inequality in middle and low-income countries? Lastly, is there any effect of digital financial inclusion on inequality in high-income countries?

This paper is divided into five chapters, where the remainder of this paper is organized as follows: chapter two presents the literature review, chapter three outlines the methodology, chapter four provides the presentation and discussion of empirical results, and chapter five presents the conclusion as well as policy recommendations.

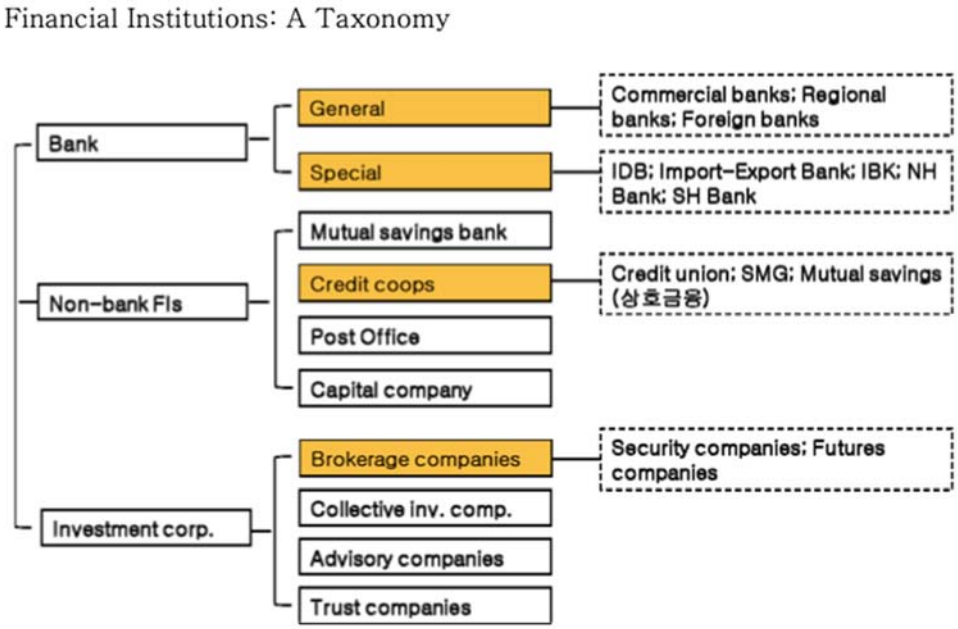
Chapter 2. Literature review

The growing number of digital technologies in financial inclusion has been spurred by many factors. These are the sections of the chapter: 2.1 Understanding financial inclusion, 2.2 International commitments to financial inclusion, 2.3 The progress of financial inclusion, 2.4 The digitalization in financial development, 2.5 International commitments to digital financial inclusion, 2.6 Inequality, and 2.7 Effect of digital financial inclusion on inequality.

2.1 Understanding financial inclusion

Before explaining financial inclusion itself, let us review the taxonomy of financial institutions to understand how financial services are usually provided.

Figure 2. 1 Financial institutions: A Taxonomy, Fintech, and Financial Regulations Lecture Note, Cho Man, 2020



From the taxonomies (Figure 2.1) above, we may understand the different kinds of financial institutions and their divisions. One of the non-bank financial institutions is credit coops or cooperative financial institutions (CFIs). Cuevas & Fischer (2006) claimed that CFIs are one of the financial institutions that have been acknowledged by the existing literature as institutions that serve the financial needs of poor populations. CFIs are also able to reach out

to the poor segment without having to compromise their sustainability. CFIs consist of the various member-owned financial intermediaries, including credit unions, cooperative banks, saving and credit cooperatives, and other different terms. Furthermore, CFIs achieve the intermediation process through resource allocation, where they allocate the input procurement such as services, materials, and capital goods from suppliers and labor. A CFI usually has a close relationship with its clients by assessing the community's demand. Besides, CFIs are usually owned and governed by the clients themselves (Cuevas & Fischer, 2006). The nature of CFIs allows people from lower economic income groups to access financial services and creates more financial inclusion.

Throughout this paper, I will use the terms "financial inclusion" and "digital financial inclusion". First of all, let us take a look at how financial inclusion is defined. World Bank (2014) defines financial inclusion as proportion of individuals and businesses that utilize financial services (p.1). World Bank (2018) further explains that financial inclusion enables individuals and business sectors to access affordable and helpful financial products. People can fulfill financial activities such as transactions, savings, payments, and credits. In the same vein, Global Partnership for Financial Inclusion (2014) states that financial inclusion is the condition where all adults at working-age can access financial products or services provided by formal institutions. With access to financial products, people are able to facilitate their daily necessities. When daily financial activities are fulfilled, people would be encouraged to prepare for financial emergencies by using insurances, or long-term financial planning through investments. This is believed to be able to increase the quality of people's lives (World Bank, 2018). Not only does it increase life quality, financial inclusion also has implications for poverty reduction and increases the prosperity of the people (World Bank, 2014). Furthermore, financial inclusion also promotes stronger domestic financial situation

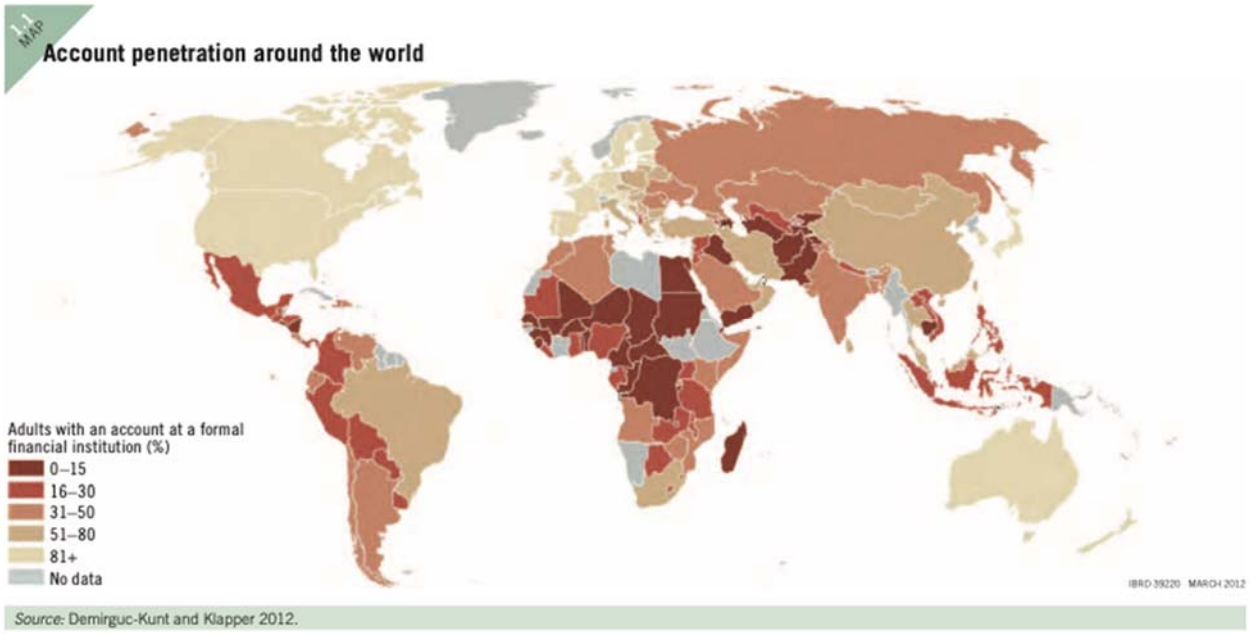
where it encourages people to engage in entrepreneurial activities and create job opportunities. Pertaining to its effect, financial inclusion is expected to decrease inequality and boost growth and development (GPFI, 2015). In this paper, we will use the definition by World Bank which emphasizes access to affordable and beneficial financial products. On the other hand, it is also essential to note that the access effect of financial inclusion is divided into two concepts, voluntary and involuntary exclusion (Kumar et al., 2007). Voluntary exclusion is explained as a situation where individuals are not aware of the availability of financial products and assume that financial services are not affordable. Meanwhile, involuntary exclusion occurs when those with credit-risk in their financial histories and individuals who have more risk in financial services are excluded by the institution.

2.2 International commitments to financial inclusion

One of the international forums which has been actively advancing the agenda of financial inclusion is the Group of 20 (G20) (World Bank, 2014; Ozili, 2018; Senou et al., 2019;). The G20 is an international economic forum that consists of countries from the developed and emerging worlds. The G20 claims that its member countries represent 80% of the world economy and two-thirds of the world population. The forum itself was started in 1999 in Washington D.C. as a response to the Asian financial crisis in 1998. After the financial crisis in 2008 occurred, the leaders agreed to conduct the G20 summit annually so as to anticipate any unforeseen crises or crucial issues (ISPI). Ignited by the global economic shock, the G20 became aware that there is global interconnectedness, where events in one place can affect conditions in other places. Therefore, the G20 believes that to achieve inclusive and sustainable growth, high, middle, and low-income countries should be able to enhance their roles in shaping conducive and stable growth. The forum contributed to the mitigation of the economic shock through a financial regulatory framework. For instance, the G20 established

the Financial Stability Board (FSB) in 2009 to ensure the assessment of weaknesses in the financial system and coordinate the effectiveness of other financial institutions such as the Basel Committee for Banking Supervision (BCBS) (Yi, 2008). The change in the regulatory framework was mainly conducted to achieve a more comprehensive harmonization of banking regulations. A coordinated local and national regulation is expected to reduce market distortions and enhance financial globalization. Recalling the G20's commitment to financial issues, we will use its documents and outputs as one of the bases for discussions in this paper. In 2009, the G20 acknowledged that financial inclusion is one of the most important pillars to ensure stable economic growth mainly in emerging and least developed countries. Financial inclusion is believed to be able to complement the regulatory effort in improving financial stability (Busch, 2017). The G20 Summit 2010 in Seoul became the milestone for the G20's commitment to financial inclusion, where the Financial Inclusion Action Plan (G20 FIAP) was endorsed by all the members (G20, 2011). The G20 FIAP highlights the fact that almost half of the world population – or 2.5 billion people – have no account at a formal institution. Moreover, World Bank (2018) also claims that having an account to perform a transaction is the key to a more inclusive financial environment, as it opens up to other financial services. Meanwhile, Demirguc-Kunt & Klapper (2012) mention in their findings that there is a notable disparity between developed and emerging countries in terms of account ownership. While in developed countries there is 91 percent account penetration, there is only 41 percent in emerging countries (refer to figure 2.2).

Figure 2. 2, Account penetration rate around the world, Demirguc-Kunt and Klapper, 2012



Furthermore, World Bank reports that around 39% of the unbanked population around the world claim that the reasons they have no financial accounts are, but not limited to, lack of trust toward formal institutions, distance to the banks, high cost, and the complex required documentation (2014, p.3). The most-mentioned reason why people have no account at a formal institution is that people have no money to put in the account (around 30 percent), followed by the high cost of having an account, having a family member with an account, and far distance to the formal institution (Demirguc-Kunt & Klapper, 2012, p.19). Hieminga et al. (2016) also mention that the credit gap for medium and small enterprises in developing countries still about $2.3 trillion. This gap seems to exist because the small businesses do not have access to loans when they are in need (unserved) or they have loans but still attempt to find access in financing a business constraint (underserved).

Seeking to reduce the financial inclusion gap among countries, the G20 has formulated principles for financial inclusion: leadership, diversity, innovation, consumer protection, empowerment, knowledge, cooperation, proportionality, and regulatory framework (GPFI,

2011, p.2). To the extent of the efforts, the G20 also engages with other international organizations such as World Bank, OECD, and IMF particularly with updated data and report provision. Both G20 and non-G20 countries are encouraged to participate in fostering these principles to improve financial inclusion in each respective country.

2.3 The progress of financial inclusion

Dollar & Kraay (2002) managed to find that development of financial services has a positive impact on economic growth, where financial development is associated with the attainment of higher income in a poor society. Besides, they also underlined the crucial role of advancing the law and rules in implementing financial inclusion. Similarly, Gine (2007) attempted to observe the relationship between access to financial services and poverty as well as growth. The findings explained that every percentage increase in the share of private credit reduces the annual growth rate of the percentage of the poor population by 0.0095. Besides, Beck et al. (2007) also conducted cross-country research which revealed that an increase of access to financial services has a positive impact on poverty reduction and growth. Furthermore, since 2011, more than 1.2 billion people around the world have opened an account at a financial institution. Data has also shown that there was an increase in account ownership between 2011 and 2014. Despite no major change in developed countries, low and middle-income countries have, in fact, performed well with an increase of 13 percent in account ownership in 2014 (World Bank, 2018). Meanwhile, there is also a broader availability of other financial services such as microfinance (loan), credit, and insurance which are able to increase the financial inclusion scope (Demirguc-kunt et al., 2017).

2.4 The digitalization in financial development

While the G20 is consistently responding to global issues, it acknowledges the fact that innovation in technology cannot be separated from the financial aspect. In fact, OECD (2018)

asserts that innovation in financial services that is driven by technology is not a new story. The ongoing progress of financial service innovation is the evolution of the financial market reform implemented in the 1980s and 1990s. Financial reform is a process of reducing or removing distortions in financial market caused mainly by the intervention of government due to interest rates setting and allocation of credit. In effect, financial reform enables the government to gradually dismantle regulations that impede economic activities. The strategies to implement financial reform policies can differ depending on macroeconomic and financial structure conditions in each country. The idea behind the implementation of financial reform policies is that the government should relax regulations thereby enabling markets to conduct their operations more freely. In the 1950s and 1960s, governments of various countries, especially in the developing world, applied policies that created distortions in the financial markets. The governments enforced ceiling rates for loans and nominal deposit. Due to low ceiling rates, there were more debt financing for unproductive purposes. In addition, the central banks also provided subsidized interest rates for commercial banks with the purpose of encouraging loans in prioritized sectors. As a result, in the 1960s and 1970s, the growth of those countries weakened and inflation exploded. The low cost of borrowing capital also promoted inefficiency in investment. Alternative policies were offered to remove the distortions. For instance, there was a removal of barriers when new institutions entered the financial system, the domestic financial system opened to a more competitive market, and financial market liberalization (Bascom, 1994, p.1-2). When the financial reform is done, there is no longer any government allowing private companies who have access to enter the market. To ensure the stability of financial reform, the government should understand the behavior of the market through market expectations. In analyzing market expectations, the government should underline the importance of rational expectations.

Basically, the concept of rational expectations means the expectation of rational investors is consistent with the economic structure and any future events that influence the structure. This is where technology plays an important role.

In the 1970s and 1980s, developed countries experienced financial reform and development in technology and communication. The wider use of technology such as telecommunication devices and computers allowed markets to have larger amounts of transactions to deliver development more quickly and produce more innovative financial products. Digital technology has blurred the barriers in the financial sector and enabled the integration of international financial institutions. It also encouraged governments to have more effective fiscal and monetary policies. Thus, digital technology has assisted countries to have more effective market expectations (Bascom, 1994, p.95-96).

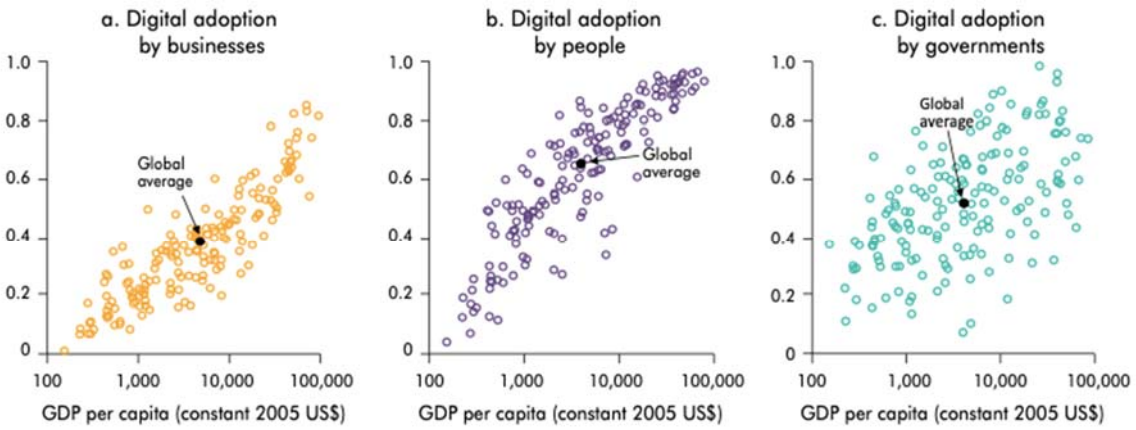
However, it is important to note that the evolution of technology in financial development may be varied in each country. This is due to the variation in time-series and cross-sectional differences in financial development (Rajan & Zingales, 2001). To explain the situation, Rajan and Zingales (2001) propose the **"interest group"** theory of financial development. They argue that although financial development is a precondition for greater access to external financing by the poor, it does not necessarily improve equal distribution. This is because, even in a financially mature economy with sophisticated financial infrastructure, those in power (by which they mean wealthy individuals and large firms) exercise political influence to oppose deregulation that relaxes credit constraints on households and SMEs who might then compete for access to bank financing. This opposition perpetuates the systematic discrimination against and credit rationing of low-income households and SMEs, causing a deterioration in income distribution. The political influence or interest of certain groups may affect the introduction of technology in financial development.

Nonetheless, because of the financial reform and market openness in the 1970s, interventions from private and foreign competitors were inevitable in domestic financial systems. Thus, financial development had another take-off.

Furthermore, a report by the Group of Ten (2001) suggested the idea that technology holds an important role in the productive utilization of information and the facilitation of the development of financial products to be delivered to the targeted customers. This suggestion was also supported by the increasing acceptance of electronic devices usage in financial services which enabled institutions to reach new customers without physical presence.

Similarly, World Bank (2016) shows that there is a growing number of digital technologies such as mobile phones, internet, and other devices used to gather information. World internet users tripled from 1 billion in 2005 to 3.2 billion at the end of 2015, while mobile phone penetration in developed countries has reached 98% and 80% in emerging countries (para.2). There has also been a consistent increase in technology usage in terms of mobile phone subscriptions; at least 1 to 10 out of 100 people subscribed from 2005 to 2015 (World Bank, 2018b). The numbers have been evidence of how technology is involved in people's lives. Generally, digital penetration in business, individual lives, or government is followed by an increase in GDP per capita as shown in these figures. All the figures below show a positive relation between diffusion of digital adoption and GDP per capita.

Figure 2. 3, The diffusion of digital adoption, World Bank, 2016a

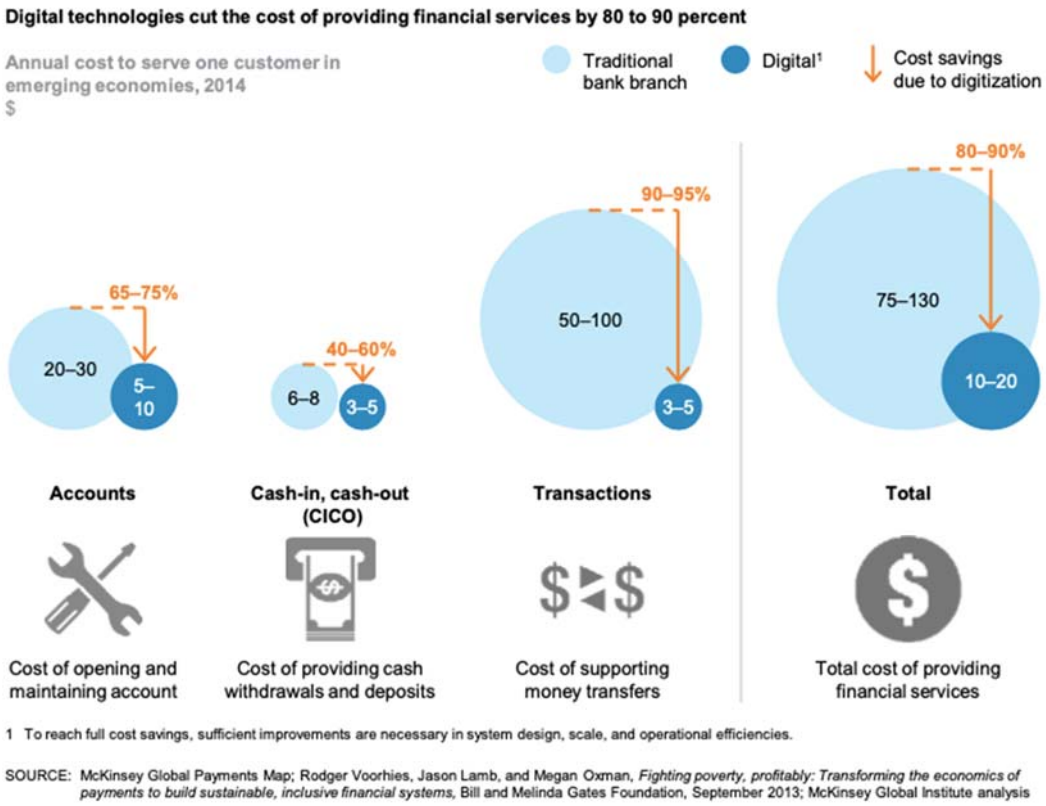


Source: WDR 2016 team. Data at http://bit.do/WDR2016-Fig0_1.

Indeed, the Fourth Industrial Revolution has a significant influence on the development of financial services. The variety in the financial industry is expected to grow as different FinTech companies are also growing and specializing in their financial services. FinTech (or Financial Technology) refers to innovations in financial services that are enabled by technology and can produce new business models, applications, and processes or products that have a material effect on financial service provision (FSB, 2017). WEF (2015) also identifies the functions of financial services that experience disruption from Fintech: payments, market provisioning, investment management, insurance, deposit and lending, also capital raising.

FSB (2017) also identifies the drivers of innovation in financial services. From the demand side, there is a shift in consumer preferences where the customer expects a more convenient, quick, less costly, and user-friendly service. Digital technology claims to be able to cut the cost of financial service provision by 80 to 90 percent. Figure 2.4 below depicts how digitalization in financial services reduces the usual cost to serve one customer in emerging countries.

Figure 2.4, Cost reduction in financial service provision, McKinsey Global Payments Map, 2013



Meanwhile, the supply side faces constantly evolving technology based on the internet, big data, mobile technology, and computing power. Besides technology, there is also changing financial regulations and other changes related to the business incentive of incumbents and new players.

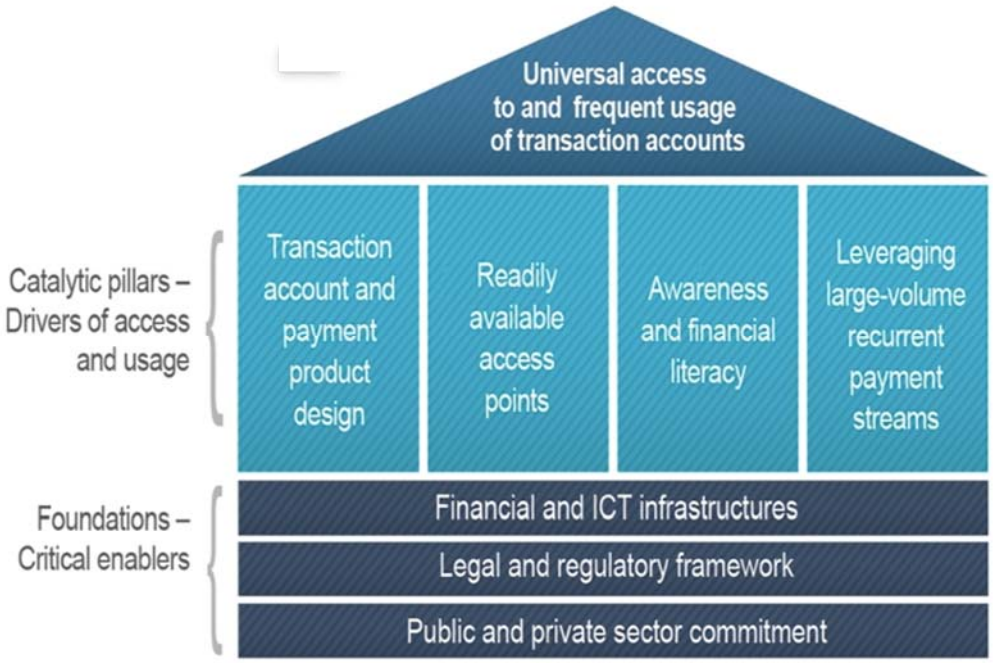
A recent report from CCAF et al. (2019) also found that FinTech start-up is rapidly advancing in ASEAN countries, where there are more than 600 FinTech start-ups in the region with $485 million of investment in 2018. Several factors influence the demand for FinTech start-ups development in ASEAN: increasing penetration rate of mobile phone and smartphone, rising internet penetration rate, a growing number of literate and young-urban population, high number of consumers and small & medium enterprises which are underserved and not served by existing financial services, and the continuous strong potential for increases in economic values such GDP per capita.

2.5 International commitments to digital financial inclusion

In 2016, G20 recognized digitalization as one of the approaches to improve financial inclusion. The rising development of Fintech became one of the supporting factors for the G20 to promote a better sphere for digital financial inclusion. The disruption in the banking system has caused people to lose trust in conventional institutions and shifted to Fintech companies who offer trust, transparency, and technology (Menat, 2016). Technology also creates the possibility for financial institutions to offer services at an adequate and affordable price for individuals and small businesses. For instance, the presence of peer-to-peer lending in a mobile application encourages people to receive loans directly from creditors, rather than borrow indirectly from banks or other institutions that would bear more costs (Kern, 2019). China, as the G20 2016 Presidency and also one of the leading countries in FinTech, is known for its highly advanced FinTech companies such as Alibaba, Ali Ant Finance, and Baidu. With the vision of catalyzing new drivers of growth, China believes that the G20 should strengthen its growth agenda through digitalization (Inan, 2016). Therefore, to complement the existing G20 FIAP, the members adopted the G20 High Level Principles for Digital Financial Inclusion. In the scope of G20, digital financial inclusion is understood as using digital tools in providing formal financial services delivered to customers at affordable costs while providers can also use the services sustainably (GPFI et al., 2014, p.3). Through digitalization, G20 attempts to address the barrier issue in financial services such as high cost and distance to financial institutions. The principles underline how technology can be utilized to provide appropriate financial products for the financially excluded and underserved groups, which include poor people, teenagers, women, or people who live in rural areas (G20, 2016). Moreover, the principles (as depicted in Figure 2.3) have also become a foundation for the advancement of

the World Bank's initiative for mainstreaming financial inclusion, Universal Financial Access by 2020 (World Bank, 2018c).

Figure 2. 5, Eight principles of G20 High-Level Principles for Digital Financial Inclusion, World Bank, 2018



2.6 Inequality

We will now discuss the concept of inequality. Inequality has been a concept that ignites confusion for many people as it provides different perceptions for each individual. Therefore, it is important to identify how the concept of inequality has been defined by experts. First, let us see from the perspective of "Inequality of Opportunity". Sen (2014) argued that the concept of being equal means that paying more attention to the individual's well-being and how the individual is able to function (or known as the equal capability for functioning). Being equal can also be understood as having the same opportunity to live and free to pursue one's life choices. Therefore, what should be emphasized is equal opportunities, not the means of living such as income. However, this perception of being equal is in contrast with the perspective of "Inequality of Outcomes". Being equal in outcomes takes place when individuals have the same amount of income or the same economic condition (UN-DESA,

2015). It is also argued that income inequality is an indication that there is an imbalance of goods and services distribution (de Camargo Jr, 2008). Thus, income inequality has a role to determine the variations in well-being. Therefore, it is indispensable to moderate equal income starting points as it contributes to a more equal opportunity (p.16). Since income inequality is mentioned as a vital key to determine access to well-being such as health, nutrition, and education, throughout this paper we use the concept of "Inequality of Outcomes" as the basis to define inequality.

2.7 Effect of digital financial inclusion on inequality

What is the effect of digital financial inclusion?

Several studies have observed the effect of financial inclusion on inequality. Before going into further discussion, we may need to understand that the effect of digital financial inclusion on inequality can be different depending on the financial development maturity of a country. One proposition is that the linkage between financial deepening and income distribution is non-linear because it resembles the Kuznets inverted U-shaped relationship between economic growth and income distribution (Greenwood & Jovanovic, 1990). The non-linear hypothesis is based on the observation that during the early stages of financial development, it is costly for low-income households and SMEs to access financial intermediaries for financing, largely because they cannot provide tangible collateral, a credible credit history, or the political connections that banks demand to approve lending. Many of these potential borrowers who are denied access to bank financing are unable to undertake indivisible investment beyond their initial wealth, thereby forgoing profitable investment opportunities that would improve their earning capacities. The limited access then tends to intensify income inequality, and more so if financial industries are characterized by an oligopolistic market structure captured by the wealthy. As the financial sector grows and acquires more

efficient infrastructure, financial institutions are able to lower transaction costs and improve credit and market risk management. This enables them to loosen the credit constraint on low-income small borrowers. Financial growth allows banks to increase their capacity to accommodate the credit needs of these newcomers to the financial sector. This change in the bank lending structure which favors new entrants relatively more than the incumbents lessens and then gradually stabilizes income inequality.

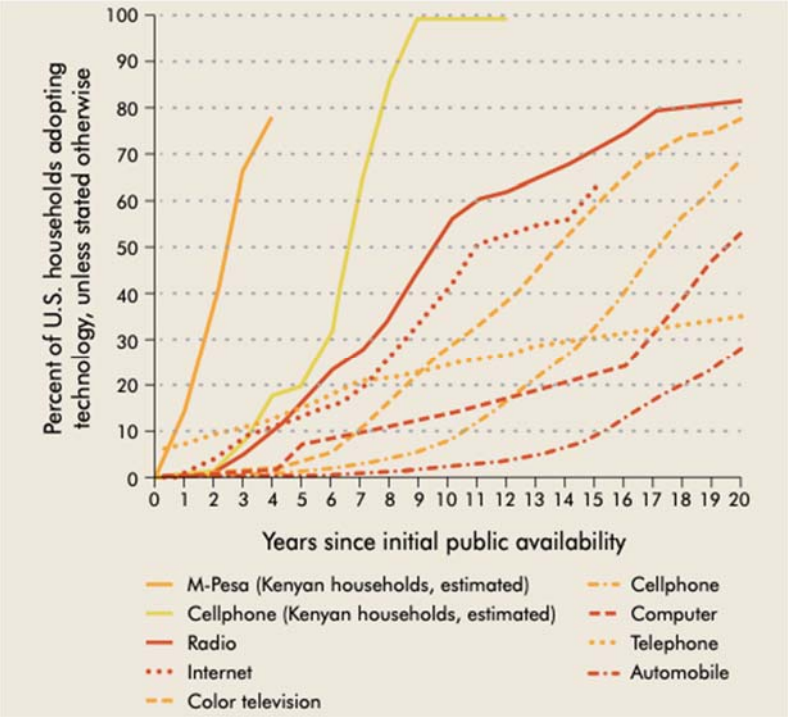
In the same vein, Dabla-Norris et al. (2015b) found that in low-income countries, as financial inclusion rises, income inequality first increases then decreases. This occurs due to the decreasing credit participation cost from a very high value, which encourages only a small number of business groups to conduct businesses or other economic activities. However, as the participation cost decreases, the business group can invest more capital for further production. Further production can drive more opportunities for other people who initially could get access to credit in the early stage of development.

With regard to other studies, findings suggest that access to financial products is able to enhance long-term economic growth (Sahay et al., 2015; Sahay & Cihak, 2018). Honohan (2008) also found that access to finance has a strong correlation with GDP per capita income. Furthermore, several findings also suggest that financial inclusion contributes to the reduction in income inequality (Beck et al., 2007; Gine, 2007; Kim, 2016). Kim (2016) emphasized that in low-income countries, a reduction in income inequality through financial inclusion is likely to emerge if access to financial services is improved.

Since FinTech started contributing to financial inclusion, many studies have been conducted to observe the effect of digital financial inclusion. It is has been found that digital finance advances financial inclusion in the sense that financial service provision through mobile phones can increase access to finance (World Bank, 2016). Digital finance is found to

contribute to overcoming the barriers in access to financial services mainly in a suitable environment. According to World Bank (2016), M-Pesa in Kenya is a notable proof that digital services help more people in their financial needs. In fact, M-Pesa reached out to 80% of Kenyan households in four years. In figure 2.6 below, we can see how M-Pesa rapidly penetrated the households compared to other digital technology.

Figure 2. 6, Kenya's M-Pesa reach out the households within four years, World Bank, 2016



Studies also found that digital financial inclusion contributes to less discrimination in lending, thereby allowing more people to have access to loans (Bartlett et al., 2019; Philippon, 2019). For instance, Bartlett et al. (2019) conducted research on whether algorithm decision-making permits or hinders discrimination. They found that compared to overall lenders, FinTech lenders discriminate against the borrowers approximately one-third less. However, we still need to note that Latin and African-American borrowers still pay higher interest rates for their mortgages. Thus, it is still insufficient to remove the discrimination in terms of loan pricing. Moreover, Philippon (2019) states that the use of big data in the credit market is likely to

increase participation from less wealthy households and reduce non-statistical discrimination. However, inequality is still not lowered across groups.

The findings of Gathoni (2018) suggested that the use of integrated mobile banking increases household consumption in Kenya. However, the study found that integrated mobile banking has a higher impact on the income of the top 20th household income quantile. Therefore, he concluded that digital financial inclusion significantly affects the top half of households compared to the top rich and bottom poor households (Gathoni, 2018).

Looking at the above-mentioned findings, to some extent, the wider use of digital technology corresponds to a reduction in income inequality. However, global inequality still does not show any significant change. Between the period of 2003 and 2008, the level of inequality (measured by Gini index) was very high, about 70.5 percent and 70.2 percent respectively (Lakner & Milanovic, 2015, p.24). While most of the studies observe this relationship at the single-country level, through this paper we will attempt to add our understanding on the analysis of the effect of digital financial inclusion on inequality at the cross-country level.

Chapter 3. Methodology

This chapter provides the research methodology of this thesis. These are the sections: 3.1 Research design, 3.2 Model specification, 3.3 Explanation of the variables, 3.4 Data analysis, and 3.5 The ethical considerations.

3.1 Research design

In this paper, we use a quantitative research method and apply the panel fixed-effect model. According to Barro's findings (as cited in Banerjee and Duflo, 2003), removing the fixed-effect worsens the measurement error problem. Especially for variables like the Gini coefficient, which varies across countries, it is more important that variation occurs over time. Therefore, in this paper, a time fixed-effects specification is applied.

We use quantitative research methods to find out the causal relationship between the independent variables and the dependent variable and expect to answer the above-mentioned research questions. More specifically, we use the quantitative framework to test the following hypotheses:

1. An overall increase in digital financial inclusion leads to a decrease in inequality (Bartlett et al., 2019; Philippon, 2019);
2. An increase in digital financial inclusion leads to an increase in inequality in emerging and low-income countries. The hypothesis also refers to the Kuznets curve (see Appendix a4), where the nature of countries in the early and middle stage of development have their infrastructure interoperability and customer readiness applied to a certain group of people (Kuznet, 1955; Greenwood & Jovanovic, 1990; Porteous, 2007);
3. An increase in digital financial inclusion leads to a decrease in inequality in high-income countries.

3.2 Model specification

The panel fixed-effect estimation model used to test the hypothesis is as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + Z'_{it}\beta_2 + \mu_t + \delta i\, T + u_{it}$$

Where:

Y represents the outcome variable in a specific *country i* in a specific year *t*.

β_1 represents coefficient for the independent variables.

X_{1it} represents independent variables.

β_2 represents the coefficient for the control variables.

Z'_{it} represents a vector time-variant individual country characteristics (control variables).

μ_t represents the unknown intercepts for time constant factor (t = 2011…n).

δi T represents the unit-specific time trend.

u_{it} represents the idiosyncratic error term.

The effect of digital financial inclusion on inequality

Model 1

Log Number of mobile banking and internet banking transactions

$$\mathrm{G}_{it=}\beta + \partial.\mathrm{mibt} + \gamma.\mathrm{gdppc} + \delta.\mathrm{gpc2} + \lambda.\mathrm{se} + \nu.\mathrm{tgdp} + \mathrm{i.year} + \mathrm{Iccyear} * + \epsilon$$

Log Mobile cellular subscriptions

$$\mathrm{G}_{it=}\beta + \partial.\mathrm{mcs} + \gamma.\mathrm{gdppc} + \delta.\mathrm{gpc2} + \lambda.\mathrm{se} + \nu.\mathrm{tgdp} + \mathrm{i.year} + \mathrm{Iccyear} * + \epsilon$$

Log Digital financial inclusion

$$\mathrm{G}_{it=}\beta + \partial.\mathrm{dfi} + \gamma.\mathrm{gdppc} + \delta.\mathrm{gpc2} + \lambda.\mathrm{se} + \nu.\mathrm{tgdp} + \mathrm{i.year} + \mathrm{Iccyear} * + \epsilon$$

Log Credit card user per 1000 persons

$$\mathrm{G}_{it=}\beta + \partial.\mathrm{cc} + \gamma.\mathrm{gdppc} + \delta.\mathrm{gpc2} + \lambda.\mathrm{se} + \nu.\mathrm{tgdp} + \mathrm{i.year} + \mathrm{Iccyear} * + \epsilon$$

Log Debit card user per 1000 persons

$$\mathrm{G}_{it=}\beta + \partial.\mathrm{dc} + \gamma.\mathrm{gdppc} + \delta.\mathrm{gpc2} + \lambda.\mathrm{se} + \nu.\mathrm{tgdp} + \mathrm{i.year} + \mathrm{Iccyear} * + \epsilon$$

Model 2

Log Number of mobile banking and internet banking transactions

$$G_{it=}\beta + \partial.\text{mibt} * \text{midlow} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Mobile cellular subscriptions

$$G_{it=}\beta + \partial.\text{mcs} * \text{midlow} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Digital financial inclusion

$$G_{it=}\beta + \partial.\text{dfi} * \text{midlow} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Credit card user per 1000 persons

$$G_{it=}\beta + \partial.\text{cc} * \text{midlow} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Debit card user per 1000 persons

$$G_{it=}\beta + \partial.\text{dc} * \text{midlow} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Model 3

Log Number of mobile banking and internet banking transactions

$$G_{it=}\beta + \partial.\text{mibt} * \text{high} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Mobile cellular subscriptions

$$G_{it=}\beta + \partial.\text{mcs} * \text{high} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Digital financial inclusion

$$G_{it=}\beta + \partial.\text{dfi} * \text{high} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Credit card user per 1000 persons

$$G_{it=}\beta + \partial.\text{cc} * \text{high} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Log Debit card user per 1000 persons

$$G_{it=}\beta + \partial.\text{dc} * \text{high} + \gamma.\text{gdppc} + \delta.\text{gpc2} + \lambda.\text{se} + \nu.\text{tgdp} + \text{i.year} + \text{Iccyear} * + \epsilon$$

Where:

G	represents the Gini coefficient
mibt	represents the number of mobile and internet banking transactions
mcs	represents the mobile cellular subscriptions
dfi	represents the digital financial inclusion
cc	represents the number of credit card per 1000 adults
dc	represents the number of debit card per 1000 persons
gdpcc	represents the GDP per capita income
gpc2	represents the GDP per capita income squared
se	represents the secondary education
tgdp	represents the trade to GDP
midlow	represents the middle and low-income country interaction term
high	represents the high-income country interaction term
i.year	represents the year fixed-effect
Iccyear*	represents the unit specific time trend

3.3 Explanation of the variables

The dependent variable used in this paper is the Gini coefficient which is widely used to measure the Inequality of Outcome. Gini coefficient measures the extent to which the income distribution contrasts with the perfect equal distribution. The coefficient shows the comparison of income distribution among populations despite its sizes. A higher Gini coefficient presents a more unequal distribution (UN, 2015). Gini coefficient has its limitation which is not easily separated into components. Also, a very distinct income distribution can provide the same coefficient. Despite its limitation, the Gini coefficient is still the most efficient proxy to use as an income inequality measure.

Furthermore, the independent variables used in this paper are based on the issue paper of Digital Financial Inclusion and the Implications for Customers, Regulators, Supervisors, and Standard-Setting Bodies from GPFI, a body which was established by the G20 (GPFI, 2014). According to the issue paper, there are four essential components of digital financial inclusion:

1. *Digital transactional platform*: by using a digital device, a customer is able to receive or make payments, as well as transfer and save money electronically. The device allows data reception and transmission to a bank or a non-bank;
2. *Device*: a customer can use electronic devices such as a mobile phone, or an instrument such as a payment card that connects to a digital device;
3. *Retail agents*: a retail agent is a person who has a digital device that is connected to communication infrastructure and able to receive or transmit transaction data. The agent also has a cash drawer that allows a customer to do cash-in (store cash into electronic value) and cash-out (transform the electronic value into cash). In several countries, retail agents could also be seen as ATMs and payment terminals;
4. *Additional financial services via the digital transactional platform*: a digital platform can also provide more financial products and services such as credit, savings, insurance, and securities.

Based on the above-mentioned four essential components, these are the independent variables used to estimate the effect of digital financial inclusion on inequality:

1. *Number of mobile and internet banking transactions (during the reference year, for commercial banks only)*: IMF through its Financial Access Survey data suggests that there is a 'muted growth' of the number of commercial banks and their branches internationally. This decline can be a result of the decreased number of commercial banks in North America and Europe. This indicates that there is a shift to different

methods of providing financial services, which is through mobile and internet banking. Furthermore, the data shows that there is a growing number of mobile and internet banking use in emerging economies and least-developed countries;

2. *Number of mobile cellular subscriptions*: mobile cellular subscription is one of the important factors in information and communication technologies (ICTs) that influences digital financial inclusion. Wamboye et al. (2016) argues that mobile cellular subscription affects growth in sub-Saharan African countries through the channel of financial inclusion;
3. *Digital financial inclusion*: we compute the composite index of number of mobile and internet banking transactions variables and number of mobile cellular subscriptions to get the main combined value of the digital financial inclusion variables. The combined values are counted as follows: number of mobile and internet banking transaction + mobile cellular subscriptions;
4. *Number of credit cards per 1000 adults*: owning a credit card indicates cashless transactions in the form of a payment card. A credit card is also one of the common forms of credits which are usually used by households for small amounts of expense (Federal Deposit Insurance Corporation, 2018);
5. *Number of debit cards per 1000 adults:* owning a debit card indicates cashless transactions in the form of a payment card. The possession of a debit card is also associated with the possession of basic accounts, which is focused on low-cost and common product payment services (BIS, 2016).

We also use other control variables that are related to the dependent variable to balance the effect in the equation. Therefore, several control variables included in the control groups are:

1. *GDP per capita*: GDP per capita is gross domestic product divided by midyear

population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (World Development Indicator, n.d.). The data is taken from World Bank World Development Indicator;

2. *GDP per capita square*: GDP per capita square is used to respond to the Kuznets U-curve in explaining diminishing marginal effect in inequality, that eventually will turn around as a country enters the mature stage of development;
3. *Secondary education*: Secondary education indicates the stage after primary education. In many countries, secondary education is compulsory. This variable indicates the number of people with secondary school education and data is taken from World Bank World Development Indicator;
4. *Trade to GDP*: Trade to GDP indicates the combined value of export and import by the gross domestic product (World Development Indicator, n.d.). This variable indicates the percentage of trade to GDP and data is taken from World Bank World Development Indicator.

3.4 Data analysis

In this paper, we use data that is retrieved from World Bank Global Financial Inclusion (Global Findex) Database, World Bank G20 Financial Inclusion Indicators, IMF Financial Access Survey, World Bank World Development Indicators, and UNU-WIDER World Income Inequality Database (WIID). The institutions who produce the data ensure high levels of data quality by implementing high standards and methodologies, and also collect data from sources and definitions that are globally accepted.

The data used in this study is longitudinal from 2011 to 2018 and consists of 31 countries (7 high-income countries, 23 emerging countries, and 1 least-developed country). The years and

countries included in the study were selected based on data availability. See Appendix a1, a2, and a3 for the data summary, correlations, and scatter plots. STATA statistical software is used to analyze the data. After converting the data into a STATA-compatible dataset, we then ordered it in panel form, where STATA indicated that it is a strongly-balanced panel data.

To estimate the relationship between the variables, we use the fixed-effect specification. In the fixed-effects specification, the unobserved variables are correlated with the observed variables. The fixed-effect specification partials out or control for the effect of time-invariant effects (Allison, 2012). In this paper, we will use the time fixed-effects specification in order to sustain the cross-sectional variations across countries.

3.5 Ethical considerations

This study conforms to the ethical standards of professional research. There was no unethical data manipulation while we compiled and managed the data. The references will serve as a source for further confirmation. The data used is available for public use and there was no modification during data processing.

Chapter 4. Presentation and discussion of empirical results

This chapter presents the empirical results of the data analysis according to the above-mentioned objectives of this study. This chapter also aims to test whether to reject or not reject the hypotheses stated in the research design.

4.1 Presentation of the results

The results provide statistical evidence about the effect of digital financial inclusion on inequality, using fixed-effect model. Model 1 contains the estimates for the effect of digital financial inclusion, Model 2 contains the estimates for the effect of digital financial inclusion when we apply the middle and low-income country interaction term, and Model 3 contains the estimates for the effect of digital financial inclusion when we apply the high-income country interaction term.

First of all, we can refer from the table 4.1 that all the results in Model 1 show negative signs. The number of mobile banking and internet banking transaction coefficient shows that a 1 percent increase in the number of mobile banking and internet banking transactions decreases the Gini coefficient by 0.77 percentage points. However, this estimate is not statistically significant. Meanwhile, the result of mobile cellular subscriptions shows that a 1 percent increase in the mobile cellular subscriptions decreases the Gini coefficient by 4.64 percentage points. This estimate is significant at 5 percent level of significance. We can also see that coefficient of digital financial inclusion variable shows that a 1 percent increase in the digital financial inclusion decreases the Gini coefficient by 0.18 percentage points. However, this result is not statistically significant. On the other hand, the results of the number of credit card and debit card per 1000 adults show significant results.

Secondly, we can refer from the table 4.1 that all results in Model 2 show positive signs. The coefficient of the number of mobile and internet banking transactions shows that a 1 percent

increase in the number of mobile and internet banking transactions in middle and low-income countries increases the Gini coefficient by 0.27 percentage points. However, this result is not statistically significant. Meanwhile, the coefficient of mobile cellular subscriptions shows that a 1 percent increase in the number of mobile cellular subscriptions in middle and low-income countries increases the Gini coefficient by 0.78 percentage points. The result is significant at 0.1 percent level of significance. We can also see a significant result from the coefficient of digital financial inclusion, where 1 percent increase in the digital financial inclusion in middle and low-income countries increases the Gini coefficient by 0.51 percentage points. The result is significant at 1 percent level of significance. The results of the number of credit card and debit card per 1000 adults also show significant results at 0.1 percent and 1 percent level of significance, respectively.

Lastly, we may refer to Model 3 in table 4.1 where it shows the results of the effect of digital financial inclusion when we apply high-income country interaction term. First of all, we can see that 1 percent increase in the number of mobile and internet banking transactions in high-income countries decreases the Gini coefficient by 0.37 percentage points. This result is significant at the 1 percent level of significance. The result also shows that 1 percent increase in the number of mobile cellular subscriptions in high-income countries decreases the Gini coefficient by 0.14 percentage points. However, the result is not significant. Meanwhile, the coefficient shows that a 1 percent increase in the digital financial inclusion in high-income countries increases the Gini coefficient by 0.15 percentage points. The result is also not significant.

Table 4. 1 The effect of digital financial inclusion to Gini coefficient

Gini Coefficient	**Model 1**	**Model 2**	**Model 3**
Log Number of mobile banking and internet banking transactions	-0.769 (0.757)	0.275 (0.133)	-0.336** (0.088)
Log Mobile cellular subscriptions	-4.638* (2.170)	0.780*** (0.111)	-0.141 (13.409)
Log Digital financial inclusion	-0.179 (0.187)	0.508** (0.155)	0.150 (0.187)
Log Number of credit card per 1000 adults	-3.021** (0.949)	1.631** (0.533)	9.696 (11.233)
Log Number of debit card per 1000 adults	-1.983** (0.645)	1.232* (0.470)	-5.657 (5.174)
Control	Yes	Yes	Yes
Middle and low-income countries interaction term	No	Yes	No
High-income countries interaction term	No	No	Yes
Time fixed-effect	Yes	Yes	Yes
Country fixed-effect	No	No	No

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Discussion

The results from Model 1 indicate that, overall, digital financial inclusion leads to a decrease in income inequality. For instance, the number of mobile cellular subscriptions is an important element for an individual to download a financial services application to their phones. When they have their applications, that is when they are able to do transactions from anywhere without spending money and time to go to existing financial institutions. That money can be used for savings or other needs that improve their lives and income. The number of credit card and debit card per 1000 adults also captures proof that digitalization may contribute to income inequality reduction. However, it is important to underline that credit card and debit card have been used as payment tools before FinTech is rising. Furthermore, people may use credit cards for consumption which rather increases their spending. Therefore, these results may refer to the use of credit cards for productive purposes and how digital technology is able to decrease the information asymmetry between financial institutions and consumers. We must also take note that the results capture variations in developed countries where infrastructure is more developed and income is likely to be more well-distributed compared to emerging and low-income countries.

Meanwhile, the results from Model 2 indicate that in the middle and low-income countries, the effect of digital financial inclusion is likely to increase income inequality. This finding is fairly in accordance with our hypothesis that according to the Kuznets curve, countries that are at the early stage or middle stage of development experience higher income inequality. This is generally because their financial markets are growing at a much slower rate. When it reaches the intermediate stage, economic growth increases and causes a widened distribution of income between high-income and low-income populations (Greenwood & Jovanovic, 1990). Digital financial inclusion also requires good financial infrastructure as the

foundation for providing financial services. We may consider the fact that infrastructure such as electricity and internet are still developing, and technology only reaches a certain group of people due to accessibility challenges. At the initial stage, developing an electronic payment system usually demands a high fixed investment, however, it operates at low marginal cost when it comes to the implementation stage. Nevertheless, policy uncertainties and other factors in many countries can hinder providers from establishing the initial infrastructure (Porteous, 2007). While infrastructure such as the internet is highly important for digital financial inclusion, it is still unlikely to advance rapidly in rural and remote areas. Tools such as smartphone and other gadgets are also not a priority for low-income people due to the cost involved (Hieminga et al., 2016). The financial knowledge of people may also affect the results. Generally, people who understand the benefit of financial services from FinTech companies can maximize their financial needs and attain more benefits. The use of digital financial inclusion will expand the scope of the economy and contribute to their economic situation. While people who are not exposed to such knowledge will stay unbanked or underbanked. This situation may widen the gap and thus worsen inequality. Therefore, in middle and low-income countries, while people with higher income may demand and benefit from digital financial inclusion, the lower-income population are instead limited in their ability to access it.

On the other side, from the results in Model 3 we can see that digital financial inclusion tends to reduce income inequality in high-income countries. This result is also fairly in line with our hypothesis, where high-income countries are in the state where good infrastructure and financial system are ready to support the digital financial inclusion development. The development of infrastructure in financial services contributes to economic growth and income levels because a wider group of the population benefit from the effective financial

services (Greenwood & Jovanovic, 1990). We must also emphasize that developed countries are the leaders in terms of the number of FinTech companies. With highly-developed infrastructure, high-income countries are able to maximize financial services provision through technologies such as blockchain, Artificial Intelligence, or Robo-advisor, etc. (Hieminga et al., 2016). Therefore, people from broader economic level can benefit from the digital financial inclusion.

Chapter 5. Conclusion and policy recommendation

This chapter provides the conclusion and policy recommendations based on the results from previous chapter.

5.1 Conclusion

This paper has so far strived to shed light on the effect of digital financial inclusion on inequality. Using a longitudinal dataset of 31 countries provided by the World Bank, IMF, and UNU-Wider from 2011-2018, we estimated the relationship based on a panel fixed-effect model. The empirical analysis resulted in three major findings. Firstly, digital financial inclusion, in general, decreases income inequality, even not all variables show statistically significant estimates. Secondly, middle and low-income countries are likely to have a higher increase in income inequality when there is an increase in digital financial inclusion. Thirdly, digital financial inclusion is likely to decrease income inequality when there is an increase in digital financial inclusion in high-income countries. This finding is based on statistically significant estimates.

Furthermore, these findings are fairly in accordance with the Kuznets hypothesis that countries at the early and intermediate stages of development may experience a widening gap in income inequality. However, when countries enter the mature stage of development, income inequality will eventually decrease as shown in the first estimation results. This is because, at that stage, savings rate falls, economic growth stabilizes, and thus income distribution balances.

While these findings provide rich insights into the relationship between digital financial inclusion and inequality, they should not be interpreted at face value due to the following limitations. Firstly, there is potential for reverse causality that cannot be solved by the fixed-effect estimation model. Applying an instrumental variable estimation model may solve the

reverse causality issue. Secondly, we could not estimate how digital financial inclusion may have an effect on inequality in specific income quantiles due to data limitation. Thirdly, the sample mainly focuses on emerging countries due to data limitations. Therefore, future research may consider the above-mentioned issues.

5.2 Policy recommendation

Based on the findings of this paper, we proffer the following recommendations which may be of use to policymakers, international organizations, civil society groups, digital finance enthusiasts, FinTech companies, and researchers interested in financial inclusion and inequality:

1. As formulated in the G20 High-Level Principles for Digital Financial Inclusion, it is critical to emphasize the foundation or enabler for digital financial inclusion. These include advancing financial and ICT infrastructure, strengthening the legal and regulatory framework, and reinforce the commitment of public and private sector;
2. Governments should set a reduced tax rate on necessity goods. This would allow a wider group of the population to benefit from digital financial inclusion;
3. Both government and FinTech companies should provide consumer protection in order to prevent any form of fraud or cyber-crime in the digital ecosystem that may deteriorate the consumer's benefit;
4. Governments should reaffirm the legal system and regulations for FinTech companies or start-ups in their respective countries;
5. All elements and actors should cooperate in advocating and monitoring financial literacy and knowledge for the benefit of a wider group of people.

References

Allison, P. (2012). Fixed effects regression models. In *Fixed Effects Regression Models*. https://doi.org/10.4135/9781412993869

Banerjee and Duflo. (2003). Inequality and growth: what can the data say? Journal of Economic Growth. *Journal of Economic Growth*, *8*(3), 267–299.

Bank, W. (2016). *World Development Report 2016: Digital Dividends*. The World Bank. https://doi.org/10.1596/978-1-4648-0671-1

Bartlett, R., Morse, A., Stanton, R., & Wallace, N. (n.d.). *Consumer-lending discrimination in the FinTech era*. 1–51. https://www.nber.org/papers/w25943.pdf

Bascom, W. O. (1994). The economics of financial reform in developing countries. In *The Economics of Financial Reform in Developing Countries*. https://doi.org/10.1007/978-1-349-23372-4

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. *Journal of Economic Growth*, *12*(1), 27–49. https://doi.org/10.1007/s10887-007-9010-6

BIS. (2016). *Payment aspects of financial inclusion* (Issue April). www.worldbank.org

Busch, M. O. (2017). Broadening the G20 financial inclusion agenda to promote financial stability: The role for regional banking networks. *G20 Insights*, *April*, 4. http://www.g20-insights.org/wp-content/uploads/2017/05/04_Financial_Broadening-the-G20-financial-inclusion.pdf

CCAF, ADBI, & Space, F. (2019). *The Asean fintech ecosystem benchmarking study*. 89. https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2019-ccaf-asean-fintech-ecosystem-benchmarking-study.pdf

Cuevas, C. E., & Fischer, K. P. (2006). Cooperative financial institutions. In *Finance* (Vol. 82,

Issue Issues in Governance, Regulation, and Supervision). https://doi.org/10.1596/978-0-8213-6684-4

Dabla-Norris, E., Ji, Y., Townsend, R. M., & Unsal, D. F. (2015a). Distinguishing constraints on financial inclusion and their impact on GDP, TFP, and the distribution of income. *National Bureau of Economic Research*, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

Dabla-Norris, E., Ji, Y., Townsend, R., & Unsal, D. F. (2015b). Identifying constraints to financial inclusion and their impact on GDP and inequality: A structural framework for policy. *IMF Working Papers*, *15*(22), 1. https://doi.org/10.5089/9781498381598.001

Demirguc-kunt, A., & Klapper, L. (2012). Measuring financial inclusion: The global findex database. In *Policy Research Working Paper*. https://openknowledge.worldbank.org/bitstream/handle/10986/6042/WPS6025.pdf?sequence=1&isAllowed=y

Demirguc-kunt, A., Klapper, L., & Singer, D. (2017). Financial inclusion and inclusive growth: A review of recent empirical evidence. *Policy Research Working Paper*, *April*, 1–27.

Dollar, D., & Kraay, A. (2002). Growth is good for the poor. *Journal of Economic Growth*. https://doi.org/10.1023/A:1020139631000

Federal Deposit Insurance Corporation. (2018). *2017 FDIC national survey of unbanked and underbanked households*. https://www.fdic.gov/householdsurvey/2017/2017report.pdf

FSB. (2017). Financial stability implications from Fintech: Supervisory and regulatory issues that merit authorities' attention. *Financial Stability Board*, *June*, 1–61. www.fsb.org/emailalert

G20. (2011). *Seoul development consensus for shared growth*. Annex 1. www.g20.org

Gathoni, A. G. (2018). *Impact of Mobile Financial Services on Household's Welfare and Inequality: Evidence from Kenya*. *16*.

Gine, X. (2007). Why does access matter? Impact on growth and poverty. *Building Inclusive Financial System: A Framework for Financial Systems*, 33–56.

GPFI. (2011). G20 Financial Inclusion Action Plan. *Global Partnership for Financial Inclusion*, *September*, 1–16.

GPFI. (2014). *Issues Paper Digital Financial Inclusion and the Implications for Customers*. *October*.

GPFI. (2015). *G20 Financial Inclusion Action Plan Progress Report 2010-2014*. *March*, 1–22.

GPFI. (2016a). *G20 Financial Inclusion Indicators Overview*. 1–6.

GPFI. (2016b). *G20 High-Level Principles for Digital Financial Inclusion*. 3–23. https://www.gpfi.org/sites/gpfi/files/documents/G20 High Level Principles for Digital Financial Inclusion - Full version-.pdf

Greenwood, J., & Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *Journal of Political Economy*, *98*(5), 1076–1107.

Group of Ten. (2001). *Report on the Consolidation of the Financial Sector* (Issue January). https://www.imf.org/external/np/g10/2001/01/Eng/pdf/file1.pdf

Hieminga, G., Lande, F., & Nijboer, F. (2016). FinTech For Micro , Small and Medium Sized Enterprises. *ING Economics Department*, *October*, 1–38.

Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking and Finance*. https://doi.org/10.1016/j.jbankfin.2008.05.004

IMF. (2019). IMF releases the 2019 Financial Access Survey results. https://www.imf.org/en/News/Articles/2019/09/27/pr19359-imf-releases-the-2019-financial-access-survey-results

Inan, Feride. (2016, September 9). What did the G20 accomplish during China's presidency, https://thediplomat.com/2016/09/what-did-the-g20-accomplish-during-chinas-presidency/

ISPI. (2016, September 2). G20's history and membership. https://www.ispionline.it/en/pubblicazione/g20s-history-and-membership-17116

Kern, A. (2019). *Financial technology, digital currencies and inclusion.* In A. Kern (Eds.), *Principles of Banking Regulation Online* (pp. 329–346). https://doi.org/10.1017/9781108551557

Kim, J. H. (2016). A study on the effect of financial inclusion on the relationship between income inequality and economic growth. *Emerging Markets Finance and Trade*, *52*(2), 498–512. https://doi.org/10.1080/1540496X.2016.1110467

Klapper, L., El-Zoghbi, M., & Hess, J. (2016). *Achieving the Sustainable Development Goals The Role of Financial Inclusion —Queen Máxima of the Netherlands/UNSGSA Achieving the Sustainable Development Goals: The Role of Financial Inclusion Message from the UNSGSA*. *April*. www.cgap.org

Kumar, A., Joshi, M., Ronchi, L., & Tzioumis, K. (2007). Measuring financial access. *Building Inclusive Financial System: A Framework for Financial Systems* (7–32).

Kuznet, S. (1955). Growth and income inequality. *The American Economic Review XLV*(1). https://assets.aeaweb.org/asset-server/files/9438.pdf

Lakner, C., & Milanovic, B. (2015). Global income distribution from the fall of the Berlin wall to the great recession. *Revista de Economia Institucional*, *17*(32), 71–128. https://doi.org/10.1596/1813-9450-6719

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

15. https://www.mckinsey.com/~/media/McKinsey/Featured Insights/Employment and Growth/How digital finance could boost growth in emerging economies/MGI-Digital-Finance-For-All-Executive-summary-September-2016.ashx

Menat, R. (2016). Why we're so excited about FinTech. In *The FinTech Book*. https://doi.org/10.1002/9781119218906.ch2

OECD. (2018). *Financial Markets, Insurance and Private Pensions: Digitalisation and Finance*. http://www.oecd.org/finance/Financial-markets-insurance-pensions-digitalisation-and-finance.pdf

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, *18*(4), 329–340. https://doi.org/10.1016/j.bir.2017.12.003

Philippon, T. (2019). On FinTech and financial inclusion. *National Bureau of Economic Research*, 162–172. https://doi.org/10.4337/9781788114226.00024

Philippon, T. (2014). *Has the U.S. finance industry become less efficient? On the theory and measurement of financial intermediation*. http://pages.stern.nyu.edu/~tphilipp/papers/Finance_Efficiency.pdf

Porteous, D. (2007). Financial infrastructure and financial access. In *Building Inclusive Financial System: A Framework for Financial Systems*.

Rajan, R., & Zingales, L. (2001). *The great reversals: The politics of financial development in the 20th century*. *3*s http://www.nber.org/papers/w8178

Sahay, R., & Cihak, M. (2018). Women in Finance: A Case for Closing Gaps. *Staff Discussion Notes*. https://doi.org/10.5089/9781484375907.006

Sahay, R., Cihak, M., N'Diaye, P., Barajas, A., Mitra, S., Kyobe, A., Mooi, Y., & Yousefi, R. (2015). Financial Inclusion: Can it Meet Multiple Macroeconomic Goals? *Staff Discussion Notes*, *15*(17), 1. https://doi.org/10.5089/9781513585154.006

Sen, A. (2014). Inequality reexamined. In *Essays and Reviews: 1959-2002*. https://doi.org/10.2307/40184045

Senou, M. M., Ouattara, W., & Acclassato Houensou, D. (2019). Financial inclusion dynamics in WAEMU: Was digital technology the missing piece? *Cogent Economics and Finance*, *7*(1). https://doi.org/10.1080/23322039.2019.1665432

UN-DESA. (2015). *Concepts of inequality*. Development Issues No.2 United Nations. https://www.un.org/en/development/desa/policy/wess/wess_dev_issues/dsp_policy_01.pdf

UN. (2015). *Inequality Measurement.* Development Issues No.2 United Nations. http://www.un.org/en/development/desa/policy/wess/wess_dev_issues/dsp_policy_02.pdf

UNCDF. (n.d). Financial inclusion and the SDGs. https://www.uncdf.org/financial-inclusion-and-the-sdgs

Wamboye, E., Adekola, A., & Sergi, B. (2016). ICTs and labour productivity growth in sub-Saharan Africa. *International Labour Review*, *155*(2), 231–252. https://doi.org/10.1111/j.1564-913X.2014.00021.x

WEF. (2015). *The Future of Financial Services*. https://doi.org/10.1002/9781119218906.ch59

WHO Commission on Social Determinants of Health., & W. H. O. (2008). Closing the Gap in a Generation. In *Health Equity Through Action on the Social Determinants of Health*. https://doi.org/10.1080/17441692.2010.514617

World Bank. (2014). Global Financial Development Report 2014: Financial Inclusion. In *World Bank* (Vol. 49, Issue 33). https://doi.org/10.9774/gleaf.9781315103457_5

World Bank. (2018). Overview of financial inclusion, https://www.worldbank.org/en/topic/financialinclusion

World Bank. (2018b). Mobile cellular subscriptions per 100 people, https://data.worldbank.org/indicator/IT.CEL.SETS.P2

World Bank. (2018c). UFA2020 Overview: Universal Financial Access by 2020, https://www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020

Yandle, B., Vijayaraghavan, M., & Bhattarai, M. (2002). The Environmental Kuznets Curve A Primer.

Yi, J. (2008). *G20's Financial Regulatory Reform and Korea's Response*. *2*(3), 3–9. www3.kcmi.re.kr

DATABASE

IMF Financial Access Survey Database

UNU-Wider Income Inequality Database (WIID)

World Bank Global Financial Inclusion (Global Findex) Database

World Bank G20 Financial Inclusion Indicators

World Bank World Development Report Database

Appendix

Appendix a1. Summary of the data

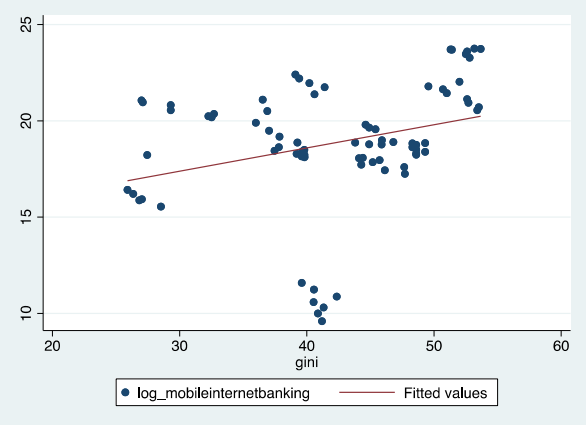
VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Gini coefficient	222	38.27	8.313	25.31	56.23
Trade to GDP	248	75.03	33.15	22.49	158.0
Log Mobile cellular subscriptions	239	17.07	1.413	14.98	21.22
Log Number of mobile and internet banking transactions	86	18.92	3.172	9.601	23.75
Log Number of Credit cards per 1000 adults	180	5.356	1.127	2.089	7.133
Log Number of Debit cards per 1000 adults	223	6.740	0.774	3.529	8.707
Log Digital financial inclusion	239	18.03	2.052	14.98	23.75
Log Secondary education	221	14.29	1.485	12.18	18.16
log_GDP	248	9.199	1.189	6.470	11.69
log_GDPpercapita2	248	86.03	22.09	41.87	136.5

Appendix a2. Correlation

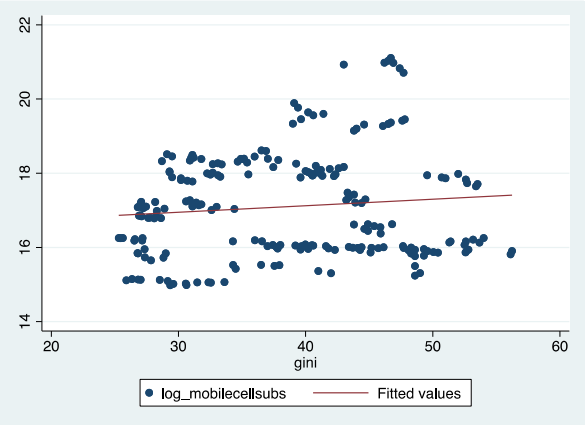
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Gini	1.000									
(2) Log Mobile and internet banking transactions	0.401	1.000								
(3) Log Mobile cellular subscriptions	-0.025	0.099	1.000							
(4) Log Credit card user per 1000 persons	0.635	-0.053	0.178	1.000						
(5) Log Debit card user per 1000 persons	-0.082	-0.206	0.137	0.500	1.000					
(6) Log Digital financial inclusion	0.523	0.794	0.424	0.298	-0.077	1.000				
(7) Log GDP per capita	-0.313	-0.220	-0.106	-0.164	0.049	-0.232	1.000			
(8) Log GDP per capita squared	-0.384	-0.228	-0.113	-0.234	0.045	-0.263	0.995	1.000		
(9) Log Secondary education	0.033	0.042	0.967	0.197	0.011	0.351	-0.088	-0.107	1.000	
(10) Trade to GDP	-0.474	0.194	-0.148	-0.236	0.303	-0.063	0.290	0.346	-0.278	1.000

Appendix a3. Scatter plot

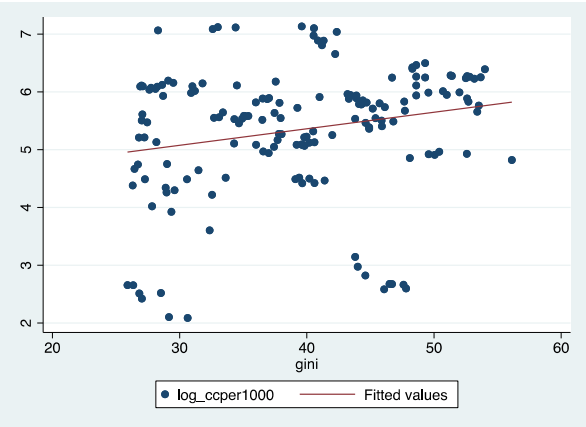
Log Number of mobile and internet banking



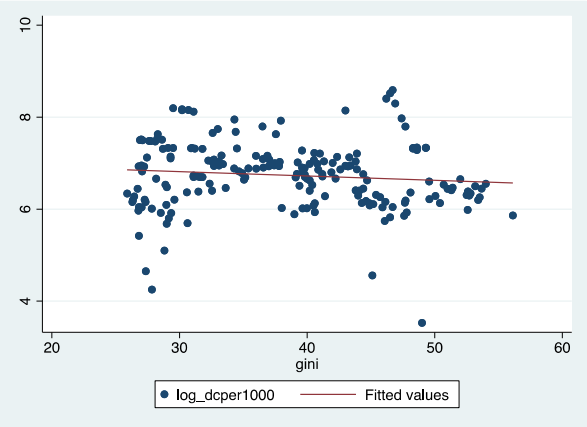
Log Mobile cellular subscriptions



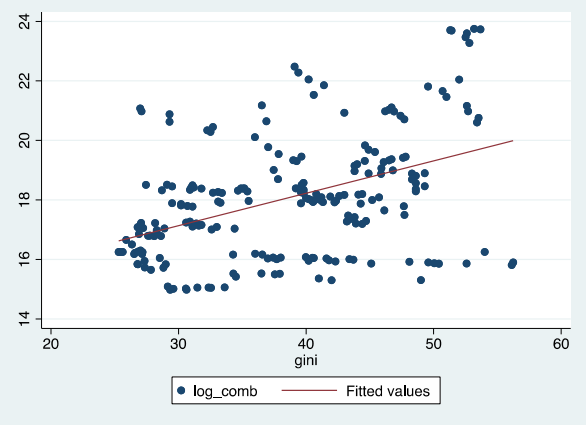
Log Number of credit card per 1000 adults



Log Number of debit card per 1000 adults



Log Digital financial inclusion



Appendix a4. Kuznets curve