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Master's Thesis of International Studies

**The Impact of Digital Transformation
on Financial Inclusion:
Through the Case of Mobile Money Account
in Senegal**

디지털 전환이 포용금융에 미치는 영향:
세네갈의 모바일 머니 계좌 사례를 중심으로

August 2023

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Abstract

Emerging technologies offer the potential for broadening the scope of financial inclusion. One of the digitalized financial services called a mobile money account expands access to financial services, especially for those who are underserved or excluded from traditional banking services. In a country where the use of mobile phones is prevalent, introduction to mobile money services can intensify the effect of financial inclusion. Likewise, being one of the top countries in West Africa to have the highest mobile phone penetration rates, Senegal was expected to reach successful financial integration when the mobile money service was first introduced by Orange Money in the market. Senegal's mobile money account service is largely dominated by the French telecommunications company, Orange S.A. With the company's initial attempt to connect more people in the country regarding their purpose to fulfill Sustainable Development Goals, Orange Money significantly increased the registration rate of mobile money accounts in Senegal.

While digitalized financial services are widely accepted as a successful asset to financial inclusion, this paper highlights the potential variability of outcomes by examining the case of Senegal. Multiple logistic regressions are conducted based on microeconomic data collected by the World Bank's Global Findex Database. By conducting a comparative analysis of the logistic regression outcomes for individuals holding traditional accounts and those with mobile money accounts in the years 2014, 2017, and 2021; this study identifies evidence of inequality in financial inclusion concerning mobile money accounts in Senegal. Whereas the account holders in financial institutions show inclusion among different categories with a strong statistical significance, the mobile money account holders demonstrate the opposite

regression slopes. The impact of mobile money accounts in Senegal seems to be concentrated on those who are male, relatively richer, and more educated.

Based on these findings, this research offers policy recommendation that considers the different situations encountered in the country. To ensure that mobile money accounts contribute fully to financial inclusion in Senegal, it is important to address the barriers and ensure that mobile money services are accessible and available to all groups, regardless of their gender, education, income level, or age. This may require targeted efforts to increase awareness and understanding of mobile money services, as well as measures to address broader socioeconomic inequalities that can limit access to financial services.

Keywords: digital transformation, financial inclusion, digital financial inclusion, financial technology, inequality in financial inclusion, mobile money account

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I. Introduction

1-1. Background and Concepts

Digital transformation has been widely accepted by many experts and policymakers that successful digitalization leads to inclusive economic growth by enhancing productivity and economic activity. With the advent of the COVID-19 pandemic, the process of digitalization has vehemently accelerated, expanding the potential and opportunities of people around the world to actively participate in diverse economic activities online. The digital transformation of the financial sector especially gave rise to financial inclusion in developing countries that allowed easy accessibility and reduced barriers to monetary services.

Financial inclusion mainly refers to the accessibility of financial services. According to the World Bank Group (2022), access to applicable and inexpensive financial products and services available to individuals and businesses can be defined as financial inclusion. Whether the purposes of the usage are money transactions, payments, account savings, credit, and/or insurance; they must be delivered in a sustainable method. When an individual possesses the ability to actively engage in a range of financial activities through suitable methods, this individual is regarded as being integrated into the financial economy. Such accessibility plays a pivotal role in enhancing the quality of life and enables families or businesses to effectively strategize for short- and long-term objectives as well as unforeseen contingencies.

A transition from a traditional financial institution account to mobile money account is one of the greatest examples of digitalized financial services that

successfully led to financial inclusion (Alexander & Karametaxas, 2021).^① Normally offered by a mobile network operator (MNO) or other similar lines of an entity in partnership with the MNOs, mobile money account is an innovative way to access financial services through the implemented system of “pay-as-you-go”^② service. Unlike the former banking services, without confinements to regions or restrictions to the level of infrastructures, mobile money account has a particularly prominent rate of penetration outcome in developing countries. As the only requirement for opening a mobile money account is the possession of a mobile phone, the accessibility of mobile money accounts extends to a wide range of individuals. This innovative financial service overcomes the limitations faced by rural residents in opening a traditional bank account, which was hindered by the limited availability of banking infrastructure in their localities. By leveraging the widespread ownership of mobile phones, mobile money accounts offer a promising path for financial inclusion, bridging the gap between individuals in underserved areas and formal financial services (International Monetary Fund, 2019). Thus, mobile money account has integrated people into various financial activities that were previously excluded.

Due to such characteristics, mobile money account has become a notable driver of financial inclusion in sub-Saharan Africa. Largely dominated by M-Pesa, a mobile money service introduced by Kenya’s telecom service providers of Safaricom

^① Mark Carney (2017), a former governor of Bank of England, gave speech at the Deutsche Bundesbank G20 Conference emphasizing that the development of financial technology – also referred to as fin tech – has many fundamental potentials not only in providing more widely available and affordable services, but also in including more individuals and business models into the financial system.

^② The mobile money service is a pay-as-you-go digital mechanism. This means that the users perform financial transactions – including savings, peer-to-peer transfers, in-store purchases, and bill payments – by using mobile money accounts. With this mechanism, the individual can pay upfront, and he/she is not entitled to any contract or commitment (International Monetary Fund, 2019).

together with the Vodafone group from the United Kingdom, mobile money eminently developed in sub-Saharan Africa (GSMA, 2018). Recent research showed that since the introduction of mobile money services in 2008, about 2 percent of households were out of extreme poverty in 2016 as the service increased the level of daily per capita consumption (Matheson, 2016). East Africa's successful implementation of mobile money account quickly disseminated beyond its borders and impacted the sub-Saharan regions. Amongst many countries in sub-Saharan Africa, the mobile money industry in Senegal has experienced remarkable growth, comparable to that of the previously leading region of Kenya, and has achieved a significant milestone (GSMA, 2022). This accomplishment is expected to foster further progress in financial inclusion throughout the country, similar to the achievements observed in Kenya.

1-2. Purpose of Research

Digital financial services, especially those that utilize mobile phones as their medium, facilitate the integration of individuals into the financial sphere at an accelerated pace. This holds particularly true for sub-Saharan Africa, where mobile phone coverage exceeds 60 percent of the population, and subscription rates are consistently growing at a faster pace than in Europe each year (Aker & Mbiti, 2010). The World Bank (2022) refers to the concept of financial inclusion as providing access to affordable and appropriate financial services to society. In doing so, access to accounts is the first step and the very critical step in the process toward financial inclusion. Against this backdrop, the combination of widespread mobile phone ownership and the efficacy of utilizing mobile phones for digital financial services collectively contributes to the attainment of a bank account, which can be regarded

as a manifestation of financial inclusion.

A consensus among experts has been widely established regarding the positive impact of digital financial services on financial inclusion. Kenya has set a great case example of significantly reaching financial inclusion in the country through mobile money accounts. Despite being introduced to the new technology at a later stage compared to Kenya, Senegal rapidly achieved significant levels of penetration and registration. This development led many scholars to anticipate that Senegal would achieve a level of successful financial inclusion similar to that of Kenya. However, we cannot take it for granted that there would be a similar positive influence of integration in Senegal. Whether such striking progress of mobile money accounts successfully reached financial inclusion in Senegal is an area of study that requires further research.

While it is commonly emphasized that financial inclusion is attained through accounts in financial institutions and/or mobile phones, this paper posits the significance of equitable dissemination of financial inclusion. Achieving successful financial inclusion should not solely focus on the mere possession of financial accounts, but rather on ensuring equal access to accounts for all segments of society and the economy. As stated by Mbiti and Weil (2011), individuals utilizing M-Pesa in Kenya are found to exhibit characteristics such as younger generation, higher income, advanced education, already with bank accounts, employment in non-agricultural sectors, ownership of mobile phones, and residence in urban areas. By employing the case of Senegal as a framework for the previous findings, this paper introduces a new concept that highlights the significance of inequality within the context of financial inclusion.

In order to substantiate the arguments, this research strives to answer the

following questions:

- (1) Does digital transformation from the traditional financial account to the mobile money account lead to financial inclusion?
- (2) Does the possession of mobile money accounts show equal distribution among individuals from various socioeconomic groups? What was the impact of Orange Money, the mobile money service provider in Senegal, on the country's financial inclusion?
- (3) Corresponding to the findings from the quantitative and descriptive analysis, what are some important policy implications that can improve not only financial inclusion but also inequality in financial inclusion in the country?

Global Financial Inclusion (Global Findex) Database is a comprehensive dataset collected by the World Bank Group. Starting from 2011 and updated on the basis of about 3 to 4 years, the data contains financial inclusion indicators of how and how much adults – aged 15 and above – are participating in the activities of saving, borrowing, making payments, and managing risks. Based on the Global Findex Database for the years 2014, 2017, and 2021 in Senegal, the logistic regression models will be conducted. The objective of this paper is to examine the impact of digital transformation of the financial service sector on financial inclusion and measure the inequality in financial inclusion. On top of the quantitative analysis, descriptive analysis of the mobile money service provider will be given to understand its relation to the dataset and to identify the patterns and trends of the results. By analyzing these findings, this paper intends to provide a number of policy suggestions that could act as a fundamental recommendation to better develop equal financial inclusion to the appropriate measures taken from digital transformation.

The significance of this research lies in its contribution to understanding the

potential and risks of digital transformation to promote comprehensive financial inclusion not only in Senegal but in developing countries. Senegal serves as an ideal case for this study due to its comparable potential to Kenya in achieving successful financial inclusion through mobile money accounts. However, unlike Kenya, there is a lack of comprehensive research in this specific context, making it a pertinent subject for examination in Senegal. By specifically examining the case of Senegal, this research highlights the opportunities and challenges of facilitating digital financial services in the context of a developing country. The research findings presented herein can serve as valuable insights for policymakers, international monetary organizations, financial institutions, and development organizations. These stakeholders can utilize these findings to effectively formulate strategies and implement appropriate measures for promoting successful financial inclusion and advancing access to mobile money services in the region, ultimately working towards the goal of inclusive financial participation for all.

1-3. Literature Review

1-3-1. Defining Financial Inclusion

Financial inclusion has become a pivotal priority for governments, policymakers, and financial institutions around the world. This is because many studies have shown that when people take part in the financial system, they are more likely to be exposed to economic opportunities (Ashraf, Karlan, & Yin, 2010; De Koker & Jentzsh, 2013; Fall, Orozco, & Akim, 2020). Such activities include starting and expanding businesses, investing in education and basic needs, and managing risks and financial shocks. With greater opportunities available, financial inclusion is recognized as one of the key factors in reducing poverty and promoting inclusive

economic growth (Beck, Demirguc-Kunt, & Ross Levine, 2007; Demirguc-Kunt et. al., 2015; Beck, Levine, & Loayza, 2000). Acknowledging the importance of financial inclusion to the economy, regulatory and supervisory bodies in both country- and international-level mandate regulations and strategies that promote financial inclusion (World Bank, 2014).

The benefits of achieving financial inclusion are evident and widely recognized. However, it is imperative to precisely define the concept of financial inclusion to gain a comprehensive understanding of its implications and significance. The World Bank (2022) emphasizes one term when explaining financial inclusion: “accessibility”. The concept of financial inclusion refers to providing access to affordable and appropriate financial services to all through a secure, sustainable method. Access to accounts is the first step and the very critical step in the process towards financial inclusion. This is because having an account act as a gateway in opening basic financial transaction services such as saving, sending, and receiving money. For this reason, increasing access to a financial account is set as a target of focus for many financial institutions and the World Bank Group (2014).

Such widely available and affordable access to accounts or other means of financial services to savings and payment mechanisms positively affect the economy. Access to financial services can help individuals, firms, and households to save, invest, and manage their money more efficiently. This can improve their financial stability and resilience. Financial inclusion can also increase access to credit which can facilitate entrepreneurship and job creation (Karlan & Zinman, 2010). In addition, financial inclusion can contribute to greater gender equality and empowerment by enabling women to participate more fully in economic activities and decision-making processes (Ashraf, Karlan, & Yin, 2010). Successful financial inclusion can

increase governmental savings, empower women, and produce significant investment and consumption (Demirguc-Kunt et. al, 2015). In other words, financial exclusion derives from barriers that hinder users from accessing the services (World Bank, 2014).

1-3-2. Digital Financial Inclusion Through Mobile Money Account

Fundamentally, financial inclusion begins with the possession of a bank account as it acts as a medium for connecting users to financial activities. In order to achieve greater levels of inclusion, efforts were made to address its entry barriers. The barriers include affordability, eligibility, gender gap, and geographical restriction that have previously prevented socially vulnerable users from participating in financial inclusion initiatives (De Koker & Jentzsch, 2013). On account of recent innovative technologies, the digital transformation of traditional bank account services has made financial services available to more people, also referred to as “digital financial inclusion^③”.

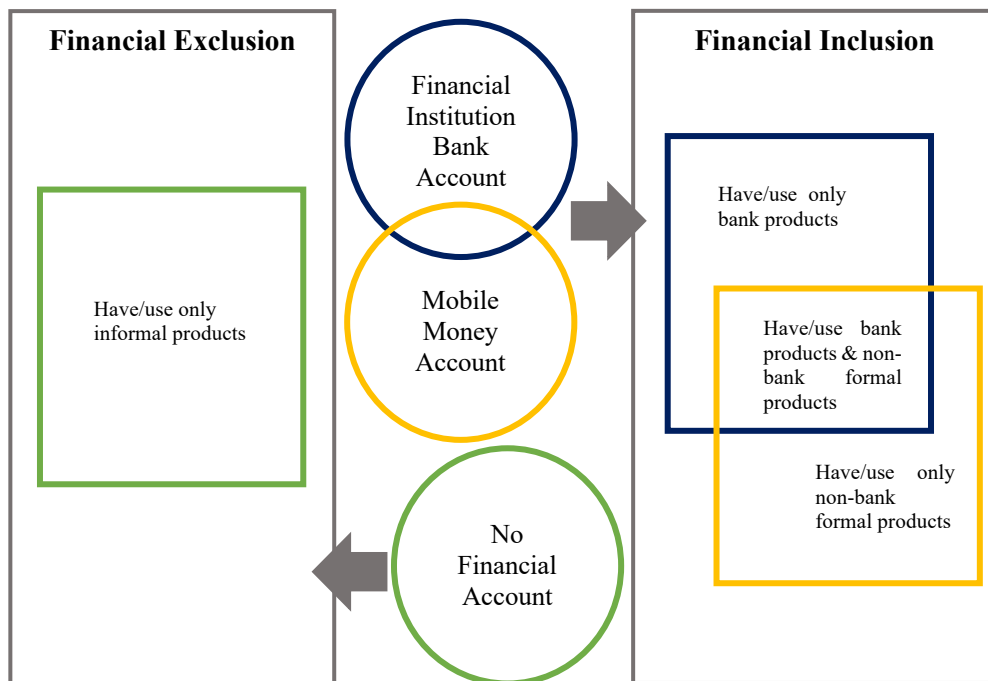
Figure 1 illustrates how the levels of financial inclusion can be achieved through both types of accounts. According to the FinScope survey (FinMark Trust, 2011) and De Koker and Jentzsch (2013), a bank account at a financial institution refers to an individual with accounts from financial institutions regulated by the central bank. Mobile money account^④ includes individuals who have access to

^③ As according to the World Bank (2022), the digital financial inclusion encompasses the use of economical digital methods to extend formal financial services that cater to the requirements of financially underserved and excluded populations. These services are delivered in a responsible manner at a reasonable cost for customers and sustainable for providers. Except for the fact that the means of access is digitalized, the concept of digital financial inclusion can be used interchangeably with financial inclusion.

^④ Although the FinScope survey indicate this area as “Served by Other”, for the sake of this paper’s topic, the category has been renamed as “Mobile money

mobile money accounts provided by the mobile network provider. As depicted in Figure 1, the concept of financial inclusion indicates individuals who possess financial accounts in traditional banking institutions as well as those who hold accounts with mobile service providers. Additionally, financial inclusion also encompasses individuals who have accounts with both types of financial service providers. On the other hand, financial exclusion indicates those who do not have access to any of the financial products or services. In this case, people will have to rely on their own savings at home or may borrow from friends or family, which is financially unstable.

Figure 1. Levels of Financial Inclusion and Exclusion



Source: Recreated by the author with data from FinScope South Africa 2011 (FinMark Trust, 2011, p.4) and De Koker and Jentsch (2013, p. 272)

account” in the figure. According to the report (FinMark Trust, 2011; De Koker & Jentsch, 2013), “Served by Other” category consists of providers who are considered semi-formal due to their occasional registration, but typically lack supervision from financial sector regulators.

One of the best examples of an intermediary means of financial inclusion is a mobile money account. Mas and Radcliffe (2010) prove this point through an examination of the M-Pesa case in Kenya. Mobile money account services promote digital financial inclusion by enabling people to access financial services through their mobile phones. People can easily make transactions, access credit, make bill payments, and store money simply with their mobile phones. Given that the coverage rate of mobile phones takes up higher in percentage compared to the population with bank accounts around the world, mobile phones have become an indispensable tool in financial inclusion strategies (De Koker & Jentzsch, 2013; Fall, Orozco, & Akim, 2020; Pickens, 2009; Shem, Misati, & Njoroge, 2012; Shem, Odongo, & Were 2017).

Mobile money services can reach out to more people than traditional bank services. While traditional banking services are often expensive, physically distant, and require a certain level of financial literacy; mobile money account is a simple channel to financial services that are widely accessible to all and even to remote areas. The utilization of digital financial services enables individuals to store their funds securely and affordably, as well as transfer them over long distances in a prompt manner (Demirguc-Kunt et al., 2022).

1-4. Development of Research Questions

Mobile money services can reach out to more people than traditional banking services. The effectiveness of this technology is particularly noticeable in developing countries among individuals with low income, a significant proportion of whom do not have access to conventional banking services and live in rural or suburban regions (ECLAC, 2021; Fall, Orozco, & Akim, 2020; Lauer & Lyman,

2015; Pickens, Porteous, & Rotman, 2009). Given that mobile money accounts provide a straightforward way to access financial services that are readily available to the general population, it can be easily hypothesized that there will be a larger user base of mobile money accounts in Senegal. In line with the World Bank (2022) and FinMark Trust (2011), the purpose of the first research question is to analyze whether digitalizing a traditional financial account to a mobile money account has contributed to financial inclusion in Senegal.

However, focusing mainly on account accessibility falls short of achieving successful financial inclusion in the country. Many practitioners appear to prioritize the sheer expansion of financial account registrations, which can inadvertently widen the gap among different socioeconomic groups within the country. As discussed in Aker and Mbiti's study (2010), mobile phones were predominantly allocated to higher socioeconomic status individuals: well-educated young males residing in urban areas with great wealth in the family. Building upon this research, Mbiti and Weil (2011) obtained similar findings in the context of Kenya's use of the mobile money service known as M-Pesa. They discovered that the adoption of M-Pesa was relatively more prevalent among the affluent segments of society. By describing such a case in terms of financial inclusion as "inequality in financial inclusion", the subsequent question arises regarding the presence of similar disparities in the case of Senegal and the possibility of providing an analytical response to address this inequality.

Given the significance of financial inclusion for numerous developing countries, the final question pertains to policy recommendations for governmental entities, international organizations, and financial institutions. As evident in prior research, the introduction of new technology in developing countries often results in

a pattern where the socially dominant group has a higher likelihood of accessing and utilizing such technology. Consequently, the primary focus on financial inclusion should not solely revolve around augmenting the total count of financial accounts within the country but should also prioritize the equitable distribution of financial services across the entire region. Bearing this in mind, it is crucial to propose policy recommendations accordingly.

II. A Study in Kenya

2-1. The Case of Mobile Money Accounts in Kenya

Examining the case of Kenya, which has successfully implemented mobile money accounts throughout the country, is crucial in gaining valuable insights for understanding the situation in Senegal. Kenya stands as a leading country in the successful initiation of mobile money accounts, and extensive research has been conducted on this topic. While several other countries in sub-Saharan Africa have been provided with a similar mobile money service from the same mobile provider as Kenya, Senegal utilizes a different mobile financial service from a different provider. Given the scarcity of studies in Senegal that investigate the impact of digitalizing financial accounts, a comprehensive examination of Kenya's mobile financial service case becomes vital and insightful in informing the framework of this study.

Launching mobile money account service in Kenya has placed the country as one of the most successful and leading financial inclusion initiatives in sub-Saharan Africa (Alexander & Karametaxas, 2021; IFC, 2010; Mas & Morawczynski, 2009; Natile, 2020; UNSGSA, 2017). First introduced in 2007, M-Pesa^⑤ is a mobile financial service provided in partnership between Vodafone, a telecommunication company based in the United Kingdom, and Safaricom, a local provider. M-Pesa has experienced an astonishing expansion, quickly taking over 70% of the population in

^⑤ M-Pesa is frequently mentioned as a notable case of effective financial inclusion in a developing nation, as it has played a significant role in uplifting approximately 10% of Kenya's most impoverished households out of poverty (UNSGSA, 2017).

Kenya (Natile, 2020). Since the start of the business, it has expanded access to financial services, particularly in rural areas, where traditional banking services were limited. M-Pesa allowed people to send and receive money, pay bills, and access other financial services through their mobile phones, which proved to be more convenient and cost-effective than traditional banking services. As a result, the use of mobile money accounts in Kenya has grown significantly, with over 40 million users in 2020, according to the Central Bank of Kenya.

2-2. Contributing Factors to Financial Inclusion in Kenya

Several factors contributed to financial inclusion through mobile money accounts in Kenya, with M-Pesa playing a major role. Mas and Radcliffe (2010) largely divide the contribution of M-Pesa to financial inclusion into three sets of factors. Aside from M-Pesa's well-designed service and its effective business strategy, the existing conditions in Kenya that created a favorable environment for the successful implementation of mobile money services enabled M-Pesa to quickly attain a substantial customer base. Underlying demand in Kenya has been instrumental in driving this expansion. According to Mas and Morawczynski (2009), this demand is primarily fueled by the migration of rural residents to urban areas in Kenya. Given the economic disparities in the country, it is common for a member of a rural household, typically the male head, to seek employment in the city while their wives and children remain in the rural areas. Despite residing in urban areas, many migrants maintain a strong connection to their rural homes. To sustain these ties, regular home visits and frequent money transfers were common practices.

The growth of M-Pesa can also be attributed to the lack of viable alternatives for domestic money transfers. Many low-income Kenyans resort to informal

methods to send money home, such as giving money to friends or family members who are traveling back to the rural areas. While this approach may be cost-effective, it carries considerable risks as there is a chance of losing some or all of the money during transit (Jack, Ray & Suri, 2013). Since cash is readily accessible in rural areas and small towns, individuals tend to spend a larger portion of it within the local community, thereby boosting the local economy (Ng'weno, 2010). Therefore, when M-Pesa was introduced, there was a substantial gap in the domestic remittance market, and it played a crucial role in filling this gap.

In large part, M-Pesa was able to reach out to more people in a short period of time due to Safaricom's dominant position in the market before its deployment. At the end of the year 2009, Safaricom held a significant share of over 77% and had the broadest coverage across the country (Mas & Morawczynski, 2009). Other players in the market included Zain with a 14% share, Orange with 6%, and Essar with the remaining 3% (IFC, 2010). However, such a large scale of customer base did not necessarily monopolize the economy. Rather, Safaricom's dominant position provided other players with access to a substantial pool of willing subscribers, which undoubtedly played a crucial role in the swift adoption of their mobile money services.

Beyond the environmental factors, the regulatory approach taken by the Central Bank of Kenya (CBK) played a crucial role in facilitating the growth of M-Pesa and is worth highlighting. Instead of opposing the entry of the telecom operator into the financial sector, the CBK adopted a stance that allowed for experimentation and innovation, as long as sufficient guarantees were provided. Instead of focusing on the provision of necessary resources to fully utilize financial opportunities, M-Pesa's primary emphasis lies in offering unbanked individuals the chance to avail

themselves of diverse mobile money services (Natile, 2020). The CBK recognized that harnessing the potential of mobile networks to facilitate a fundamental payment service had the greater potential to create numerous opportunities for enhancing financial inclusion in Kenya (AFI, 2010). This position adopted by the regulator supported the expansion of M-Pesa. Safaricom's dominant position in the market enabled significant investments in agents and the mobile network infrastructure. However, due to resistance from its competitors, the Competition Authority of Kenya intervened in 2016 and ordered Safaricom to open its network of M-Pesa agents to other telecom companies offering mobile money services. Subsequently, in a collaborative effort among telecom operators, an agreement was reached in which users could exchange money irrespective of whether both parties involved in the transaction were using the same provider (Soyres et al., 2018).

These factors largely contributed to the successful adoption of mobile money accounts in Kenya, which led to increased financial inclusion and improved access to financial services for millions of people. Nevertheless, although the case of Kenya shows an implication of successful financial inclusion made by the mobile money accounts, whether the same method of introduction of the mobile money service can lead to the same effect of financial inclusion in Senegal is what this study strives to answer.

III. Data and Methodology

3-1. Data

To assess the extent and the distribution of financial access in Senegal, this study is conducted based on the microeconomic data that is compiled to build the Findex database for Senegal. The dataset employed in this analysis is from the World Bank Group's Global Findex and encompasses data collected through national representative surveys conducted in 2014, 2017, and 2021. Each survey consists of a sample size of 1,000 individuals. In order to compare the impact of digital transformation on financial inclusion throughout the years, the account ownership at a financial institution and the ownership of mobile money account are set as dependent variables. Table 1 shows both dependent and independent variables used in executing the estimation.

The dependent variables in this study pertain to the ownership of financial accounts. In the case of the *account* variable, it indicates whether an individual possesses a traditional bank account, a mobile money account, or holds both simultaneously. The dependent variables in this study are binary indicators representing the ownership of accounts. A value of 0 signifies that an individual does not possess any accounts, while a value of 1 indicates that an individual has ownership of account(s).

Table 1. Description of Variables

Dependent Variables	Description
account	An individual has an account at financial institutions, mobile money account, or both accounts
account_fin	An individual has an account at a financial institution
account_mob	An individual has a mobile money account
Independent Variables	Description
Education: The highest completed education level of a respondent (ref: primary or less)	
edu2	Completed secondary level of education
edu3	Completed tertiary level or more
Income: Within-economy household income quintile of the respondent (ref: poorest quintile)	
income2	Second quintile
income3	Third quintile
income4	Fourth quintile
income5	Fifth quintile
Female	
female	A respondent is female
Age (ref: age group of 15-20)	
age2	The age range of 21-30
age3	The age range of 31-43
age4	Age range 44-99

The independent variables are further subdivided into categorical variables except for the *female* variable. In the case of the gender variable, a value of 1 represents male, while a value of 2 represents female. For the two independent variables, namely *education* and *income*, their initial values are established as the base value or the reference group. Specifically, the base value for education represents the highest education level attained in primary or less, while the base value for income denotes the poorest quintile of household income. In the case of the *education* variable, there were a few who answered either that they were unsure or the column was left blank. For the sake of clear observation, these two values have been modified into the value of 1, which indicates a respondent who has attained an

education level of primary or less. Therefore, a total of 6 modifications are made for 2017 and a total of 7 modifications are made for 2021. In sum, by categorizing the values of the independent variables, the estimation would allow each of the interpretations for the expected change in response to moving from the reference level to the level associated with the other multiple categories within the group.

The age variable has been also treated as a categorical variable. The category was divided into subgroups with a roughly equal distribution of 1,000 respondents among each subgroup. Each category shown under the age categorical variable represents a dummy variable comparing the youngest category of *age*, a group of respondent age ranging from 15-20.

3-2. Methodology

This research intends to analyze the significance of mobile money accounts on financial inclusion in Senegal. In order to successfully observe its significance and progress from 2014 until the very recent report of 2021, a logistic regression model will be conducted for data analysis.

Logistic regression is a statistical method to analyze the relationship between a binary or categorical dependent variable and a set of independent variables. The model serves as a means to objectively estimate the probability of the dependent variable taking on a particular value of either 0 or 1 in response to the independent variables. In this research, the regression model will be interpreted in a similar manner, adhering to its common application. In general, the logistic regression model shows what influence the independent variables have on the dependent variable. In return, if there is an influence, we can also predict how likely an individual is to take the dependent variable in association with the independent variables. The logistic

regression model used in this research is as follows:

$$\text{logit}(\text{account})$$

$$= f(\text{account} = 1|z) = \frac{1}{1 + e^{-z}}$$

$$\text{Where, } z = \beta_0 + \beta_1 \text{edu2} + \beta_2 \text{edu3} + \beta_3 \text{income2} + \beta_4 \text{income3} + \\ \beta_5 \text{income4} + \beta_6 \text{income5} + \beta_7 \text{female} + \beta_8 \text{age2} + \\ \beta_9 \text{age3} + \beta_{10} \text{age4}$$

Similar regression is conducted with `account_fin` and `account_mob` as dependent variables. By comparing both accounts in financial institutions and in mobile money services, the estimations demonstrate the impact of mobile money accounts in Senegal. Moreover, conducting a comparison across years enables us to discern the extent to which the gap within identical socioeconomic groups either diminished or expanded.

This paper establishes the concept of “inequality of financial inclusion” to analyze the effects of mobile money on the disparity of financial inclusion across socioeconomic groups. More specifically, this study defines inequality in financial inclusion as the ratio of the odds ratios ($\frac{p}{1-p}$) of having a financial account between the selected socioeconomic groups. The equation used to assess inequality in financial inclusion is as follows:

$$\text{Ratio of Odds Ratio} = \frac{\left\{ \frac{p_x}{1-p_x} \right\}}{\left\{ \frac{p_i}{1-p_i} \right\}}$$

where, p_x denotes the odds of the probability of having an account of the group for years x , and p_i represents the odds of the probability for the initial year i within the selected group. Based on the available data, the initial year chosen for this study is 2014, serving as a controlled variable. When this ratio is equal to 1, it signifies

equality between the two groups, whereas any deviation from 1 indicates an increase in inequality. Through a comparison of the odds ratios among the different socioeconomic statuses, any observed disparities in the ratio of the odds ratio will enable the study to establish evidence of inequality in financial inclusion.

The study refrains from employing the probability gap as a measure of inequality in financial inclusion due to its limitations in addressing the challenges associated with increasing the probability based on the initial level. For instance, when the probability rises from 5% to 10% in group 1, it remains uncertain whether the probability of group 2, initially standing at 40%, should increase to 45% or 80% to maintain the same level of inequality. Neither of these two options is accurate, as 45% is too low and 80% is too high. According to the same ratio of odds ratios, the probability of group 2 must increase to 58% to maintain an equivalent degree of inequality as observed in group 1.

IV. Key Findings and Analysis

4-1. Assessing the Financial Inclusion in Senegal

4-1-1. Financial Inclusion in Senegal

Along with many other countries in sub-Saharan Africa, account ownership has increased in Senegal. Based on the Global Findex Dataset in Senegal, the overall account ownership constantly grew since 2014.

Table 2. Summary of Account Ownerships

Variable	Obs	2014	2017	2021
<i>account</i>	1,000	.217	.464	.646
<i>account_fin</i>	1,000	.179	.245	.339
<i>account_mob</i>	1,000	.070	.353	.546

Notes: The numbers represent mean values of account ownership

Source: Created by the author with data from the World Bank's Global Findex Database

As can be seen through the summary of the means in Table 2, not only did the number of general financial accounts registered accelerated, but also the number of mobile money accounts outpaced accounts in financial institutions. In the case of overall account ownership, there was an increase of 113.82% from 2014 to 2017 and an increase of 39.22% from 2017 to 2021. Among this overall account ownership, while financial accounts took up a constant increase of 36.87% from 2014 to 2017 and 38.37% from 2017 to 2021; the mobile money accounts had an exponential heap of 404.29% from 2014 to 2017 and 54.67% from 2017 to 2021. This means that there was a significant penetration rate of mobile money accounts in Senegal.

Table 2 can be further disaggregated by different socioeconomic status groups, as demonstrated in Table 3. This table provides a comprehensive summary

of account holders across various socioeconomic groups, presenting the number of account holders for each group. The ratios of account holders in relation to the total number of individuals surveyed within each represented socioeconomic group are presented in parentheses alongside their corresponding numbers. The data in Table 3 reveals a consistent rising trend in the number of overall accounts, accounts held at financial institutions, and mobile money accounts as the year progresses. This suggests that an increasing number of individuals in Senegal have been successfully integrated into the financial economy through the widespread accessibility of mobile money accounts.

Table 3. Summary of Account Ownerships by Socioeconomic Status

	<i>account</i>			<i>account_fin</i>			<i>account_mob</i>		
	2014	2017	2021	2014	2017	2021	2014	2017	2021
Female	76 (0.155)	201 (0.409)	287 (0.576)	58 (0.118)	85 (0.173)	139 (0.279)	28 (0.057)	152 (0.310)	234 (0.470)
Male	141 (0.277)	263 (0.517)	359 (0.715)	121 (0.238)	160 (0.314)	200 (0.398)	42 (0.083)	201 (0.395)	312 (0.622)
edu1	63 (0.117)	219 (0.374)	291 (0.532)	45 (0.084)	101 (0.172)	155 (0.284)	27 (0.050)	159 (0.271)	221 (0.405)
edu2	132 (0.305)	225 (0.574)	324 (0.766)	112 (0.259)	126 (0.321)	156 (0.369)	37 (0.085)	180 (0.459)	297 (0.702)
edu3	22 (0.759)	20 (0.909)	31 (1.000)	22 (0.759)	18 (0.818)	28 (0.903)	6 (0.207)	14 (0.636)	28 (0.903)
income1	7 (0.047)	52 (0.327)	72 (0.459)	2 (0.013)	22 (0.138)	41 (0.261)	5 (0.034)	40 (0.252)	54 (0.344)
income2	13 (0.078)	74 (0.413)	92 (0.571)	8 (0.048)	35 (0.196)	45 (0.280)	5 (0.030)	57 (0.318)	74 (0.460)
income3	29 (0.180)	74 (0.411)	109 (0.606)	21 (0.130)	34 (0.189)	61 (0.339)	15 (0.093)	56 (0.311)	84 (0.467)
income4	47 (0.220)	92 (0.438)	130 (0.667)	33 (0.154)	50 (0.238)	68 (0.349)	23 (0.107)	64 (0.305)	114 (0.585)
income5	121 (0.392)	172 (0.632)	243 (0.792)	115 (0.372)	104 (0.382)	124 (0.404)	22 (0.0712)	136 (0.5)	220 (0.717)

Notes: The numbers in parentheses represent the ratios of the number of account holders to the total number of respondents within each socioeconomic group surveyed.

Source: Created by the author with data from the World Bank's Global Findex Database

The summary tables provide evidence that digitalized financial services have contributed to financial inclusion in Senegal, as indicated by the increasing number

of accounts. Largely thanks to Orange Money service, a mobile money service offered by Orange S.A. – a multinational telecommunication operator based in France – Senegalese was able to participate in diverse digitalized financial activities. The Orange Money service quickly dominated the country because of its simple and instant service (Robert & Gauthier, 2016). It did not even require people to possess a traditional bank account. An individual only had to have a mobile plan with a national ID and the service was provided for free of charge.

4-1-2. The Estimation of Financial Inclusion Through Accounts in Financial Institutions

Through the logistic regression model, the research is able to estimate the relevance of predictor variables and their association with the result. According to the logistic regression model, Table 4 demonstrates the regression results for accounts and Table 5 demonstrates the regression results for accounts at financial institutions based on the Global Findex dataset. Overall, there is a statistically significant relationship between the dependent variables and the predictor variables: attained education level, household income, gender, and age group.

Table 4 presents estimations for the account variable segmented by factor variables. It is important to note that the account variable indicates individuals who may possess one or both types of accounts at financial institutions or mobile money providers. The logistic regression analysis of the account variable demonstrates a consistent pattern resembling a U-shaped curve across various socioeconomic groups. Specifically, in 2017, there is a decrease in the probability of owning an account for individuals with higher socioeconomic levels compared to the base value. The downward probabilities indicate a reduction in the gap between account ownership for individuals in the lowest socioeconomic groups, represented by the

base value. This implies that a greater number of individuals in these groups have gained access to accounts in general. However, this trend reverses towards 2021, with an increase in the probability of account ownership for those in higher socioeconomic groups.

Table 4. Logistic Regression Results for Account

Dependent: <i>account</i>	(1) 2014	(2) 2017	(3) 2021
<i>edu2</i>	1.397*** (0.204)	0.704*** (0.149)	0.976*** (0.158)
<i>edu3</i>	2.264*** (0.482)	2.244*** (0.755)	
<i>income2</i>	0.548 (0.497)	0.248 (0.237)	0.349 (0.239)
<i>income3</i>	1.501*** (0.454)	0.218 (0.235)	0.466** (0.235)
<i>income4</i>	1.559*** (0.436)	0.234 (0.229)	0.741*** (0.234)
<i>income5</i>	2.123*** (0.424)	0.817*** (0.223)	1.101*** (0.228)
<i>female</i>	-0.622*** (0.183)	-0.253* (0.138)	-0.479*** (0.146)
<i>age2</i>	1.804*** (0.326)	1.017*** (0.193)	1.126*** (0.206)
<i>age3</i>	2.419*** (0.338)	0.917*** (0.211)	1.188*** (0.215)
<i>age4</i>	2.218*** (0.345)	0.767*** (0.214)	1.085*** (0.220)
Constant	-4.502*** (0.568)	-1.170*** (0.321)	-0.581* (0.315)
Observations	1,000	988	998

Notes: This table shows an estimation of logistic regression results. Standard errors are in parentheses. *Significance: 10%, **Significance: 5%, ***Significance: 1%

In terms of education, the probability of having an account relative to the probability of not having an account for individuals who completed secondary education is 4.04 (=exp(1.397)) times higher than those with a primary education level or less in 2014. This odds ratio decreases to 2.02 in 2017, but increases to 2.65

in 2021, all with 1% of statistical significance. This significant decrease in probability suggests that there is not much difference in account ownership between individuals with primary and secondary education. However, higher-educated individuals are more likely to have accounts, with probabilities as high as 9.62 in 2014 and 9.43 in 2017 ($p < 0.01$). The probability for the year 2021 is not reported due to the fact that 31 respondents who completed tertiary or higher education all reported holding an account.

The remaining variables exhibit a similar U-shaped trend. The coefficients for these variables significantly decreased in 2017 but showed an increasing trend in 2021. Regarding income level, the probability of having an account relative to the probability of not having an account of those who are in the fourth income quintile is 4.75 ($=\exp(1.559)$) times higher than those who are in the lowest income quintile in 2014. This odds ratio decreases to 1.26 in 2017 but increases once more to 2.10 in 2021. In terms of gender, the odds ratio for females holding an account relative to the probability of not having an account is 0.54 ($=\exp(-0.622)$) of that of a man in 2014. This probability increased substantially to 0.78 in 2017 but declined again to 0.62 in 2021. This suggests that while more men-owned accounts were in 2014, a significantly higher number of women began to own accounts in 2017, but this probability decreased again in 2021.

In each case, we can observe an initial improvement in the inequality of financial inclusion between 2014 and 2017, followed by a subsequent deterioration between 2017 and 2021. This peculiar pattern arises from the divergent behaviors of holding mobile money accounts than holding accounts at financial institutions. The dynamics and factors influencing the two types of accounts appear to have distinct impacts on the overall inequality in financial inclusion during these time intervals.

Table 5. Logistic Regression Results for Accounts at Financial Institutions

Dependent: <i>account_fin</i>	(1) 2014	(2) 2017	(3) 2021
<i>education2</i>	1.531*** (0.227)	0.764*** (0.176)	0.409*** (0.150)
<i>education3</i>	2.416*** (0.494)	2.449*** (0.579)	2.941*** (0.628)
<i>income2</i>	1.352* (0.811)	0.203 (0.310)	-0.0248 (0.260)
<i>income3</i>	2.463*** (0.763)	0.186 (0.307)	0.249 (0.249)
<i>income4</i>	2.420*** (0.748)	0.369 (0.294)	0.314 (0.244)
<i>income5</i>	3.401*** (0.737)	0.833*** (0.277)	0.209 (0.231)
<i>female</i>	-0.772*** (0.208)	-0.583*** (0.164)	-0.447*** (0.143)
<i>age2</i>	2.943*** (0.540)	0.983*** (0.262)	0.775*** (0.231)
<i>age3</i>	3.535*** (0.549)	1.268*** (0.277)	1.192*** (0.235)
<i>age4</i>	3.490*** (0.554)	1.324*** (0.283)	1.173*** (0.242)
Constant	-6.852*** (0.939)	-2.072*** (0.412)	-1.302*** (0.336)
Observations	1,000	988	998

Notes: This table shows an estimation of logistic regression results. Standard errors are in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Table 5 shows the estimation for accounts held in financial institutions analyzed in segmentations through factor variables. The probability of having an account at financial institutions relative to the probability of not having an account of those who completed secondary education is 4.62 (=exp(1.531)) times higher than those who have a primary education level or less in 2014. This probability greatly decreases in 2021 to 1.51 times higher relative to those who have completed primary education level or less. This indicates that the inequality based on education decreased in the case of accounts at financial institutions. However, in the case of

higher education level, the probability of having an account relative to the probability of not having an account constantly rose from 11.20 times to 18.94 times higher relative to the respondents who have completed primary or less level of education.

The coefficients of income become statistically insignificant after 2014, which means that having an account at a financial institution does not depend on income. This implies financial inclusion of the people with lower income towards 2017 and 2021. In 2014, the probability of having an account relative to the probability of not having an account of those who are living in the second quintile income is 3.87 ($=\exp(1.352)$) times higher than that of those in the first quintile income with statistical significance at 10%. This difference becomes bigger within the category in 2014 by 11.74, 11.25, and 29.99 times of difference in third, fourth, and fifth quintile income, respectively, relative to the first quintile income with statistical significance at 1%. However, the probability of fifth quintile income decreased to 2.30 times higher relative to the first quintile with statistical significance at 1% in 2017 and to 1.23 in 2021. Given that this difference was about 30 times difference in the likelihood of owning a bank account in 2014, a 2.30 is a tremendous improvement in financial inclusion in terms of household income.

In the case of a gender gap, the observation infers that there is gender inclusion with the rise of account ownership. Although the regression shows negative coefficients throughout the years with a strong statistical significance at 1%, there is a steady increase from 2014 to 2021. The inequality of financial inclusion between men and women also decreases in the case of financial accounts. The female's odds ratio is 0.46 ($=\exp(-0.772)$) that of men in 2014 but increases to 0.64 in 2021. This implies that while men are generally more likely to have financial accounts than women, this account ownership gap between genders has been

decreasing in recent years.

4-1-3. The Estimation of Financial Inclusion Through Mobile Money Accounts

The logistic regression results for mobile money accounts are shown in Table 6. Unlike the positive and decreasing regression slopes of *education* and *income* for accounts in financial institutions, the slopes tend to be positive but increasing in the case of mobile money accounts. What this means is that mobile money account holders are largely comprised of people who have attained higher degrees in education and who are comparatively richer as the year progresses.

Table 6. Logistic Regression Results for Mobile Money Accounts

Dependent: <i>account_{mob,y}</i>	(1) 2014	(2) 2017	(3) 2021
<i>edu2</i>	0.514* (0.295)	0.684*** (0.153)	1.064*** (0.149)
<i>edu3</i>	1.504*** (0.558)	1.021** (0.468)	1.825*** (0.628)
<i>income2</i>	-0.158 (0.647)	0.270 (0.252)	0.416* (0.244)
<i>income3</i>	0.971* (0.535)	0.165 (0.250)	0.389 (0.239)
<i>income4</i>	1.099** (0.512)	0.0422 (0.246)	0.898*** (0.236)
<i>income5</i>	0.296 (0.531)	0.686*** (0.232)	1.240*** (0.226)
<i>female</i>	-0.333 (0.262)	-0.224 (0.142)	-0.473*** (0.141)
<i>age2</i>	0.958** (0.394)	0.973*** (0.204)	1.056*** (0.206)
<i>age3</i>	0.936** (0.415)	0.846*** (0.223)	0.719*** (0.212)
<i>age4</i>	0.0505 (0.477)	0.577** (0.230)	0.562** (0.219)
Constant	-3.551*** (0.699)	-1.529*** (0.339)	-0.905*** (0.316)
Observations	1,000	988	998

Notes: This table shows an estimation of logistic regression results. Standard errors are in parentheses. *Significance: 10%, **Significance: 5%, ***Significance: 1%

The table shows the detailed results of logistic regression for mobile money accounts. The education predictors are both positive and statistically significant. The log-odds of owning mobile money accounts relative to the base value for both *edu2* and *edu3* are predicted to be 2.90 ($=\exp(1.064)$) and 6.20 times greater in 2021. Compared to the year 2014, these numbers are great increases as the log-odds were 1.67 and 4.50 times more likely for *edu2* and *edu3* than the primary level of education respectively.

The logistic regression results of income variables generally show a trend of positive and increasing slopes. In 2014, statistically significant at 10%, the third quintile income group is 2.64 ($=\exp(0.971)$) times more likely and the fourth quintile group is 3.00 times more likely, with 5% significance, to own a mobile money account relative to the first quintile group. Although this contrast lessened in the case of the fourth quintile group in 2021 with 2.46 times more likely to own a mobile account compared to the reference group, the other categorical groups show more increase in this number. With statistical significance at 10%, the second quintile income group shows a 1.51 times higher likelihood to own mobile money account and 3.46 times more likely in the case of the fifth quintile income group, statistically significant at 1% level.

The gender gap tends to have worsened with the introduction of mobile money accounts. The coefficients of gender were found to be statistically insignificant in 2014; however, they became significant in 2021 with a greater decrease in log odds, indicating that the presence of mobile money accounts is influenced by the gender factor. The inequality of financial inclusion between males and females has increased in the context of mobile money accounts. The probability

of owning a mobile money account for females was 0.72 ($=\exp(-0.333)$) time likely compared to that of males in 2014, but it deteriorated to 0.62 in 2021. This finding suggests that mobile money account ownership is more concentrated among men than women.

The probability of having a mobile money account becomes more likely for the younger generation as the year progresses than for the older generation. While the age group of *age2* and *age3* started out similar with about 2.60 times higher probability to own a mobile money account compared to the youngest age group, the number diverged towards 2021. In 2021, this estimation becomes 2.88 ($=\exp(1.056)$) times higher for *age2* and 2.05 times higher for *age3* relative to that of the youngest categorical group, both being 1% statistically significant. Compared to the younger groups, the oldest group has less probability of owning a mobile money account as the estimation shows 1.75 in 2021, being statistical significance at 5%.

4-1-4. Inequality in Financial Inclusion

Drawing upon the Global Findex data for Senegal, the introduction of mobile money accounts is found to contribute to financial inclusion; however, it is accompanied by unequal distribution across various socioeconomic strata. Table 7 summarizes the number of mobile money account holders over the years. The data clearly demonstrate a progressive increase in the count of mobile money account holders, indicating a notable financial inclusion facilitated by the digitalization of traditional banking services.

While an increase in the number of account holders might suggest financial inclusion with the introduction of mobile money accounts, a deeper analysis using the ratio of odds ratios reveals evidence of inequality in financial inclusion. As described in the methodology section, this paper defines inequality in financial

inclusion based on the presence of a disparity in the ratios of odds ratios of holding a mobile money account among the selected socioeconomic groups. Consequently, Table 7 provides clear evidence of such inequality. The utilization of mobile money accounts appears to be disproportionately higher among men and individuals from higher socioeconomic backgrounds, as indicated by the odds ratios.

Table 7. Summary Table for Mobile Money Account Holders

	2014				2017				2021			
	user	pop	prob	odds ratio	user	pop	prob	odds ratio	user	pop	prob	odds ratio
Female	28	491	5.7	0.060	152	491	31.0	0.448	234	498	47.0	0.886
Male	42	509	8.3	0.090	201	509	39.5	0.653	312	502	62.2	1.642
edu1	27	538	5.0	0.053	159	586	27.1	0.372	221	546	40.5	0.680
edu2	37	433	8.5	0.093	180	392	45.9	0.849	297	623	47.7	0.911
edu3	6	29	20.7	0.261	14	22	63.6	1.750	28	31	90.3	9.333
income1	5	149	3.4	0.035	40	159	25.2	0.336	54	157	34.4	0.524
income2	5	167	3.0	0.031	57	179	31.8	0.467	74	161	46.0	0.851
income3	15	161	9.3	0.103	56	180	31.1	0.452	84	180	46.7	0.875
income4	23	214	10.7	0.120	64	210	30.5	0.438	114	195	58.5	1.407
income5	22	309	7.1	0.077	136	272	50.0	1.000	220	307	71.7	2.529

Source: Estimated and organized by the author based on the data from the World Bank's Global Findex Database

Regarding the gender category, the ownership of mobile money accounts in Senegal is predominantly skewed toward males. This observed disparity in gender distribution signifies an inequality in financial inclusion, as the gap between males and females widens over time. In 2014, the odds ratio for men was 0.09, which is 1.5 times higher than that for women. By 2021, this ratio increased to 1.642, indicating that men were 1.85 times more likely to own a mobile money account than women. The ratio of odds ratio for men in 2017 is 7.256 and for women is 7.414. In 2017, the ratios indicate a relatively small difference between men and women. However, in 2021, the gap widens significantly, with the ratio of odds ratios for men reaching 18.259 and 14.657 for women. These considerable differences in the ratio of odds ratios further emphasize the presence of severe inequality in financial inclusion

based on gender in Senegal.

Similar trends of inequality in financial inclusion can be observed based on education and income levels. In 2017, the ratios of odds ratio for individuals with primary education or less, secondary education, and tertiary education are 7.047, 9.087, and 6.708, respectively. These ratios all fall below 10 in 2017 but tend to widen the gap among one another towards 2021, reaching 12.870, 9.751, and 35.778, respectively.

Similar patterns of disparity exist in the case of income. In 2014, the odds ratio for the fifth quintile income is 0.077, which is 2.2 times higher than that of the first quintile income. This ratio increases even further by 2021 to 2.529 for the fifth quintile, which is about 4.9 times higher than the first quintile. In summary, these observations collectively point to the existence of inequality in financial inclusion across more dominant demographic factors in the country.

4-2. Assessing the Role of Mobile Money Account

4-2-1. The Purpose of Mobile Money Service Provider

Briefly mentioned in the previous chapter, Orange Money is a mobile money service provider by Orange S.A., a multi-service telecommunication corporation in France. Also known as Orange-Sonatel or Orange, Senegal's mobile broadband market is mostly dominated by Orange-Sonatel (Cruz, Dutz & Rodriguez-Castelan, 2021). First launched in Côte d'Ivoire in 2008, the service quickly disseminated to Senegal and other African countries. Partnering with local and international banks to make money transfers via mobile in 2014 and establishing regulated entities in Senegal in 2017 especially triggered exponential growth in the newly registered mobile money accounts (Orange, 2020a).

The main purpose of Orange S.A.'s mobile money services is to contribute to global issues through their social and environmental commitments. Among the four commitments, the company strives to achieve "digital equality" that mainly deals with access to widely available digital services. This service tackles its mission to offer people with simple user-driven-experience method of financial transactions through their mobile phones (Orange, 2023a). Orange Money is specially designed to drive financial inclusion to people with little or no access to traditional banking services. This is possible due to the high possession rate of mobile phones in the country (Orange, 2020a). The service allows users to easily save money, pay utility bills, transact money to and from abroad, and manage businesses. By doing so, the mobile money service is eligible to provide equal access to a person with diverse demographical backgrounds, either underserved or excluded.

Orange Money also tackles the United Nation's Sustainable Development Goals (SDGs) for more financial inclusion and sustainable growth in developing countries. Frederic Blehaut (2012), a manager of Group Business at Orange Money, pointed out that the mobile money service is not only an investment for the company but also a key player in promoting the economic and social development of the country. According to the company's business strategy (Orange, 2023b), their mobile money account directly addresses Sustainable Development Goals 9^⑥ and 10^⑦. The

^⑥ According to the United Nations, Goal 9 focuses on "building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation" (2022, 16). This goal further targets not only in developing the quality of information and communication technology (ICT) but also in increasing financial services with reliable technological assistance. This goal recognizes the important roles of infrastructure and industrialization that would contribute to the developing countries.

^⑦ The aim of the Goal 10 is to "reduce inequality within and among countries" (Ibid., 17). Goal 10 addresses its crucial part in achieving the other SDGs. The

company initiated strategic plans, such as the “Essentials2020” and “Engage 2025”, that target company goals and commitments to the SDGs. Aligned with the SDGs, in order to give people equal and inclusive access to the service, the company facilitates (1) network coverage whether the region is urban or rural; (2) affordable devices, such as smartphones, especially for the disadvantaged communities; and (3) educational programs that would train both young and old for digital literacy. These agendas promote the accessibility of mobile money accounts (Orange, 2022).

4-2-2. The Outcomes of Orange Money in Senegal

Orange Money has played an important role in expanding access to financial services in Senegal. As can be analyzed according to the summary tables of the Global Findex Dataset (Table 2), the mobile money account in Senegal had an annual growth rate of 34.10% from 2014 to 2021. Given that the annual growth rate of accounts in financial institutions is 9.55%, mobile money account holders certainly grew in high numbers every year.

The successful deployment of the service influenced the economy in terms of financial inclusion. According to the 2020 Integrated Annual Report by Orange, Orange Money has contributed to national wealth through various inclusion initiatives. For example, the mobile money service by Orange represents 10% of the GDP in Senegal acting as a major contributor to development in regional areas (Orange, 2020b).

In relation to mobile money service, the company targets Goals 9 and 10 of SDGs. Orange considers Goal 9 as its core business strategy. The service of mobile

main idea lies in empowering and promoting the social, economic, and political inclusion for all without any distinctions to age, sex, disability, race, ethnicity, origin, religion, or other social or economic status.

money account itself is an innovative technology that will enable social and regional development. Though a specific number of percentages is not indicated for Senegal, at the end of the year 2020, Orange has extended 4G coverage in rural areas by 39% in 16 operating countries overall in Africa and the Middle East (Orange, 2020b).

Under Goal 10, the group intends to empower those who are left behind and promote digital inclusion that would bring equal opportunities and gender equality. On top of expanding the 4G coverage, Orange offers affordable smartphones that target not only low-income families but for those who live in rural areas (Orange, 2023b). Additionally, Aminata Ndiaye (n.d.), a former Head of Marketing Orange Money Senegal, interviewed that Orange Money has contributed to 7% of increased active female users in Senegal from 2017 to 2020. The service supports women to be financially self-sufficient through various programs such as Hello Women. Lastly, in order to achieve digital inclusion in the country, the group launched Orange Digital Center (ODC)^⑧ in the capital city of Senegal, Dakar. ODC offers various programs^⑨ to train young people. The programs are meant to alleviate the problem of digital literacy which would enhance their participation in the Orange Money services (Orange, 2019). In addition to the improvement of digital literacy, the programs are generally built to cultivate equality and inclusion in gender by encouraging the participation of women and girls in the center (Komara & Oyono, 2023).

^⑧ The Orange Digital Center in Senegal is located in the capital city of Senegal with a surface area of 2,000 square-meters that is six floors high. Being the second ODC in Orange but the first center to be opened in West Africa, ODC in Dakar becomes the major driver to digital ecosystem (Chevrier, Komara & Diallo, 2019).

^⑨ The ODC offers four large programs: Coding School, Solidarity FabLab, Orange Fab, and Orange Ventures. The Coding School provide trainings in the use of technology. The Solidarity FabLab targets younger generations who are 12 to 25 years old to introduce them with emerging technology, such as 3D printers. Both Orange Fab and Orange Ventures deal with start-ups and entrepreneurs who will be able to work in close collaboration with the Orange venture funds (Orange, 2019).

4-3. Comprehensive Analysis in Relation to the Observations

Assessing the financial inclusion together with the role of mobile money account providers in Senegal presents unexpected outcomes. Despite indications from several reports that the introduction of mobile money accounts in Senegal has contributed to financial inclusion, the assessment based on the World Bank's Global Findex Database presents a contrasting perspective. There is no doubt that Orange Money largely contributed to the growth of mobile money accounts. Nevertheless, this growth rate in Senegal does not necessarily signify that it was equally distributed to different groups in terms of education, income, gender, or age. This uneven distribution of mobile money accounts can be seen as an indication that the digital transformation of traditional financial accounts is not enough to fully achieve financial inclusion in Senegal.

Senegal has presented great potential for mobile money accounts that could have led to successful financial inclusion. A study claims that the biggest barrier to using mobile money to bring about financial inclusion is a country with characteristics of a low penetration rate of mobile phones with a large number of financially excluded populations (Fanta et al., 2016). However, this is not the case in Senegal. Senegal ranks 170 out of 191 countries with a value of Human Development Index (HDI) of 0.511 in 2021, considered to be low according to the Human Development Report (2022). Yet, the mobile penetration rate is substantive, reaching almost 103.3% at the end of 2017 (World Bank, 2019a). This is a high percentage as Senegal takes in the top 10 of the most developed mobile markets in Africa. Given such suitable conditions to prosper, Orange Money seems to have not been able to lead Senegal into equally successful financial inclusion.

Based on the observations, it can be analyzed that the mobile money account provider tends to have focused more on its commercial growth than on driving successful financial inclusion in the country. Although Orange Money may have started the service with the purpose of achieving Sustainable Development Goals in developing countries, its intentions became indistinct and leaned towards its commercial values. One of the examples is the fact that the company built its main training center in the heart of Dakar, the capital city of Senegal. This observation suggests that the provision of the service is predominantly focused on and concentrated in urban areas.

Furthermore, there is a problem with affordability in terms of fixed broadband and mobile services. Despite the increasing penetration rate of mobile phones, access to the Internet and inexpensive telecommunications services hinder Senegal to take advantage of the potential. In the case of affordability of telecommunication services, Senegal ranks 130 out of 138, and in terms of accessibility of Information and Communication Technology (ICT), Senegal ranks 138 out of 176 countries (Pop & Corthay, 2018). This internet penetration rate is below the level of Ghana and Kenya. Even if the majority of people in Senegal own mobile phones, without affordable internet access, mobile money account services cannot deliver their purpose efficiently nor can they encourage the use. Consequently, the inclination of Orange Money towards its commercial objectives has had a discernible impact on the outcomes derived from the logistic regression analysis conducted in this study.

V. Policy Recommendations

To promote financial inclusion, it is necessary to tackle the policy and market challenges that contribute to financial exclusion. The public sector has a crucial role to play in this endeavor by establishing the necessary legal and regulatory framework, fostering an informative environment, and ensuring the education and protection of mobile money service users. Drawing upon the quantitative and analytical findings, this section presents three policy recommendations aimed at enhancing the implementation of mobile money accounts that ultimately leads to financial inclusion for all segments of society and the economy in Senegal.

5-1. Tackling Digital Divides Through Financial Education

The quantitative analysis revealed a notable disparity in the usage of mobile money in Senegal. This signifies the presence of digital divides depending on socioeconomic characteristics. To bridge the digital divide and empower individuals to use mobile money services effectively and safely, knowledge plays a pivotal role. A widely available and adequate financial education must be given across different areas and population groups. According to the results of the Financial Development Barometer (World Bank, 2014), a significant majority of respondents perceived a lack of awareness about fundamental financial products and services as a major obstacle to financial inclusion. In alignment with this finding, when the survey asked about the most effective policy to enhance financial access for low-income groups, the highest proportion of respondents, about 32%, chose financial education.

Despite notable improvements in coverage, gaps in mobile internet coverage and accessibility remain throughout Senegal. In the case of coverage areas, there

exists a significant 3G coverage disparity between urban and rural areas, even within the neighborhoods in Dakar. The urban areas have a higher share of mobile money account ownership at 35 percent compared to 27 percent in rural areas (Cruz, Dutz, & Rodriguez-Castelan, 2021). Additionally, significant disparities can be observed within the country, particularly in relation to gender. Men, those with higher education levels, individuals in the labor force, and those at the top of the consumption distribution are more likely to engage in online payments. This limited use of digitally enabled financial services can hinder financial inclusion.

Senegal has the potential to facilitate financial education initiatives that address digital disparities and empower individuals to actively engage in mobile money services. This endeavor will augment the people's comprehension and assurance in utilizing digital financial tools, consequently fostering financial inclusion and harnessing the advantages of mobile money services for socioeconomic development. Education must acknowledge the diverse needs of different demographic cohorts and tailor financial education initiatives correspondingly. The needs have to consider the particular obstacles encountered by women, youth, rural communities, and individuals with limited literacy capabilities to make financial education more inclusive and effective.

The implementation of financial education programs necessitates collaboration and support from various organizations. Partnerships between the government, private sectors, NGOs, and international organizations can pool resources, expertise, and networks for financial education initiatives. Collaboration among stakeholders will ensure the scalability, sustainability, and wider reach of financial education programs. Greater emphasis should be placed on local community education centers. Well-trained local educators can serve as trusted

sources of information and provide ongoing support to individuals in their communities.

5-2. Providing Affordable Internet and Broadband Through Market Liberalization

The findings showed the need for more affordable internet and broadband network services in Senegal. To enhance financial inclusion through mobile money services, it is crucial to address the market dominance of Orange Money and promote a more competitive market environment. Based on the assessment of Senegal's telecommunications regulator, the Autorité de Régulation des Télécommunications et des Postes (ARTP), Sonatel maintains a dominant position in all relevant markets within the mobile telephony segment. Even when Espresso and Tigo entered the market as a competitor, Sonatel continues to maintain a market share of 97% (Pop, Georgiana & Laurent O. Corthay, 2018). With this excessive dominance, liberalizing the mobile money market and fostering competition can encourage the entry of new internet service providers (ISPs). The competitive market will not only drive down prices but will also expand the coverage and quality of internet and broadband services in both urban and rural areas.

The level of broadband penetration and the quality of service in the market are limited in Senegal. A 4G license allocated to Orange-Sonatel through bilateral negotiation instead of an open and competitive procedure exemplified a high degree of Orange-Sonatel's market concentration in the country. In terms of active mobile broadband subscriptions, Senegal exceeds the regional average (43.7 subscriptions per 100 inhabitants compared to 35), as well as the number of fixed broadband subscriptions (0.82 per 100 inhabitants compared to 0.43). However, these figures remain low compared to other regional leaders such as Namibia, Cabo Verde, and

Mauritius, where the numbers of fixed broadband subscriptions are significantly higher (2.5, 2.8, and 21.6 per 100 inhabitants, respectively) (Cruz, Dutz & Rodriguez-Castelan, 2021).

Despite owning a substantial amount of fiber-optic infrastructure, Senegal is unable to fully utilize it, especially under public ownership. Although the State Informatics Agency (Agence de l'Informatique de l'État, ADIE) has made tremendous public investments in establishing a network, ADIE lacks an operator's license that hinders its ability to provide access to the network (World Bank, 2019b). In addition to this legal obstacle, Orange-Sonatel holds a monopoly over data transmission in Senegal due to its exclusive access to the main international gateway. The lack of regulatory measures pertaining to gateway access further reinforces the company's dominant position and contributes to the high costs associated with internet coverage (Cruz, Dutz & Rodriguez-Castelan, 2021).

These pose challenges in terms of security, governance, and the adoption of the Internet, e-commerce, and mobile money services. Alleviating the market tension can create an inclusive environment for mobile money services. Collaboration between regulatory bodies, mobile network operators, and other stakeholders to develop and implement policies can contribute to a more comprehensive financial inclusion strategy and enable the benefits of mobile money services to reach a larger segment of the population.

5-3. Building a Close Bond with the Central Bank

The intervention of the central bank can serve as a potential solution to mediate market problems and address the issue of inequality in financial inclusion by ensuring the equitable provision of secure financial services. To ensure the

sustainable provision of financial services for all, in accordance with the World Bank's guidelines on financial inclusion, it is imperative that mobile money services are equipped with a high level of safety and security measures. As can be seen from the case of Kenya, M-Pesa maintains a strong relationship with the Central Bank of Kenya (CBK). Despite the classification of both M-Pesa and Orange Money as branchless banking entities operating outside the purview of traditional banking regulations, it is noteworthy that M-Pesa has undergone rigorous auditing procedures and obtained official approval from the Central Bank of Kenya (CBK). Furthermore, transactions conducted through the M-Pesa platform benefit from the safeguard of insurance coverage provided by the Deposit Protection Fund, which is managed by the CBK (IFC, 2010). Such relation with the central bank ensures effective regulation, oversight, and support for mobile money services, fostering an environment that promotes innovation, consumer protection, and financial stability.

Collaboration with the central bank can serve as a catalyst for fostering innovation within the realm of mobile money services while ensuring consumer protection and financial integrity. It is incumbent upon the central bank to create a supportive ecosystem that incentivizes mobile money providers to introduce novel offerings, services, and technological advancements. This proactive approach will also foster interoperability among diverse mobile money providers. The central bank will play a pivotal role in facilitating the development of open standards and interoperable platforms, thereby enabling seamless transactions across different mobile money systems. Such initiatives promote healthy competition, enhance convenience, amplify customer choice, and prevent the fragmentation of the mobile money market.

VI. Limitations and Suggested Research

Some limitations of the research on enhancing financial inclusion through mobile money accounts in Senegal include the reliance on secondary data sources, which may not fully capture the complexity of individual experiences and behaviors regarding financial services. The study is limited to a specific time period and may not reflect ongoing developments and changes in the mobile money industry. Additionally, there is a lack of data. For example, the study is unable to assess Orange Money's contribution to the 4G coverage in Senegal as Orange provides the overall coverage rate as a whole instead of specific regional data.

This study, unfortunately, could not include estimations for urban and rural areas as independent variables due to the unavailability of such data in the Findex database. Similar to the findings of Mbiti and Weil (2011), which revealed a concentration of mobile money usage in urban areas, this paper lacks the necessary data to investigate this aspect in Senegal.

To address these limitations and build on the findings of this research, further studies could incorporate primary data collection through surveys, interviews, or focus groups to gain a more understanding of the barriers and opportunities for financial inclusion through mobile money accounts in Senegal. Future research could also expand the scope of analysis to include other mobile money service providers and examine the effectiveness of different policy interventions to enhance financial inclusion. Additionally, the research could investigate the potential impact of digital literacy programs and other initiatives to increase awareness and understanding of mobile money services among underserved populations.

VII. Conclusions

The digitalization of traditional financial accounts has a considerable impact on promoting financial inclusion. Mobile money accounts, as a digitalized financial service, provide access to financial services, particularly for underserved or excluded individuals who lack access to traditional banking services. In countries where mobile phone usage is widespread, the introduction of mobile money services can significantly enhance financial inclusion. Senegal, with one of the highest mobile phone penetration rates in West Africa, was expected to achieve successful financial integration with the introduction of Orange Money's mobile money service in the market. In its efforts to support the achievement of the Sustainable Development Goals, Orange Money has increased the registration rate of mobile money accounts in Senegal.

Although digitalized financial services have demonstrated successful financial inclusion in Kenya, this research paper argues that this may not always be the case, as evidenced by the case of Senegal. The findings of this study indicate that Senegal has achieved a level of financial inclusion through mobile money accounts, evident from the increasing number of account holders. However, upon closer examination of the data, it becomes apparent that inequality in financial inclusion persists when considering further segmentation by socioeconomic status. There is potential for unequal financial inclusion with mobile money accounts in Senegal, implying that certain more dominant demographic groups may benefit more than others from this digital financial service. While account holders in financial institutions exhibit inclusion across various categories with strong statistical

significance, the regression slopes for mobile money account holders show the opposite trend. The impact of mobile money accounts in Senegal appears to be concentrated on individuals who are young males, relatively wealthier, and more educated.

The paper found that the possible reasons behind such an unexpected outcome are due to the mobile money provider's concentrated efforts on commercial purposes. Most of its so-called "Sustainable Development Goals" oriented services are available in the capital city of Senegal. In particular, although Orange Money offered mobile phones at reasonable prices, the cost of their broadband network service was not affordable to the low-income group and in rural areas. Compared to the other countries in West Africa, Senegal had the highest cost for internet coverage. This meant that even with the possession of mobile phones, people were unable to access mobile money services due to inaccessible networks. The findings of the analysis indicate that traditional financial accounts have demonstrated greater inclusivity, while the introduction of digitalized financial services has led to financial exclusion by exacerbating disparities within socioeconomic categories. Consequently, as conventional financial accounts become more inclusive and mobile money accounts concentrate among more dominant socioeconomic groups, the overall account regression results depict a U-shaped pattern. This trend suggests that the probabilities of the factor variables relative to the reference variable decreased in 2017 but increase in 2021.

This paper posits that while the introduction of digital transformation in financial banking services has made significant contributions to financial inclusion, it has not comprehensively fulfilled its intended objective. While the increased number of mobile money account holders may indicate a level of financial inclusion,

a closer examination of the data by socioeconomic status reveals certain discrepancies in this inclusion. Therefore, it may be more prudent to consider the issue of financial inclusion in a more nuanced manner, accounting for the varying distribution of accounts among different socioeconomic groups within the country. This discrepancy arises from the unequal distribution of digital financial services among individuals of varying socioeconomic statuses. Although certain limitations exist within the available data, such as temporal gaps and a lack of comprehensive data on urban and rural regions in Senegal, this paper proposes the implementation of regulatory frameworks to address the disparity in the distribution of services. The suggested policies emphasize three strategic approaches: (1) to enhance awareness of mobile money services through financial education; (2) to address larger socioeconomic disparities by market liberalization; and (3) to encourage the active involvement of the central bank in regulating mobile money service providers.

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Abstract in Korean

전통적인 금융 계정의 디지털 변환은 금융 포용에 상당한 영향을 미친다. 모바일 머니 계정이라는 디지털 금융 서비스 중 하나는 특히 전통적인 은행 서비스에서 소외되거나 배제된 사람들을 위해 금융 서비스에 대한 접근성을 확장한다. 특히나 휴대전화 사용이 보편화된 국가에서 모바일 머니 서비스 도입은 포용금융 효과를 강화할 수 있다. 이처럼 세네갈은 서아프리카에서 휴대전화 보급률이 가장 높은 국가 중 하나로 “오렌지머니”가 모바일 머니 서비스를 시장에 처음 선보였을 때 성공적인 금융통합이 이뤄질 것으로 기대됐다. 세네갈의 모바일 머니 계정 서비스는 주로 프랑스 통신 회사인 Orange S.A 주도하에 지속 가능한 개발 목표를 달성하기 위해 세네갈의 더 많은 사람들을 연결하려는 초기 시도가 있었고 이는 세네갈에서 모바일 머니 계정의 등록율을 높였다.

디지털화된 금융 서비스는 일반적으로 포용금융의 성공적인 요소로 인식되지만, 이 연구에서는 세네갈의 사례를 통해 그 결과에 잠재적인 변동성을 강조한다. 이 연구는 세계은행의 글로벌 핀텍스에서 수집한 미시 경제 데이터를 기반으로 다중 로지스틱 회귀 분석을 수행한다. 이를 통해 2014년, 2017년 및 2021년에 기존 은행 계정을 보유한 개인과, 모바일 머니 계정을 보유한 개인 간의 로지스틱 회귀 결과를 비교하고, 세네갈의 모바일 머니 계정에 대한 불평등한 포용금융의 사례를 주목한다.

연구 결과에 따르면, 금융기관 계좌 보유자들은 통계적으로 유의미한 다양한 범주에 포함되는 것으로 나타났다. 반면, 모바일 머니 계정 보유자들은

반대의 회귀 기울기를 보였으며, 이는 세네갈에서 모바일 머니 계정이 상대적으로 부유하고 교육 수준이 높은 남성들에게 집중되는 것으로 보인다는 것을 증명한다. 이러한 결과들은 세네갈에서 모바일 머니 계정의 영향이 금융 포용성에 불평등을 가져오고 있음을 시사한다.

이러한 연구 결과를 바탕으로 본 연구는 국가에서 직면한 다양한 상황을 고려한 정책 제안을 제공한다. 모바일 머니 계정이 세네갈의 금융 포용에 완전히 기여하도록 하려면 이에 따른 장벽을 해결하고 교육, 소득 수준, 성별 또는 연령에 관계없이 모든 그룹이 모바일 머니 서비스를 사용할 수 있도록 하는 것이 중요하다. 이를 위해서는 금융 서비스에 대한 접근을 제한할 수 있는 광범위한 사회경제적 불평등을 해결하기 위한 조치 뿐만 아니라 모바일 머니 서비스에 대한 인식과 이해를 높이기 위한 집중적인 노력이 필요하다는 것을 알 수 있다.

주제어: 디지털 전환, 포용금융, 디지털 포용금융, 핀테크, 불평등한 포용금융, 모바일 머니 계정

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