



SCHOOL OF ECONOMICS AND MANAGEMENT

Mobile Money and Financial Development in Sub-Saharan Africa

A Digital Key to Economic Growth?

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Abstract

This thesis examines whether, and to what extent, mobile money drives financial development in Sub-Saharan Africa. Given the well-documented positive effect of financial development on economic growth, it is of interest to determine whether mobile money in turn will have a positive impact on economic growth. Three different multiple regression analyses using unbalanced panel data are performed to estimate the effect of mobile money usage on three aspects of the financial system: *personal remittances received*, *gross capital formation*, and *domestic credit to private sector*. The regressions draw on data from 11 Sub-Saharan African countries over the period 2000-2023. The results reveal a statistically significant negative relationship between mobile money and remittance inflows. In contrast, the analyses find no significant relationship between mobile money and either *gross capital formation* or *domestic credit to private sector*. While the findings offer limited evidence of an impact on financial development, they underscore the importance of further research. Given the recent emergence and rapid expansion of mobile money across Sub-Saharan Africa, its influence on the financial system and economic growth is believed to be observed over time.

Keywords: Mobile money, Sub-Saharan Africa, financial development, financial inclusion, economic growth

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1. Introduction

The world is experiencing rapid technological advancements that are reshaping several aspects of society – governments, individuals, and businesses. As digital technologies are becoming more embedded in daily life, human-to-human contact is gradually being replaced by digital platforms. Understanding how economies are changing requires identifying which sectors are being affected as well as what these changes could lead to in a longer perspective.

Technology has changed the way in which financial systems function, as seen through the rise of mobile money (MM). The first MM provider emerged in East Asia and the Pacific in 2001 but gained significant popularity with the launch of M-Pesa in Kenya in 2007. Soon after, Vodacom launched M-Pesa in Tanzania, followed by Uganda and Rwanda. Today, a majority of MM providers are concentrated in Sub-Saharan Africa (SSA) (McCaffrey 2022).

SSA consists of 48 countries with diverse income levels ranging from low to high income. Challenges related to poverty and underdevelopment are seen in several parts of the region, with limited access to financial services, electricity and clean water (Adah Onu et al. 2024). The region's vulnerability suggests that it stands to benefit significantly from technological innovations such as MM, making it an interesting area of study. The rapid adoption of MM across SSA is transforming the financial system, which potentially could spur long-term economic growth in the region.

1.1 Aim and Research Question

The aim of this study is to determine whether, and to what extent, MM drives financial development in SSA. Finding such a relationship would suggest that MM supports long-term economic growth in the region, given the well-established link between financial development and economic growth. The research question is formulated as follows:

Will the adoption of mobile money in Sub-Saharan Africa contribute to financial development and subsequently spur long-term economic growth in the region?

As MM services continue to expand across the region, it is pertinent to examine whether they will have a positive effect on long-term economic growth. Although such effects may take time to be realized, the influence of MM on financial development can be observed over a shorter time horizon. This study therefore adopts a shorter-term perspective to evaluate MM's impact

on key components of the financial system, with the aim of determining whether MM fosters financial development that, in turn, contributes to economic growth.

1.2 Method and Limitations

This study employs three multiple regression models using unbalanced panel data controlled for country and time fixed effects. This approach allows for cross-country comparisons while accounting for time-varying factors that are constant between countries. Due to data limitations and the recent birth of MM, the dataset is unbalanced. The analysis covers 11 SSA countries during the period 2000-2023. The countries, shown in *Figure 1*, are: Botswana, Ghana, Kenya, Lesotho, Madagascar, Mozambique, Namibia, Rwanda, Uganda, Zambia and Zimbabwe. The choice of countries is motivated by data availability, as these were the only ones with sufficiently complete data for the variables of interest.

Figure 1: Map of the 11 countries included in the study.



1.3 Disposition

The thesis begins with an introduction outlining the study’s aim and research question. The background chapter provides the context of the area studied, by describing trends and by

explaining key concepts. Chapter 3 reviews relevant literature to highlight the current state of research and position this study within it. The theoretical framework is then presented, based on the background and previous research. This is followed by a section describing the variables included as well as a detailed methodology chapter outlining the overall methodological approach, including the regression models and the expected outcomes. Subsequently, a section summarizing the specification testing is provided. The results are presented in section 8 and further analyzed in the discussion. Recommendations for future research are presented before concluding the study by summarizing the aim, methodology, and results.

1.4 Definitions

Financial inclusion: Broadly defined as the access to affordable and appropriate formal financial services for individuals and enterprises. This includes access to credit, savings, and payment systems (Rouse & Verhoef 2017).

Financial development: Enhancement of depth, efficiency, access and stability of the financial markets and institutions (World Bank 2019).

Mobile money (MM): A digital tool that provides financial services through a mobile phone without requiring a bank account (Shirono et al 2021).

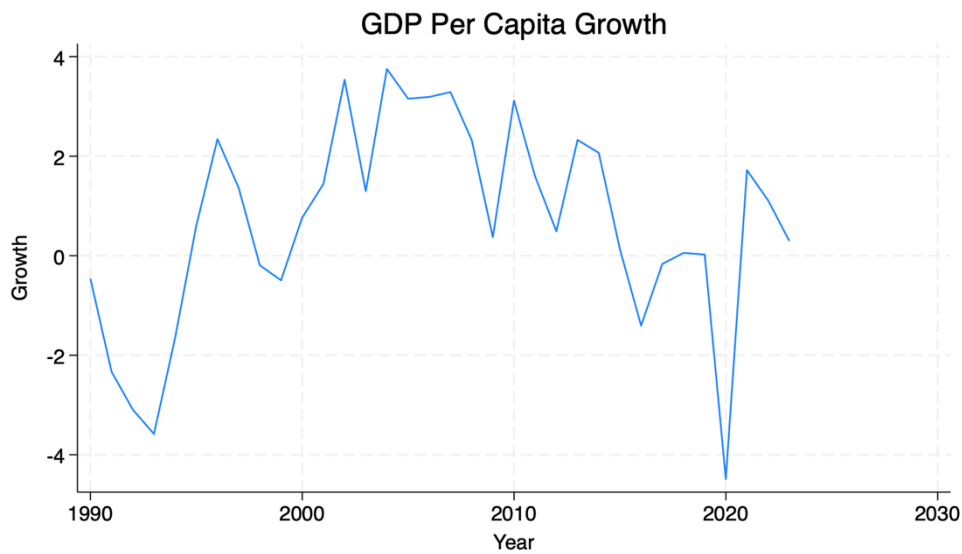
2. Background

This section provides the relevant background for the study. We start by giving a picture of general economic growth trends in SSA. After that, we define financial development and provide context for the region's current state of financial development. The focus then narrows down to MM, its definition, and its expansion across SSA. Given MM's important role in advancing financial inclusion, which in turn is an essential component of financial development, we continue by describing the relationship between MM and financial inclusion. Lastly, section 2.6 presents a table listing the major MM providers operating in the 11 countries included in the study.

2.1 Economic Growth in Sub-Saharan Africa

SSA is a diverse region consisting of a wide range of low, middle, and high-income countries. Due to this, conditions for economic growth differ widely across countries. While the region exhibits great potential for progress, SSA faces both direct and underlying vulnerabilities that hinder growth, including droughts, energy shortages, political instability and weak governance (IMF 2024). These challenges contribute to economic volatility in many SSA countries, as can be observed in the fluctuating GDP per capita growth over the recent decades (*Figure 2*). Nonetheless, there is still great potential for economic development in the region, given that appropriate reforms are implemented to restore macroeconomic stability. The richness of natural resources, a rapidly growing labor force, participation in the world's largest free trade area (AfCFTA) and emerging technologies – such as MM that promotes financial inclusion – are all reasons to believe that this in fact will become a reality (World Bank 2025a).

Figure 2: GDP per capita growth (annual %) in Sub-Saharan Africa 1990-2023. Based on constant local currency.



Source: World Bank 2025b

2.2 Financial Development in Sub Saharan Africa

Financial development plays an important role in promoting economic growth and reducing growth volatility, making it essential to examine its dynamics.

Defining financial development requires understanding the financial system's role in the economy and the interaction among its components. The financial system consists of various financial instruments, markets, intermediaries, and a regulatory framework through which the exchange of funds is facilitated. Financial development refers to the overall improvement of the financial system by reducing costs and enhancing efficiency. This includes increasing and mobilizing savings, providing information, and efficiently allocating both foreign and domestic capital flows and investments. The development of these functions can be categorized into four different dimensions applied to financial markets and institutions: depth, efficiency, access, and stability (World Bank 2019).

Measuring financial development, however, is challenging due to its multidimensional nature. The Financial Development Index created by Svirydzenka (2016) addresses this by combining indicators across the dimensions of depth, access, and efficiency in the financial markets and institutions. Thereby, it gives a measure of the level of financial development within a country or region. According to this index, SSA countries have significantly lower development levels than other developing regions in the world. While progress has been observed in some

countries, others – such as Central African Republic, Chad, Sierra Leone and Cameroon – have experienced declining financial development levels since the 1980s. Nevertheless, there are positive examples within the region. Botswana and Namibia, for instance, have experienced more rapid financial development than the regional average, driven by growth in financial institutions and markets. This development has been fueled by the expanding role of stock exchanges within the financial system, alongside an increase in commercial banks and other institutions such as pension funds and insurance companies. These trends underscore that financial development in SSA depends on the advancement of multiple dimensions of the financial system (Mlachila et al. 2016).

2.3 Defining Mobile Money

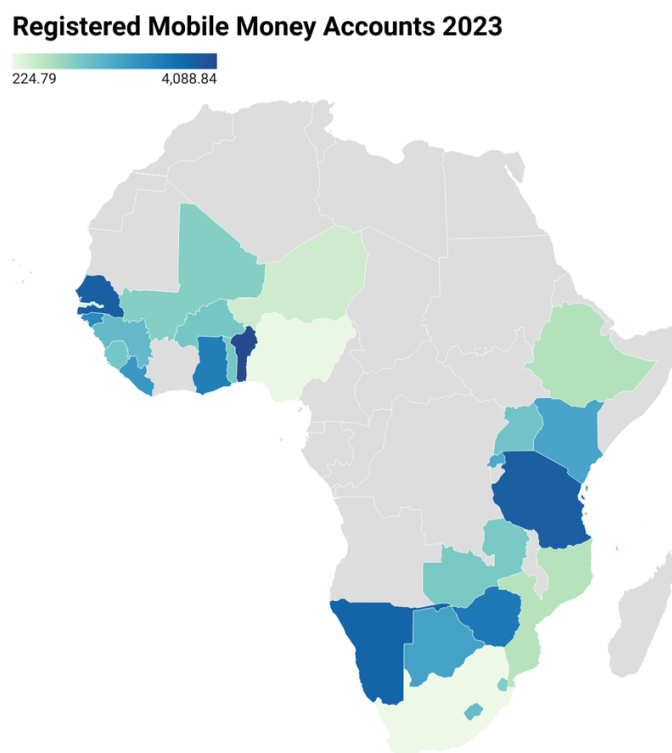
To assess the impact of MM on financial development in SSA, it is essential to understand its underlying technology. MM is a financial tool which allows individuals to store and transfer money on an account on their mobile phone. Core services include access to savings accounts, facilitating microloans, merchant payments, bill and tax payments, as well as airtime purchases. All of these services are offered without the requirement of a traditional bank account. The services are usually provided by a mobile network operator (MNO) and are typically independent of the traditional banking system. One can register for a MM account, as well as cash-in and cash-out money, at so-called MM agents. MM and mobile banking are not to be confused with each other as the latter refers to traditional banking services available on a mobile phone. A bank offering an application on the phone where one can check deposits, see balance inquiries and transfer money is an example of mobile banking. MM's independence from traditional financial intermediaries and its high accessibility is what makes it unique (Shirono et al 2021).

2.4 Mobile Money in Sub-Saharan Africa

Over the past 15 years, MM has been on the rise in SSA. In fact, it has become an epicenter for MM in the world. According to GSMA (2025), the region accounted for 1.1 billion registered MM accounts in 2024, representing 53% of the global total. During the 2021-2022 period, 28% of all adults in the region held a MM account (World Bank 2024a). Despite this growth, MM penetration varies across the region. Kenya, for instance, was an early adopter of MM with the launch of M-PESA in 2007 and remains one of the most MM-dense countries in the region. As of December 2024, Kenya had 82.43 million registered accounts (Central Bank of Kenya n.d), and 79% of its adult population held a MM account, far exceeding the regional average of 28%

(World Bank 2021). In some countries in the region, MM is less prevalent, however, these are a minority. According to the World Bank's Global Findex Database, in 20 out of 36 SSA countries surveyed, at least 30% of adults reported having a MM account (World Bank 2024b). This widespread use of MM in the region suggests it has potential to influence economic behavior, and thereby the financial system as a whole. *Figure 3* illustrates the number of registered MM accounts per 1 000 adults across SSA in 2023, with darker colors indicating higher levels of penetration.

Figure 3: Map displaying the number of registered MM accounts per 1 000 adults in Sub-Saharan Africa in 2023.



Source: IMF 2025b

Note: The non-colored countries were lacking data for registered MM accounts in 2023.

2.5 Mobile Money and Financial Inclusion

One key dimension of financial development is access to financial services, commonly referred to as financial inclusion. SSA experiences a lower degree of financial inclusion when compared to global standards. This is due to the lack of well-developed infrastructure and efficient institutions providing basic financial services such as savings accounts, loans, reasonable lending rates, and ATMs. In 2021, the share of adults owning an account at a regulated financial

institution in the region was 55%, compared to the global average of 76%. However, the rise of MM has begun to reverse this trend. MM services have emerged as a complement to traditional financial intermediaries. Between 2011 and 2021, the proportion of adult account ownership more than doubled, a shift driven by the adoption of MM (Demirgüç-Kunt et al. 2021). MM is generally a more cost efficient and accessible financial tool compared to services offered by traditional financial institutions. For example, sending remittances via MM is, on average, 47% cheaper than through other channels (GSMA 2022). By providing similar services at lower costs and with greater reach, MM has enabled a larger share of the population to participate in the financial system.

High reliability on cash is traditionally a barrier to financial inclusion, as it keeps individuals outside of the formal financial system and increases handling costs for institutions (Borreau & Valletti 2015). The transition from physical to digital money is therefore an important step in strengthening the access-dimension in financial development.

2.6 Active Mobile Money Operators in the Study Group

Table 1 presents a selection of the majority of MM providers operating in each of the 11 countries included in the study. The listed firms offer MM services according to the definition in section 2.3.

Table 1: Majority of active MM operators with their respective MM service in the 11 Sub-Saharan African countries included in the study.

| Countries | <i>Number of MM operators</i> | <i>Mobile Money Operators</i> |
|-------------------|-------------------------------|--|
| Botswana | 4 | Orange Botswana (Orange Money), Mascom (MyZaka), BTC (Smega), BotswanaPost (PosoMoney) |
| Ghana | 5 | Vodafone Ghana (M-Pesa), MTN Ghana (MoMo), AirtelTigo (Airtel Money), Telecel Ghana (Telecel Cash), Zeepay (Zeepay Mobile Money) |
| Kenya | 3 | Safaricom (M-Pesa), Airtel Kenya (Airtel Money), Telkom Kenya (T-Kash) |
| Lesotho | 2 | Vodacom Lesotho (M-Pesa), Econet Telecom Lesotho (EcoCash) |
| Madagascar | 3 | Telma Madagascar (MVola), Orange Madagascar (Orange Money), Airtel Madagascar (Airtel Money) |
| Mozambique | 3 | Vodacom Mozambique (M-Pesa), Tmcel (mKesh), Movitel (e-Mola) |
| Namibia | 1 | MTC (Maris) |
| Rwanda | 2 | MTN Rwanda (MoMo), AirtelTigo Rwanda (Airtel Money) |
| Uganda | 2 | MTN Uganda (MoMo), Airtel Uganda (Airtel Money) |
| Zambia | 4 | MTN Zambia (MoMo), Airtel Zambia (Airtel Money), Zamtel (Zamtel Mobile Money), Ecobank (MobileMoney) |
| Zimbabwe | 4 | Econet Wireless Zimbabwe (Ecocash), NetOne (OneMoney), Telecel Zimbabwe (Telecash), InnBucks MicroBank Limited (InnBucks) |

Note: Information about the operators' MM services was gathered from their official websites. No specific order in terms of market share.

This study analyzes the number of registered MM accounts in each country, regardless of service provider. It is therefore relevant that all of these offer the same, or similar, services. After reviewing the operators listed in *Table 1*, we conclude that, generally, the core services

provided are the same. The majority of the operators facilitate money transfers, bill payments, international remittances, microloans, transaction history, account services, as well as airtime purchases.

While some variation exists in the range of services offered, these differences are relatively minor. For example, only two providers, NetOne and Econet Telecom Lesotho, do not offer the possibility of receiving and sending international remittances (NetOne n.d, Econet Telecom Lesotho n.d). Additionally, Botswana Telecommunications Corporation and Mascom offer international remittance services, but to and from a limited number of countries (Botswana Telecommunications Limited n.d; Mascom n.d). Regarding credit services, a majority of the MM providers displayed in *Table 1* offer the possibility to take out loans. An exception is EcoCash, provided by Econet Telecom Lesotho, which do not offer this credit service (Econet Telecom Lesotho n.d).

Although a few providers offer a narrower range of services, they represent only a small portion of the MM operators in the sample. Despite these differences, they all provide financial inclusion by offering a variety of financial services to their customers. For this reason, we consider it appropriate to categorize actives MM operators as one homogenous group for the purpose of this analysis.

3. Previous Research

This chapter reviews the existing research relevant to our study. The primary focus is on examining the chain through which MM may contribute to financial development, and if this in turn could spur economic growth. To break down the chain, this chapter is structured as follows: first, we examine studies researching the link between financial development and economic growth. We then review studies exploring the relationship between financial inclusion and economic growth, including the empirical connection between MM and financial inclusion. Next, we present country-level studies analyzing the effects of MM on economic growth, financial development, and various components of the financial system. Finally, we review research that investigates the regional impact of MM within SSA.

3.1 Financial Development and Economic Growth

Numerous empirical studies confirm a strong, positive relationship between a well-developed financial system and long-term economic growth. However, this relationship has historically been debated. For instance, Lucas (1988) argued that the role of financial factors in economic growth has been overemphasized by economists. In contrast, Levine (1997) concludes that there in fact is a strong causal relationship between financial development and long-term growth. Levine highlights the importance of financial service *quality* and outlines several key functions of the financial system, including facilitating risk management, improving the allocation of resources by reducing costs of gathering and analyzing information, mobilizing savings, and facilitating the exchange of goods and services by lowering transaction costs. While these functions are present across countries, the differences lie in their quality and how effectively they are performed.

A study examining the level of financial development in relation to real GDP was conducted by King and Levine in 1993. The research includes 80 countries between 1960 and 1989 using four indicators of financial development – depth (measured by liquid liabilities), bank (the allocation of credit by commercial vs. central banks), private (share of domestic credit allocated to private enterprises) and privy (credit to private enterprises as a share of GDP). All four indicators show a positive relationship with the three growth indicators included in the study: real GDP per capita growth, capital accumulation, and productivity growth (Levine 1997).

A 2009 working paper published by Asian Development Bank (ADB) supports the findings of King and Levine, emphasizing that well-functioning financial systems reduce costs for

transactions, enforcement and information – all of which facilitate economic growth. The paper argues that economies with developed banking sectors and financial markets tend to experience faster growth. A well-functioning financial system helps reduce external financing constraints by making capital more accessible, affordable, and reliable for firms. This, in turn, enables firms to invest in new projects, adopt technology and scale up, contributing to companies expanding while driving overall economic growth (Zhuang, J et al.).

Evidence from Ghana further supports the positive relationship between financial development and economic growth, but applies a different approach. Adu, Marbuah and Mensah (2013) employ an autoregressive distributed lag model and find that the relationship between financial development and economic growth varies depending on the proxy used for financial development. Since the financial system is built up of several dimensions, and previous studies have focused on different ones, historical disagreements over the financial development – growth relationship may be because of this. Their findings show that credit to the private sector (ratio to GDP) and total domestic credit as proxies for financial development has significant positive effects on economic growth, while broad money stock (to GDP ratio) does not. The study also underscores the influence of country specific factors, such as political freedom and institutional trust, which affect savings and investment behavior and, consequently, economic growth. These results highlight the importance of choosing appropriate financial development indicators and accounting for country-specific factors.

Not all studies identify a positive linear relationship between financial development and economic growth. A study conducted on 27 countries in SSA in 2019 by Bandura and Dzingirai finds a U-shaped relationship between financial development and economic growth. Using private credit (% of GDP) as a proxy for financial development and the logarithm of GDP per capita for economic growth, their non-linear panel regression incorporates both institutional quality variables (e.g., corruption, government stability) and key control variables (e.g., inflation, government consumption, gross savings). The results suggest that financial development initially slows down economic growth, but beyond a certain threshold – when private credit accounts for 33-37% of GDP – it begins to have a positive effect. Furthermore, the study finds that strong institutions enhance the positive impact of finance on growth. SSA faces financial sector challenges and has a low development average compared to the global norm, leading to a lack of institutional capacity to be able to fully benefit from financial deepening.

3.2 Financial Inclusion and Economic Growth

Financial inclusion is a fundamental component of a developed financial system and is closely linked to economic growth. This section first reviews empirical evidence on the relationship between financial inclusion and economic growth, followed by a section describing how MM contributes to enhancing financial inclusion in SSA.

A growing body of empirical literature confirms a positive relationship between financial inclusion and economic growth. Adedokun and Ağa (2023) conducted a panel data analysis on 36 SSA countries between 2004 and 2017, finding that financial inclusion significantly and positively impacts GDP per capita. Financial inclusion is measured using a number of indicators, including the number of loan and deposit accounts with commercial banks per 1 000 adults, as well as the number of ATMs and branches of commercial banks per 1 000 km² and per 100 000 adults. The results also reveal a short-term effect of economic growth on financial inclusion. The authors argue that in order for SSA to achieve sustainable economic growth, policymakers must prioritize reforms aimed at increasing financial inclusion and improving access to affordable, high-quality financial services.

Another study investigating the impact of financial inclusion on economic growth was conducted by Azimi (2022). The study analyzes 218 countries over the period 2002-2020 and employs a panel regression model and a composite financial inclusion index (CFII) based on three dimensions: banking penetration, availability, and usage. Consistent with the findings of Adedokun and Ağa, the results suggest that higher financial inclusion significantly boosts economic growth across all income and regional groups observed. The study also finds a bidirectional causality between financial inclusion and economic growth – each reinforcing the other. Azimi emphasizes that financial inclusion is a driver of growth regardless of the economy. Therefore, the advancement of financial services is of importance to get a more rapid integration of formal financial systems to the excluded population. Bridging the digital divide is key to reducing inequalities in access to digital technologies. The adaptation of financial services needs to be made easy, and therefore there has to be a platform that allows for this.

For the purpose of this study, the connection between MM and financial inclusion is of particular interest. Ramfors (2024) investigated this relationship in Kenya at the national, provincial and county levels using a quantitative research method, presenting descriptive statistics to analyze the findings. His results indicate that MM services significantly increase financial inclusion and also have a positive impact on financial health, poverty reduction, and

gross county product (GCP) per capita. The study further concludes that MM, financial inclusion, and GDP per capita follow the same trends over time. Moreover, counties with slower MM adoption rates also experience lower levels of financial inclusion.

Overall, existing research provides strong evidence that financial inclusion spurs economic growth, and that MM may serve as an important tool for increasing financial inclusion by bridging the gap between the unbanked population and formal financial services.

3.3 Impact of Mobile Money on Country-level

The previous sections have provided empirical evidence supporting the positive impact of both financial development and financial inclusion on economic growth. Additionally, a positive relationship between MM and financial inclusion is observed. This section extends the discussion by reviewing country-specific studies that explore how MM impacts financial development and economic growth.

As an early adopter and one of the leading countries in MM, Kenya has experienced economic improvements across several sectors following its implementation. Fabregas and Yokossi (2022) assessed the impact of M-Pesa on economic activity by using light density derived from nighttime satellite imagery as a proxy for economic activity, and the expansion of MM agent network to measure access to M-Pesa. The study uses a dynamic difference-in-difference model and finds that access to MM services increases economic activity, and that the effects are more noticeable in urban areas with better infrastructure. A key driver of this is the reduction of transaction costs, which boosts domestic remittances. The remittances serve as a source of credit, potentially leading to growing businesses and thereby an improved allocation of investments. Additionally, MM's effective payment system facilitates the trade of goods and services, enabling the private sector, including households, to save time, money and energy, while also fostering a safer business environment.

Similar outcomes regarding remittances are observed in Uganda, where Okelo (2025) analyzed the impact of MM on remittance costs, flows, and monetary policy. The findings show that a reduction in costs due to MM is important for the growth in remittance volumes. Arinze, Aleke & Nnachi (2024) examined Uganda's mobile money ecosystem, highlighting its crucial role in extending access to payments, savings and credit services – particularly in areas underserved by traditional banks. The expansion of MM in Uganda has led to increased GDP growth by enhancing efficiency, stimulating economic activity, and fostering innovation. Rather than

replacing traditional banking, MM functions as a complementary tool, promoting broader financial development in the country.

In Ghana, the Payment Systems Department of the Bank of Ghana conducted an econometric analysis in 2017 to assess the impact of MM on the country's payment system. Ghana has experienced a growth in the usage of MM services as they have become a major source of payment for the unbanked population, replacing cash-based transactions. Similar to the case of Uganda, MM platforms have become a complement to traditional banks in Ghana, rather than replacing them. The study concludes that the growth of MM increases financial inclusion, deepens the payment systems, boosts savings mobilization, and contributes to economic empowerment across the country.

Collectively, country-specific studies confirm that MM plays a pivotal role in modernizing financial systems, increasing access to finance, and supporting broader economic development.

3.4 Impact of Mobile Money in Sub-Saharan Africa

Having explored the impact of MM in individual countries, this section presents existing research examining its effects across the region of SSA.

GSMA published a study in 2019 where the authors Kipkemboi and Bahia examine the impact of MM on monetary and financial stability in SSA using trend analyses. The study draws on multiple indicators to assess stability and evaluates MM's influence across 21 SSA countries. While trend analyses do not allow for causal inference – meaning one cannot establish that the trends in stability are solely because of MM – they can reveal notable correlations. The primary objective of the study is to analyze the effects MM has on financial development. In terms of monetary stability, the study finds that MM enhances financial depth by facilitating effective monetary policy and by transferring currency and assets into the formal financial system. In terms of financial stability, the study finds no evidence that MM poses risks or acts as a substitute for commercial banking services. Instead, countries with higher levels of MM adoption exhibit high growth in bank deposits and loans.

Another GSMA study underscores that the micro-level effects of MM are clear. The macroeconomic effects however – especially linked to GDP growth – are less documented. To address this, GSMA intelligence conducted an econometric analysis covering the period 2013-2022, establishing a causal effect of the implementation of digital financial services in low- and middle-income countries on long-term economic growth. (Storchi et. al. 2023). The *State*

of the Industry Report 2025 builds on these findings, confirming that MM has contributed to a 4.5% increase of GDP in countries with MM services in SSA between 2013 and 2023. Globally, the GDP increase in countries using MM was 1.7%. This indicates a clear relationship between economic growth and MM use, especially in SSA (GSMA 2025). However, given the relatively short time frame used, uncertainties remain about the channels through which growth is driven and whether it can be sustained over a longer period of time.

An enterprise study conducted by Islam, Muzi and Rodriguez Meza finds a positive correlation between the use of MM services and the “probability of a firm’s purchase of fixed assets”. The study uses nationally representative firm-level data from Kenya, Uganda, and Tanzania. A regression analysis is conducted where firm investment in a country serves as the dependent variable, and MM usage as the explanatory variable. Several control variables are also included in the model. The study finds that the use of MM for transactions is associated with a 16% increase in the likelihood of firms investing – largely due to reduced transaction costs, increased liquidity and increased creditworthiness. While based on a limited sample, these findings suggest a broader potential impact across the region (Islam, Muzi and Rodriguez Meza 2018).

Concluding this section, the body of research highlights the multifaceted impact of MM in SSA, ranging from improvements in monetary and financial stability to positive influences on investment and economic growth.

3.5 Concluding Remarks

Although existing research has explored the role of MM in promoting financial inclusion and development, an aggregate econometric analysis of the effects of MM on key functions of the financial system in SSA is lacking. While studies offer evidence that MM has a positive economic impact in the region, much of the research is conducted on relatively short time horizons and in individual countries. Hence, it may not fully capture the long-term nature of economic growth processes. In order to capture the potential effects of MM on GDP growth, longer time frames are preferable. However, MM’s influence on the financial system is more immediate and observable. Increasing access to credit, mobilizing savings, and making transactions more efficient are all examples of how MM has contributed to financial development in several SSA countries. Conducting a study on the impact of MM on financial development covering a greater number of countries in the region is therefore of interest.

4. Theory

In this section, we outline the theoretical framework on which this study is based. According to previous research, there are grounds to believe that MM will have a positive effect on financial development in SSA, which in turn could spur economic growth in the region. This chapter elaborates the theoretical foundations for specific components of the financial system that MM is expected to impact.

According to the Neoclassical Growth Theory, technological progress is recognized as the central driver of economic growth. In the Solow model, an economy without technological advancement will not have any GDP per capita growth. Romer's endogenous growth model extends this idea by internalizing technological change, concluding the same as Solow (Jones & Vollrath 2013, p. 97, 44, 100, 135). In our study, MM is examined as a form of technological progress that could enhance and develop the financial system and thereby drive economic growth in SSA. Its increasing penetration across the region implies its growing macroeconomic relevance (GSMA 2025). Of particular interest is therefore identifying and breaking down which aspects of the financial system MM has an impact on.

Financial intermediaries, such as banks, play a crucial role in maintaining a stable financial system. However, financial crises have shown their vulnerability. Diamond and Dybvig's work highlights that current technological changes and innovations give rise to new financial institutions, potentially replacing banks (The Royal Swedish Academy of Sciences 2022). While MM might not be classified as a financial intermediary in the traditional sense, its functions are similar to those of traditional banks. Rather than displacing them, MM could act as a complement by lowering entry barriers and enhancing transparency. By connecting the unbanked population to formal financial services, MM fosters financial inclusion. A higher diversity of financial intermediaries could also stabilize the financial system by reducing the vulnerability of traditional banks.

One of the key advantages of MM is its ability to mitigate information asymmetry. By providing an electronic financial record, users build credit histories which increases creditworthiness and allows for more people to access credit (Aron 2018). For example, M-Pesa collaborates with banks to provide credit history and improve access for their customers (M-Pesa n.d). Mobile-based microloans, linked directly to MM accounts, have expanded borrowing options. Greater access to credit boosts investment for both households and

businesses, promoting financial development. This aligns with the World Bank's depth-dimension of financial development mentioned in section 2.2, which refers to the financial system's size and liquidity.

The impact of MM extends beyond credit access. The use of MM has surged in the areas of international remittances and merchant payments, making financial transactions more efficient and secure. The number of cross-border MM transactions and digital payments continues to grow rapidly across SSA (World Bank 2024a; GSMA 2024). As remittances are the largest contributors of foreign income in SSA, they have a crucial role in poverty reduction as well as in increasing household consumption and investments (Allen 2021). Given this, MM facilitates more affordable and accessible international remittance channels and serves an important role in overall financial development.

Investment in real assets represents an essential component of the financial system and serves as a key driver of economic growth, contributing to improved living standards, employment, and industrialization (Ahirrao & Salunkhe 2013). As MM reduces transaction costs, fosters financial inclusion and expands access to credit, it is reasonable to expect that MM positively affects investments made in a country. Conversely, more investments increase the demand for credit and the need for a stable and efficient banking sector. This reflects a bidirectional relationship between financial development and investments, where each reinforces the other, promoting greater depth and efficiency in the financial system.

In summary, it is evident that MM could support financial development in SSA through several key mechanisms – by enhancing overall financial inclusion, expanding credit access, improving efficiency and volume of remittances, and stimulating investments. Given the relatively recent emergence of MM, this thesis adopts a short-term perspective to examine its impact on key functions of the financial system. These functions are expected to contribute to financial development, which in turn will spur long-term economic growth in the region.

5. Data and Variables

This section provides an explanation of all variables included in the model, as well as the data sources. See *A2* in the appendix for summary statistics of the variables.

5.1 Dependent Variables

To understand the impact of MM on long-term economic growth, the effect of MM on the financial system is examined by using three multiple regressions. The dependent variables are *personal remittances received*, *domestic credit to private sector*, and *gross capital formation*. These are essential functions in the financial systems in SSA and are therefore of importance when measuring financial development.

5.1.1 Personal Remittances Received

Personal remittances received as % of GDP is the total value of remittances received from abroad. The variable consists of personal transfers and compensation of employees. Personal transfers are those sent home by people living abroad. Compensation of employees refers to salaries earned by people working temporarily in a foreign country (World Bank 2025).

5.1.2 Domestic Credit to Private Sector

Domestic credit to private sector (% of GDP) represents financial resources provided to the private sector by institutions such as banks, insurance companies, and finance or leasing firms. The private sector includes both private businesses and individuals within a country. (World Bank 2025).

5.1.3 Gross Capital Formation

Data for *Gross capital formation* (% of GDP) is gathered from the World Bank's World Development Indicators Dataset. Gross capital formation refers to private and public investments in fixed assets – including machinery, infrastructure, buildings, and schools. It also consists of the net changes in the level of inventories held by a firm (World Bank 2025).

5.2 Independent Variable – Mobile Money

The independent variable is *Mobile money*. It is measured as the *number of registered mobile money accounts per 1 000 adults* in each country. The data is gathered from IMF's Financial Access Survey (IMF 2025b). This variable was logarithmized to be able to interpret how a change in percent affects the dependent variables respectively.

5.3 Control Variables

Control variables are included as independent variables to isolate the impact of MM on the dependent variables. The control variables vary between the regressions and are as follows: *GNI per capita*, *exchange rate*, *unemployment rate*, *government effectiveness*, *inflation*, *interest rate*, *gross national savings*, *commercial bank branches* and *domestic credit to private sector*. For consistency, the variables not already expressed in percent are being logarithmized.

5.3.1 GNI per Capita

GNI per capita (Atlas method, current US\$) serves as a proxy for income level in the country (World Bank 2025). The variable is logarithmized to be able to interpret how a change in percent affects the dependent variables. In the regression estimating the impact of MM on *personal remittances received*, a higher GNI per capita is expected to indicate that households require less remittances, and vice versa. In the regression analyzing the impact on domestic credit, a high level of GNI per capita is associated with greater creditworthiness, potentially increasing access to credit. However, a high income may also reduce the need to borrow money. Therefore, we cannot conclude an expected outcome for GNI per capita in this regression. For *gross capital formation*, high GNI is expected to have a positive effect on the amount of investments made.

5.3.2 Exchange Rate

The variable *exchange rate* (Official exchange rate, LCU per US\$, period average) is gathered from the IMF's Exchange Rates Dataset (IMF 2025c). It is included as a control variable in the regression on *personal remittances*. The exchange rate affects the value of remittances received. A depreciation of the domestic currency means that migrants can send more money home for the same amount of foreign currency, which is expected to increase the inflow of remittances. Conversely, appreciation of the domestic currency is expected to reduce the volume of remittances received.

5.3.3 Commercial Bank Branches

The variable *commercial bank branches* (per 100 000 adults) is used as a control variable when estimating the effect of MM on *personal remittances received* and *domestic credit to private sector*. The variable refers to the physical retail locations of commercial banks that offer financial services to customers. The branches are spread out geographically but are part of the same bank (IMF 2025b). The number of commercial bank branches affects accessibility to

credit and is therefore believed to have a positive relationship with the amount of domestic credit available for the private sector. In the case of *personal remittances received*, commercial bank branches are an alternative remittance channel. Thus, it is expected that an increasing number of bank branches also will increase the volume of remittances being received.

5.3.4 Unemployment Rate

Unemployment rate (% of total labor force, modeled ILO estimate) is included as a control variable in the regressions estimating the impact on remittances and domestic credit (World Bank 2025). A high unemployment rate indicates lower financial stability in households and a higher demand for external support. Hence, it is expected that it would increase the demand for remittances. Regarding *domestic credit to private sector*, the unemployment rate can affect both the demand for and the supply of credit. Not having a steady income to rely on increases the demand for credit. However, high unemployment affects creditworthiness and therefore reduces banks' willingness to lend money.

5.3.5 Government Effectiveness Index

Government effectiveness is measured by using an index including indicators of the quality of civil services, the perceptions of the quality of public services, independence from political pressure and the credibility of the government in policy commitments. The estimate is measured in standard normal units ranging approximately from -2.5 to 2.5 (World Bank 2024c). This variable is crucial to control for in every regression since well-functioning public services and credibility for the government indicates trust, stability and quality of financial institutions. A high score on this index is therefore believed to have a positive impact on credit, remittances, and gross capital formation.

5.3.6 Inflation Rate

Inflation (average consumer prices, annual percent change) is included in the regressions on *personal remittances received* and *gross capital formation* (IMF 2025d). The rate gives an indication of economic stability. When inflation is high, it indicates monetary instability and reduces the real value of remittances received. Thus, the volume of remittances should decrease. However, high inflation could increase the demand for foreign currency, leading to more remittances being received. High inflation is believed to have a negative effect on the willingness to invest by individuals and government, hence decreasing the amount of investments made.

5.3.7 Interest Rate

Interest rate (commercial bank lending rate, %) is included in the regressions on *gross capital formation* and *domestic credit to private sector* (World Bank 2025). Commercial bank lending rates are the cost of borrowing, directly affecting credit-taking and investment. A high interest rate is expected to decrease the demand for credit and, thus, also the amount of investments made. The commercial bank lending rate for Ghana is collected separately from the Bank of Ghana since data is not available on the World Bank Database. To get the annual rate instead of monthly, an annual average is calculated for every year.

5.3.8 Gross Savings

Gross national savings as % of GDP is included as a control variable when having *gross capital formation* as the dependent variable. It refers to the share of disposable income that is saved by households, businesses and governments, i.e. not used for consumption. (IMF 2025e). If the savings rate is high, there is more capital available for investment. Therefore, it is expected that there will be a positive relationship between *gross savings* and *gross capital formation*.

6. Methodology

6.1 Multiple Regression Model With Unbalanced Panel Data

A multiple regression model with unbalanced panel data is used to explain the effects of MM on financial development. This is performed by using three regressions with different dependent variables representing various components of the financial system. Since data from different countries is analyzed over several time periods, a panel data model is used. Our panel data is unbalanced due to lack of complete data for all countries during every time period. The effects of using unbalanced panel data are that some time periods for particular countries are not accounted for in the regressions due to missing data in certain variables. The regression analyses are conducted in STATA.

6.2 Fixed Effects Estimator

The fixed effects estimator will be used in the three regressions. Fixed effects are applied to control for entity-specific effects that are otherwise unobserved. Thus, changes within groups are captured. Not controlling for this might otherwise lead to omitted variable bias due to correlation between the error term and the explanatory variables. When analyzing changes over time in several countries, this is especially relevant since it helps capture country-specific effects that are constant over time but vary between countries. The countries included in the study are all located in SSA. However, all of them have their own individual attributes affecting the impact of MM in the country. Hence, the conditions for MM having an effect on economic activity might differ significantly across countries. Country-specific effects might, for instance, be the presence of conflicts in a country or access to mobile phones. In section 7, the inclusion of the fixed effects model will be motivated by a Durbin-Wu-Hausman test for fixed or random effects (Dougherty, p. 532-533, 2016).

To account for variation that is constant within groups but varies over time, the regressions include time fixed effects by incorporating time dummies. Controlling for time fixed effects reduces bias due to unobservable effects that occur due to changes over time. For instance, the Covid-19 pandemic had a severe impact on the economy of many SSA countries. Not controlling for this can potentially wrongfully affect the estimations of the regressions due to changes over time not connected to the impact of MM.

6.3 General Regression Model

The general specification for the three regression models is given by:

$$Y_{i,t} = \beta_0 + \beta_1 \ln(\text{mobilemoney})_{i,t} + \sum_{k=2}^K \beta_k X_{k,i,t} + \alpha_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

In equation (1), $Y_{i,t}$ represents the dependent variable for country i at time t .

$\ln(\text{mobilemoney})_{i,t}$ denotes the explanatory variable and is included consistently across all regressions. The control variables specific to each regression are denoted by $X_{k,i,t}$. K denotes the total number of such control variables included in that particular regression. The number of control variables varies across the three regressions. The coefficients β_0 , β_1 and β_k correspond to the intercept, the explanatory variable, and the control variables, respectively. α_i represents the country specific effects, γ_t the time specific effects and $\varepsilon_{i,t}$ is the error term.

6.4 Choice of Time Period

The examined time period ranges from 2000 to 2023. However, for the regressions analyzing *domestic credit to private sector* and *personal remittances received*, the start year is 2004. This is due to the fact that data for *commercial bank branches* only is available from this year. We acknowledge that this reduces the number of observations in the two regressions. However, we also consider it essential to include this control variable. The main reason for the choice of time period is data availability. In SSA, the availability of macroeconomic data is lacking compared to other regions of the world. Hence, finding relevant data for a longer period of time is not feasible in many cases. Several variables of interest for the study are only available from the year 2000 in the countries included. Moreover, since MM has not existed for a long period of time, the earliest data available is from 2007. Therefore, the data for MM has a value of zero for the years it did not exist in the respective countries. Otherwise, observing longer periods of time tends to be more interesting when analyzing macroeconomic effects since these generally take a long time to capture. Moreover, we are observing a time period ranging from before and after the implementation of MM in SSA. This is to gather more observations with the aim to capture significant effects on economic activity.

6.5 Choice of Countries

The aim of this study is to capture the effects of MM in SSA. This particular region is of interest since MM is widely used throughout many countries located here, potentially having a significant macroeconomic impact. The countries included are the following: Botswana, Ghana, Kenya, Lesotho, Madagascar, Mozambique, Namibia, Rwanda, Uganda, Zambia and Zimbabwe. Ideally, all countries in SSA would be included since the study aims to examine the effects on the region as a whole. However, due to lack of data, this is not possible. The variable with the most data lacking is the number of registered MM accounts. Due to this variable being essential for the study, a large number of countries are excluded. Instead, 11 countries with sufficient data are included in the study.

6.6 Possible Weaknesses with Methodology

Unbalanced panel data is used for the regressions, which reduces the number of observations, potentially lowering significance in the regressions by making the sample size smaller. While this makes regional representation difficult, we do not think that this should discourage studying MM's impact on financial development in SSA.

In some countries, data for the number of registered MM accounts is unexplainably missing even though the technology existed at the time. To improve accuracy, we estimate values for, in total, eight observations in the countries where this was the case. This reflects reality more correctly rather than leaving values blank. Which years are estimated and the method used for the estimations is described in *A3* in the appendix.

We are unable to control for emigration rates in the regression on personal remittances. Since remittances depend partly on emigration, this might lead to omitted variable bias and thus less statistically accurate estimations. Still, we include relevant control variables affecting the share of remittances and therefore we find it appropriate to perform the regression. This is only one example of where there is an omitted variable. Generally, it is worth noting that there potentially are other excluded variables having an effect on the dependent variables.

GNI per capita was included as a control variable instead of GDP per capita. It would be optimal to use GDP per capita as a control variable, but since the dependent variables are expressed as a percentage of GDP, including GDP per capita would create a problematic direct relationship. By using GNI per capita instead, this issue is reduced, although not fully eliminated, since GNI includes GDP plus net income from abroad.

6.7 Use of Lags

A lag of one year is applied to all explanatory variables except for one. The use of lags is motivated by the potentially lagged effect of the explanatory variables on the dependent variables. As mentioned earlier in this section, changes in macroeconomic variables do not typically have a direct effect. The variable *commercial bank branches*, however, is believed to have a rather direct effect since the banks' services are offered directly after the branch is established. Thus, this variable is not lagged. The remaining explanatory variables are believed to have a lagged effect of around one year. In the regressions, both lagged and non-lagged values of the MM-variable are included. This is to ensure that no potentially direct effects are excluded, while still allowing for the possibility of delayed effects. The lag leads to a loss of data from the first year of each respective regression. However, macroeconomic reasoning motivates the loss of observations.

6.8 Specification of Regression Models

The regressions presented below are those used to estimate the impact of MM on personal remittances, domestic credit, and gross capital formation, respectively.

$$\begin{aligned} \text{personalremittances} = & \beta_0 + \beta_1 \ln(\text{mobilemoney})_{i,t} + \beta_2 \ln(\text{mobilemoney})_{i,t-1} + \beta_3 \ln(\text{gnipercapita})_{i,t-1} \\ & + \beta_4 \text{exchangerate}_{i,t-1} + \beta_5 \text{unemploymentrate}_{i,t-1} + \beta_6 \text{governmenteffectiveness}_{i,t-1} \\ & + \beta_7 \text{inflation}_{i,t-1} + \beta_8 \ln(\text{commercialbanks})_{i,t} + \alpha_i + \gamma_t + \varepsilon_{i,t} \quad (2) \end{aligned}$$

$$\begin{aligned} \text{domesticcredit} = & \beta_0 + \beta_1 \ln(\text{mobilemoney})_{i,t} + \beta_2 \ln(\text{mobilemoney})_{i,t-1} + \beta_3 \ln(\text{gnipercapita})_{i,t-1} \\ & + \beta_4 \ln(\text{commercialbanks})_{i,t} + \beta_5 \text{unemploymentrate}_{i,t-1} + \beta_6 \text{interestrates}_{i,t-1} \\ & + \beta_7 \text{governmenteffectiveness}_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{i,t} \quad (3) \end{aligned}$$

$$\begin{aligned} \text{grosscapitalformation} = & \beta_0 + \beta_1 \ln(\text{mobilemoney})_{i,t} + \beta_2 \ln(\text{mobilemoney})_{i,t-1} + \beta_3 \ln(\text{gnipercapita})_{i,t-1} \\ & + \beta_4 \text{domesticcredit}_{i,t-1} + \beta_5 \text{interestrates}_{i,t-1} + \beta_6 \text{inflation}_{i,t-1} + \beta_7 \text{governmenteffectiveness}_{i,t-1} \\ & + \beta_8 \text{grossnationalsavings}_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{i,t} \quad (4) \end{aligned}$$

The interpretation of regressions (2), (3) and (4) follows the same logic as the general specification outlined in section 6.3. Some variables are now lagged by one year, which is indicated by the subscript $t - 1$. The coefficients (denoted β_1, β_2 , etc.) represent the change in the dependent variable, measured in percent, resulting from a one percent or one percentage point change in the corresponding independent variable.

6.9 Expected Outcome

We expect MM to have a positive and significant impact on each of the dependent variables – *personal remittances received*, *domestic credit to private sector*, and *gross capital formation*. This is motivated by the previous reasoning that MM facilitates remittances by reducing transaction costs, enhances access to credit through the establishment of credit histories, and stimulates investment by increasing liquidity and enabling credit access. Altogether, this enhances financial development. It is also believed that each control variable has a significant impact on the dependent variables, according to the explanations in 5.3. The control variables are included in order to isolate the impact of MM on each of the dependent variables.

7. Specification Testing

To test the robustness of our model, econometric tests are performed. To test the relationship between MM and financial development in SSA, an Ordinary Least Squares (OLS) model with unbalanced panel data is used. For the OLS estimator to be considered BLUE (Best Linear Unbiased Estimator), the Gauss-Markov assumptions need to be fulfilled (Stock & Watson, 2020, p.195). Hence, the model is tested for the normality of residuals, heteroskedasticity, autocorrelation, and multicollinearity. All of the tests are conducted in STATA.

7.1 Fixed Effects Model – Durbin-Wu-Hausman Test

To determine whether a fixed effects or random effects estimator should be used, a Durbin-Wu-Hausman test is performed. The null hypothesis is that a random effects estimator should be used, and the alternative hypothesis is that using the fixed effects estimator is more accurate (Dougherty, 2016, p.540). The null hypothesis is rejected for all three regressions and thus, the fixed effects estimator is used. For exact χ^2 - and p-values associated with the test statistic, see *A4* in the appendix.

7.2 Normality of Residuals – Shapiro Wilk Test

An important aspect of the performance of the regression model is whether the residuals are normally distributed or not. Normally distributed errors increase the validity of the significance when performing various statistical tests. Therefore, a Shapiro-Wilk test is conducted for every regression, respectively. The null hypothesis states that the residuals are normally distributed, and the alternative hypothesis is that they do not follow a normal distribution. The p-values for the regressions explaining remittances received and domestic credit to private sector are 0.000 and 0.007 for gross capital formation, meaning that the residuals are not normally distributed (J. Eckersley & P. King, 2019). However, due to a sufficiently large sample size, we assume that the residuals are approximately normally distributed, in accordance with the Central Limit Theorem (L. Sainani 2012). See *A5* in the appendix for all z- and p-values.

7.3 Heteroskedasticity – Modified Wald Test

Heteroskedasticity occurs when the variance of the potential distribution of the residuals differs between observations. Heteroskedasticity causes the OLS coefficients to be inefficient, since there are other potential estimators with smaller variances that are still unbiased. In the presence of homoscedasticity, and assuming all other Gauss-Markov assumptions are met, the OLS

coefficients have the smallest variances among all unbiased estimators that are linear functions of the dependent variable. Heteroskedasticity will also affect the reliability of hypothesis testing (Dougherty, p. 292-293). To test for heteroskedasticity, a modified Wald test is performed. The null hypothesis states that the residuals are homoscedastic (Baum 2001). In all three regressions, the p-value is 0.000 when performed. Thus, the null hypothesis is rejected. It is therefore concluded that the assumption of homoskedasticity is violated, and the estimations are no longer BLUE. To deal with this, robust standard errors are used in the regressions. Robust standard errors deal with potential bias in estimations and increase reliability. *A6* in the appendix displays χ^2 - and corresponding p-values.

7.4 Autocorrelation – Wooldridge Test

Autocorrelation in the residuals occurs when the residuals are correlated with their previous values. Therefore, the values are not independent over time, which violates the Gauss-Markov assumptions for OLS estimators. This can lead to inefficient OLS estimations as well as inaccurate and biased estimations of standard errors (Dougherty, p.445-448, 2016). To test for first-order autocorrelation in the residuals, the Wooldridge test is performed on each of the three regressions (Tilburg Science Hub n.d). In two out of three regressions the test shows a p-value of 0.000, which suggests there exists autocorrelation between the residuals in the regressions. However, in the regression analyzing personal remittances received, the null hypothesis of no autocorrelation cannot be rejected. To deal with the autocorrelation in the regressions, robust standard errors are used. See *A7* in the appendix for t-values and the corresponding p-values.

7.5 Multicollinearity – Correlation Matrix

Table 2: Correlation matrix with all explanatory variables

| | <i>Mobile money</i> | <i>Exchange rate</i> | <i>GNI per capita</i> | <i>GEI</i> | <i>Unemployment rate</i> | <i>Inflation</i> | <i>Commercial bank branches</i> | <i>Gross national savings</i> | <i>Interest rate</i> | <i>Domestic credit to private sector</i> |
|--|---------------------|----------------------|-----------------------|------------|--------------------------|------------------|---------------------------------|-------------------------------|----------------------|--|
| <i>Mobile money</i> | 1.0000 | | | | | | | | | |
| <i>Exchange rate</i> | 0.0499 | 1.0000 | | | | | | | | |
| <i>GNI per capita</i> | 0.3086 | -0.4508 | 1.0000 | | | | | | | |
| <i>GEI</i> | -0.0314 | -0.3940 | 0.7158 | 1.0000 | | | | | | |
| <i>Unemployment rate</i> | -0.0844 | -0.4267 | 0.6905 | 0.6198 | 1.0000 | | | | | |
| <i>Inflation</i> | 0.0359 | -0.0459 | 0.0050 | -0.1662 | -0.0412 | 1.0000 | | | | |
| <i>Commercial bank branches</i> | 0.3551 | -0.4900 | 0.8247 | 0.6680 | 0.5333 | 0.0189 | 1.0000 | | | |
| <i>Gross national savings</i> | -0.3446 | -0.2064 | 0.0774 | 0.0102 | 0.1361 | -0.0937 | -0.0015 | 1.0000 | | |
| <i>Interest rate</i> | -0.0891 | 0.6420 | -0.5214 | -0.5258 | -0.5404 | 0.1154 | -0.4420 | -0.0428 | 1.0000 | |
| <i>Domestic credit to private sector</i> | 0.2660 | -0.3432 | 0.6921 | 0.5460 | 0.5503 | -0.1263 | 0.7364 | -0.2345 | -0.4746 | 1.0000 |

A correlation matrix was created to assess potential multicollinearity among the explanatory variables. Multicollinearity takes place when two or more explanatory variables in a regression are highly correlated with each other. This can lead to less precise estimations and creates high standard errors for some coefficients. The matrix indicates a low correlation between the majority of the variables. Due to high correlation between some variables, for example *GNI per capita* and *Commercial bank branches*, there are signs of multicollinearity. Nevertheless, these variables are essential to control for and will therefore still be included in the regressions (Wooldridge, 2012. p.95-97).

7.6 Endogeneity

Endogeneity takes place when one or more explanatory variables are correlated with the error term, potentially leading to biased estimations in the regressions. There are several reasons for emerging endogeneity. For instance, it can arise due to measurement errors, omitted variables, and reverse causality. In the case of this study, there is risk of omitted variables since there are several variables potentially correlating with the predictor affecting the dependent variables. To address this, as many potentially relevant variables as possible have are controlled for. Nevertheless, the risk of omitted variable bias - and thus endogeneity - cannot be ruled out, as

most of the included variables are complex and influenced by multiple economic aspects. Including instrumental variables is a way to deal with endogeneity. These are essentially variables that are correlated with the explanatory variable suspected of being endogenous, but not directly related to the dependent variable. This can make the estimations less biased. However, in this case, it is difficult to find appropriate variables replacing explanatory variables. Hence, no instrumental variables are used and the risk for endogeneity is accepted (Kovac 2023).

8. Results

In this section we have gathered the results in three tables. In chapter 9, these results are discussed and compared to the previously stated expected outcomes. *Table 3* displays the results of the regression on *personal remittances received*. *Table 4* displays the regression on *domestic credit to private sector*. Lastly, *Table 5* displays the regression on *gross capital formation*. The tables show the included variables' respective coefficients and p-value. For detailed information about the regressions (R^2 - values and number of observations), see *A1* in the appendix.

8.1 Personal Remittances Received

Table 3: Regression results: international remittances received as dependent variable

| Variable | Coefficient and P-value |
|--|-------------------------|
| <i>Registered Mobile Money Accounts</i> | -0.3924 (0.050) ** |
| <i>Registered Mobile Money Accounts (Lagged)</i> | -0.1562 (0.407) |
| <i>Exchange Rate</i> | 6.05e-10 (0.523) |
| <i>GNI per capita</i> | 3.1465 (0.256) |
| <i>Unemployment Rate</i> | -0.1702 (0.429) |
| <i>Commercial Banks</i> | 0.2347 (0.806) |
| <i>Inflation</i> | -0.0087 (0.508) |

* significance on the 10% level, ** significance on the 5% level, *** significance on the 1% level

Table 3 displays the results of the model with *international remittances received* as the dependent variable. It can be observed that *registered mobile money accounts* have a significant direct effect on personal remittances received at the 5% level. The coefficient is -0.39, indicating that a 1% increase is associated with a 0.39 percentage point decrease in personal remittances received. The lagged version of *registered mobile money accounts* and the control variables are not significant, meaning that we cannot draw the conclusion that these have an effect on personal remittances received.

This model explains around 17% of the variation in remittances within the country, and around 10% of the between-country variation. The overall R^2 -value is 4%, indicating that the variables included in the model explain 4% of the overall variation. This could be due to the fact that there are other variables affecting remittances not included in the model.

8.2 Domestic Credit to Private Sector

Table 4: Regression results: domestic credit to private sector as dependent variable

| Variable | Coefficient and P-value |
|--|-------------------------|
| <i>Registered Mobile Money Accounts</i> | -0.1784 (0.640) |
| <i>Registered Mobile Money Accounts (Lagged)</i> | -0.1320 (0.643) |
| <i>Interest Rate</i> | -0.0525 (0.203) |
| <i>GNI per capita</i> | -7.5964 (0.001) *** |
| <i>Unemployment Rate</i> | 0.5450 (0.037) ** |
| <i>Government Effectiveness Index</i> | -3.1805 (0.184) |
| <i>Commercial Banks</i> | 0.8297 (0.687) |

* significance on the 10% level, ** significance on the 5% level, *** significance on the 1% level

Table 4 displays the results of the model with *domestic credit to private sector* as the dependent variable. No significant effect of *registered mobile money accounts* on *domestic credit to private sector* is found. However, *GNI per capita* and *unemployment rate* have significant effects on domestic credit, at the 1% and 5% levels respectively. An increase of *GNI per capita* by 1% leads to a 7.60 percentage point decrease in *domestic credit to private sector*. Moreover, an increase in the *unemployment rate* by 1% corresponds to a decrease in the domestic credit by 0.55 percentage points.

The within R^2 -value is approximately 65%, meaning that the majority of the within-country variation is explained by the model. The between-country variation is 2,6%, and the overall is 1,01%. As in the previous regression, this indicates that there are variables affecting domestic credit that are not included in the model.

8.3 Gross Capital Formation

Table 5: Regression results: gross capital formation as dependent variable

| Variable | Coefficient and P-value |
|--|-------------------------|
| <i>Registered Mobile Money Accounts</i> | 0.2247 (0.557) |
| <i>Registered Mobile Money Accounts (Lagged)</i> | -0.4476 (0.449) |
| <i>Interest Rate</i> | -0.2592 (0.015) ** |
| <i>GNI per capita</i> | -4.6049 (0.032) ** |
| <i>Government Effectiveness Index</i> | 2.5238 (0.160) |
| <i>Inflation</i> | 0.0418 (0.010) *** |
| <i>Gross National Savings</i> | 0.2848 (0.077) * |

* significance on the 10% level, ** significance on the 5% level, *** significance on the 1% level

Table 5 displays the results from the regression on *gross capital formation*. No significant relationship is found, as seen in the high p-values. However, four out of five control variables show a significant impact on *gross capital formation*. A one percentage point increase in *interest rate* leads to a decrease in *gross capital formation* by approximately 0.26 percentage points. A 1% increase in *GNI per capita* corresponds to a 4.6 percentage point decrease in the dependent variable. An increase in *inflation* of one percentage point leads to an increase in the dependent variable by around 0.04 percentage points. Lastly, an increase in *gross national savings* of one percentage point leads to an increase by approximately 0.28 percentage points in gross capital formation.

This model displays the highest overall R^2 -value, 18,26%. The within- and between-country variation is 36,21% and 12,04%, respectively. This indicates a better fit than the previous regressions. However, additional variables could have been included to increase its fit.

9. Discussion

9.1 Discussion of Results

In order to answer the research question, the results from chapter 8 will be discussed in relation to the previous research and theory for this study. The results will also be discussed in relation to the expected outcomes previously stated.

MM is a technological innovation that has revolutionized the financial system in terms of availability and effectiveness. This study aimed to determine whether, and to what extent, MM drives financial development in SSA. By establishing such a relationship, we would be able to confirm that MM supports long-term economic growth in the region.

The results indicate, however, no significant improvement in the financial system resulting from the implementation of MM. Therefore, we cannot conclude that MM has a positive effect on long-term economic growth in the region. In two out of three regressions, both MM coefficients were statistically insignificant, while in the regression where *personal remittances received* was the dependent variable, the coefficient of *registered mobile money accounts* was significant but negative. This contradicts theoretical expectations, previous research, and expected outcomes.

There are several potential explanations for the insignificant impact of MM on *domestic credit to private sector* and *gross capital formation*. Although both lagged and immediate effects of MM were considered, the impacts may take longer than one year to be observed, since investment and credit expansion typically evolve slowly. While MM may enhance access to financial services, translating this access to credit expansion and large-scale capital formation can take several years.

The significant negative coefficient in the regression explaining *personal remittances received* indicates that MM has a direct negative impact on remittance inflows. The explanation for this can lie in the fact that MM improves access to financial services and increases liquidity, which in turn could reduce dependence on foreign capital inflows. While this contradicts theory and what we expected, it does not necessarily indicate a negative impact on financial development. Therefore, the expansion of MM may instead increase reliance on the domestic financial system, potentially leading to its development.

In the regression estimating the effect of MM on *domestic credit to private sector*, *GNI per capita* and *unemployment rate* were statistically significant, with *GNI per capita* having a negative coefficient and *unemployment rate* a positive one. A higher GNI could decrease the need for credit, explaining the negative coefficient. A higher unemployment rate was expected to generate two different outcomes. On the one hand, the need for credit may increase due to the lack of income. On the other hand, less people might be able to borrow due to lower creditworthiness. This study shows that the first outcome outweighs the second since the coefficient is positive.

In the regression with *gross capital formation* as dependent variable, *interest rate* (-0.26), *GNI per capita* (-4.60), *inflation* (0.04) and *gross national savings* (0.28) all turned out statistically significant, suggesting they have a meaningful relationship with the amount of investments in fixed assets made in the economy. The negative coefficient of *interest rate* is intuitive since higher rates increase the cost of borrowing, discouraging investment. The negative and large coefficient of *GNI per capita* is not in line with the expected outcome since higher income levels usually are associated with more investments. The small coefficient for inflation indicates that an increase in the inflation rate has a slight positive effect on *gross capital formation*, which is contrary to expectations. A high inflation rate indicates instability and was therefore expected to decrease investments. Moreover, the results suggest that the level of national savings affects national investments positively, which is explained by the fact that as more money is saved, more is available for investment.

One key takeaway from the results in chapter 8 is the importance of certain of the included control variables in affecting credit and investment decisions. These are therefore crucial to account for when integrating new technologies into the financial system. Furthermore, the negative and significant impact of MM on *personal remittances received* suggests that MM influences individual financial behavior and decision-making. The negative coefficient indicates that the financial system is not developing as anticipated in this study. However, it may also indicate that the implementation of MM enables individuals to become more financially independent. Thus, providing them with a better economic situation and improved standards of living.

9.2 Future Research

Based on the outcome of this study, we have gathered recommendations for future research. First and foremost, including more observations by increasing the time period and number of

countries included would be beneficial. Observing a longer period of time with MM existing might lead to more observable and distinct effects on financial development. Including more countries would also lead to a higher representation of SSA as a region. Furthermore, using different proxies for financial development could lead to a more accurate representation of the specific aspects of the financial system that MM impacts. For instance, by including variables representing efficiency and stability in financial institutions.

This thesis aimed to analyze the development of the financial system caused by MM, and if this could spur economic growth. However, if the time period is sufficient, measuring the effect of MM on GDP growth directly would be an interesting research subject. This would provide a more direct answer to the question whether, and to which extent, MM leads to economic growth.

Moreover, a recommendation for future research is to include more variables representing the level of MM use. By including variables measuring activity, transaction volume, amount of MM agents and number of individuals using MM services, this would create a more accurate representation of how well-established it is. Optimally, an index which combines all of these aspects would be created and used. Doing so in this study was not possible due to lack of data. Hopefully, the amount of research and studies performed in the region will increase, making more data and information available.

10. Conclusion

This thesis aimed to determine whether, and to which extent, MM drives financial development in SSA. Evidence of such a relationship would support the conclusion that MM in turn will spur long-term economic growth in SSA. The outcomes of the study indicate that there is no significant impact of MM on financial development in the countries included. Given these results, we cannot conclude that MM will have an effect on long-term economic growth in the region. Nevertheless, lacking data and a short time period could be an explanation for the insignificant relationship between MM and financial development. Although this study cannot establish such a relationship, the research question is still of interest as MM continues to develop and spread across SSA, providing an inclusive and efficient complement to the traditional financial system. In the foreseeable future, it is therefore not far-fetched to believe that MM will ignite economic growth.

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Appendix

A1: Information about Regressions

| Variable | Number of observations | R^2 within | R^2 between | R^2 overall |
|--------------------------------|------------------------|--------------|---------------|---------------|
| <i>Gross capital formation</i> | 218 | 0.3621 | 0.1204 | 0.1826 |
| <i>Domestic credit</i> | 203 | 0.6527 | 0.0260 | 0.0101 |
| <i>Personal remittances</i> | 196 | 0.1734 | 0.1024 | 0.0404 |

A2: Summary Statistics of Variables

| Variable | Unit | Minimum | Mean | Maximum | Std. Dev. |
|---------------------------------------|---|---------|----------|----------|-----------|
| <i>Mobile money</i> | Number of registered accounts per 1000 adults | 0 | 746.930 | 3544.978 | 783.488 |
| <i>Personal remittances</i> | % of GDP | 0.130 | 4.981 | 53.826 | 9.221 |
| <i>Domestic credit</i> | % of GDP | 5,089 | 20.012 | 84.052 | 13.189 |
| <i>GCF</i> | % of GDP | 1,525 | 23.413 | 56.396 | 9.008 |
| <i>GNI/capita</i> | Current USD | 120.000 | 1611.023 | 8340.000 | 1789.479 |
| <i>Exchange rate</i> | LCU per USD | 0.044 | 2.66e+07 | 6.72e+09 | 4.23e+08 |
| <i>Gross national savings</i> | % of GDP | 2.056 | 19.668 | 47.648 | 9.261 |
| <i>Unemployment rate</i> | % of total labor force | 0.599 | 9.287 | 23.800 | 6.780 |
| <i>Inflation rate</i> | Average consumer prices | -72.700 | 15.113 | 667.400 | 57.883 |
| <i>Interest rate</i> | % | 5.250 | 20.972 | 170.294 | 16.763 |
| <i>Government effectiveness index</i> | Scale from -2.5 to 2.5 | -1.553 | -0.441 | 0.619 | 0.511 |

| | | | | | |
|----------------------------------|--------------------|-------|-------|--------|-------|
| <i>Commercial banks branches</i> | Per 100 000 adults | 0.400 | 5.017 | 15.533 | 3.167 |
|----------------------------------|--------------------|-------|-------|--------|-------|

A3: Method of Estimating Missing MM-Values

The estimates are made for year 2012 in Lesotho, years 2011-2012 in Mozambique, years 2009-2011 in Ghana, year 2011 in Zimbabwe and year 2023 in Madagascar. We analyze the growth trend of the MM variable for each country missing values to determine whether the growth is exponential or linear. Lastly, we make sure that the predicted values are reasonable in relation to the existing values. For Zimbabwe and Lesotho, we predict values according to a linear growth trend, and for the other countries according to an exponential trend, based on the steps presented above.

Results From Robustness Testing

A4: Durbin-Wu-Hausman Test

| Y-variable | Chi-Square χ^2 | Prob > χ^2 |
|--|---------------------------------------|--------------------------------------|
| <i>Domestic credit to private sector</i> | 157.83 | 0.0000 |
| <i>Personal remittances received</i> | 147.63 | 0.0000 |
| <i>Gross capital formation</i> | 103.92 | 0.0000 |

A5: Shapiro Wilk Test

| Y-variable | z-value | Prob > z |
|--|----------------|--------------------|
| <i>Domestic credit to private sector</i> | 7.496 | 0.00000 |
| <i>Personal remittances received</i> | 8.027 | 0.00000 |
| <i>Gross capital formation</i> | 2.453 | 0.00709 |

A6: Modified Wald Test

| Y-variable | Chi-Square χ^2 | Prob > χ^2 |
|--|---------------------------------------|--------------------------------------|
| <i>Domestic credit to private sector</i> | 55.79 | 0.0000 |
| <i>Personal remittances received</i> | 5263.39 | 0.0000 |
| <i>Gross capital formation</i> | 500.52 | 0.0000 |

A7: Wooldridge Test

| Y-variable | t-value | Prob > t |
|--|----------------|--------------------|
| <i>Domestic credit to private sector</i> | 161.17 | 0.000 |
| <i>Personal remittances received</i> | -1.18 | 0.264 |
| <i>Gross capital formation</i> | 31.14 | 0.000 |

Statement of Use of Generative AI

The generative AI tool Chat-GPT was used to improve formulations and the structure of the text, by providing examples of rephrased sentences, synonyms and suggestions to improve the overall flow. Chat-GPT was also used to generate code and give instructions for the econometric analysis in STATA.